Section of Epidemiology and State Medicine.

President—Dr. E. W. GOODALL, O.B.E.

The Serbian Epidemics of Typhus and Relapsing Fever in 1915: Their Origin, Course, and Preventive Measures employed for their Arrest.[1]

(An Ætiological and Preventive Study based on Records of British Military Sanitary Mission to Serbia, 1915.)

(WITH MAPS AND CHARTS.)

By WILLIAM HUNTER, C.B., Colonel, A.M.S.

PART I.

PART II.

PART III.

[1] At a meeting of the Section, held November 28, 1919.

MAP OF SERBIA, SHOWING RAILWAYS AND FORTY-TWO CHIEF TOWNS AND HOSPITAL CENTRES.

ARMY AREAS: A—First Army.
,, ,, B—Second, Third, and Belgrade Armies.
,, ,, C—Chief Railway Towns.
,, ,, D—Zeitjer Army.
,, ,, E—Ujitze Army.

CIVILIAN AREAS: F.

THE CHIEF SEATS OF HOSPITALS WERE:—

Area A	...	Valyevo.	*Area* E	...	Ujitze. Chac-Chac. Kralyevo. Krushevatz.
Area B	...	Belgrade. Palanka. Svilinatz. Kragujevatz.			
Area D	...	Zeitjer. Negotin. Kladovo.	*Area* F	...	Nish. Uskub. Monastir. Givgeli.

The Headquarters of the Mission were at *Kragujevatz*, G.H.Q.

The chief seat of its work was in Area B.

The seat chosen by it for its Quarantine and Disinfection Station to control the spread of infection from the Valyevo area A—the worst infected—to the rest of Serbia was *Mladenovac*, the junction between Areas A and B.

The English sanitary train for inoculation and disinfection operated from *Kievo* and *Ralya*.


HUNGARY
R. Danube
R. Sava
Shabat
Belgrade
R. Danube
Smederevo
R. Sava
R. Drina
Losnica
Kievo
B
Ralya
Pojarevatz
Kladovo
A
Mlad
ROUMANIA
BOSNIA
Yalyevo
Negotin
Palanka
Lapovo
C
Zeitjer
R. Timok
R. Danube
Arangelovatz
Gorni
Jagodina
D
Krag.
Tupria
Parachin
Sarajevo
Ujitze
E
Chac Chac
Stalac
Visegrad
Kralyevo
Knjevatz
Tristinek
Krushevatz
Alexinatz
BULGARIA
NISH
Pirot
F
Leskovatz
Mitrovitza
Pristina
Wranje
Sofia
Prisren
Kumanovo
Telovo
Uskub
Kochane
Gostivar
Istip
Kopruli
Debra
Gradsko
Prilep
Givgeli
Doiran
Ochrida
Monastir
GREECE
Salonica
Scale of English Miles
0 10 20 30 40 50

PART I.

Section I.—Character of Data.

The data on which this account of the great Serbian epidemics of typhus and relapsing fever in 1915 is based were furnished me and all official communications were made to me in Serbian (Cyrillic) characters, the latter so unintelligible that one could not even recognize the name, Kragujevatz, or the names of stations through which one passed. The data were furnished me every night, and their study and interpretation formed my continual occupation for three or four hours each night, on the conclusion of each day's work (involving visits, journeys, interviews, and continuous official work in headquarters) of the English Sanitary Mission to Serbia, sent out on February 15, 1915, by the War Office, under my charge. The data were of two classes:—

(1) The first of these related to the numbers of cases in hospitals in forty-two towns of Serbia, arranged alphabetically, and without, at first, any indication as to their position in relation to each other or to the various armies in the field. This relation I only ascertained as time went on, and eventually made clear to myself by the arrangement adopted in the analyses I afterwards made, and now show in the map and tables and charts now submitted.

(2) The second class of data, also furnished me nightly, related to the numbers and characters of the sick, wounded and infectious cases, and their distribution in the central military hospital and seven reserve hospitals in Kragujevatz. The latter proved to be of much interest and value, for the number of cases in hospitals in Kragujevatz were so large—constituting about one-tenth of the whole in Serbia—that their close study gave me a very clear picture and accurate sample of what was happening in all Serbia.

(3) As time went on, other data which I was constantly applying for were furnished me, so that eventually my records before I left Serbia about the middle of June, 1915, included the following. Many of them were so involved and so difficult to analyse that owing to my departure to Eastern war areas a week after my return from Serbia in June, 1915, my absence there for two more years as President of the Advisory Committee for Prevention of Disease in these areas, and my subsequent official duties in the Eastern Command which commenced two weeks after my return in 1917, it has only been in the past year, since the conclusion of the war, that I have found it possible to make the

detailed analysis of them now embodied in this account. The analysis referred to has involved a close study of the daily numbers of cases in hospitals, admissions, discharges and deaths in forty-two places in Serbia; the numbers of cases in war territories and field ambulances, the relation of the varying numbers at different periods to the preventive measures adopted.

The following are the data referred to:—

(A) WHOLE OF SERBIA.

General Return A.—(1) Daily numbers of cases of typhus, relapsing and enteric fevers in hospitals in forty-two towns in Serbia (January 1 to June 4, 1915). (Charts, pp. 44, 45, 95, 102; Tables, pp. 58, 76.)

General Return B.—(2) Daily numbers of admissions, discharges and deaths in above hospitals (April 14 to June 4, 1915). (Charts, *ibid.*; Tables, *ibid.*)

General Return C.—(3) Daily numbers of wounded and sick and of deaths; of empty beds; of the total deaths in hospitals (April 27 to June 4). (Table, p. 92.)

(B) WAR AREAS.

Special Return D.—(1) Daily number of typhus cases in war territories: (*a*) in hospitals; (*b*) in field ambulances of armies (March 28 to June 4).

Analysis D.—(2) Daily admissions and deaths in different war areas and civilian areas (April 26 to June 4). (Charts, pp. 66, 67, 96, 97; Tables, pp. 62-65, 78.)

(C) KRAGUJEVATZ DATA.

General Return E.—(1) Daily returns of numbers of wounded, sick, infectious cases, and total deaths in each of the eight hospitals (March 28 to June 4). (Chart, p. 87; Table, p. 85.)

General Return F.—(2) Daily numbers and character of cases of infectious disease in all Kragujevatz hospitals (March 14 to June 4). (Charts, pp. 86, 87.)

General Return G.—(3) Daily distribution of these cases among the various hospitals (March 28 to June 4).

Special Return H.—(4) Daily admissions and deaths of typhus cases in 1st Reserve Hospital (December 14, 1914, to May 14, 1915). (Charts, pp. 71, 72; Tables, pp. 70, 80.)

Special Return K.—(5) Mortality data for Kragujevatz military area (August 14, 1914, to May 13, 1915: (*a*) General mortality; (*b*) Mortality from typhus. (Chart, p. 86; Table, p. 82.)

Special Analysis L.—(6) Daily distribution of cases of typhus and relapsing fever in hospitals in forty-two places in Serbia. (Charts, pp. 46, 47.) (*a*) Daily numbers of cases in hospitals (March 27 to June 4): (*b*) Number of admissions and deaths (April 26 to June 4). In the different war areas and in civilian areas. (Charts, pp. 66, 67, 96-98; Tables, pp. 62-65, 78.)

This analysis was the most complicated of all, and has involved some five months' work. The results are shown in Charts, pp. 66, 67, 96-98.

Section II.—Application for help from the Serbian to the English Government.

It was under the circumstances (hereinafter detailed)—the full nature of which was unknown to anyone but themselves—that on February 9, 1915, the Serbian Government appealed to the English Foreign Office (under Sir Edward Grey) for the help of a mission of doctors—if possible about 100 in number. The response was immediate. The request was handed on the same day to the War Office (Lord Kitchener), and immediately submitted by him to the Director-General (Sir Alfred Keogh).

On the following day, Wednesday, February 10, Sir Alfred telephoned to me as senior physician to the London Fever Hospital, to confer with him as to the measures to be taken in the selection and command of a corps of twenty-five R.A.M.C. officers, which he had decided to send out to be attached to the Serbian Armies. This was the greatest number which it was possible for him to send, in view of the great calls which he had to meet for the British Armies in the field; and I was authorized to invite the help of any physicians or doctors willing to accept the duty. I attempted that evening to obtain the services of five physicians known to me, but without success; their official or other engagements preventing them giving up their duties at so short a notice.

On the following day (Thursday, February 11) I therefore accepted the duty and was appointed Colonel-in-charge of the Mission myself. The nature or extent of the chief epidemic diseases was not known at the time. It was reported to be "typhus." Whether this was "typhus abdominalis" (typhoid), or "typhus exanthematicus" (typhus), or "typhus recurrens" (relapsing fever) was not known, and I asked that a telegram be sent asking for information.

On the following Friday morning (February 11) I was informed by telephone that a reply had been received. The prevalent fever was "typhus exanthematicus." I was asked whether I could leave the following day (Saturday). I said I could, and I spent the day in providing the necessary equipment for Field Service.

The following day (Saturday), Major (afterwards Lieutenant-Colonel) G. E. F. Stammers, R.A.M.C.—an officer with wide sanitary experience

in India and South Africa—was appointed second officer in charge; Captain W. W. C. Topley, R.A.M.C., as bacteriologist, and twenty-two Lieutenants of the R.A.M.C., as members of the Mission, were directed to meet me at Victoria Station on Monday morning, February 15, "for foreign service." The place of service was not known to them; they joined me under the happy impression that they were on their way to France.

The title given to the Mission—thus rapidly formed and despatched—was that of "The British Military Hospital attached to the Serbian Armies." The instructions given to me were, that the Mission should not be employed in hospital clinical work, but that after ascertaining the actual prevailing conditions and characters of the epidemic, we should form for the Mission as a whole some definite programme of prevention work that would serve to check the epidemics in the Serbian Armies, and throughout the country.

The first and main object to be kept in view was the extreme necessity of the moment of restoring the health of the Serbian armies for fighting purposes, and freeing the land as quickly as possible from infection, in view of future possible military contingencies that might necessitate the operations of foreign military help to that country.

Provisional arrangements were made for a large supply of anti-cholera and anti-typhoid vaccine as required. The quantity of the former subsequently requisitioned by telegram on the day of our arrival and duly received and used by us was 300,000 complete sets of doses; each dose sufficient for two inoculations. At a later period 200,000 more were requisitioned and duly sent off.

The Mission was to be officially attached to the Serbian Armies, to whom all arrangements regarding provisioning, supply of interpreters and orderlies were left. Under normal circumstances the Serbian authorities might have been able to meet these requirements. Under the abnormal conditions we found on arrival this was not possible, and the absence of interpreters in particular formed from the first one of the greatest of the many difficulties I had to contend with.

Thus constituted and equipped, the Mission left London on Monday, February 15, Marseilles on February 22, and arrived in Salonica on Tuesday, March 2, and reached Nish on Thursday morning, March 4.

Sudden and hasty as our departure from London had been, equally sudden and unexpected was our arrival in Salonika on Tuesday. Our departure from England had not been announced to the Serbian Government, and the first information they received was my telegram

which I sent off according to my instructions, on our arrival at the Piraeus on Monday, March 1, the day before, to the English Military Attaché (Colonel Harrison) at G.H.Q., Kragujevatz. This only reached him on the Tuesday afternoon, twelve hours or more after our arrival in Salonica, at 6 a.m., on Tuesday, March 2. It was immediately communicated to the Prime Minister, who immediately wired to the Serbian Consul-General at Salonica (received and conveyed to me at 10 p.m., on board) and sent off a special officer, Lieutenant Petronevitch, to meet the Mission on its journey north to Nish. The latter had just time to catch the train from Nish at 8 p.m., on the Tuesday night, and meet our train next day shortly after we crossed the Serbian-Greek frontier on our journey to Nish.

On our arrival at Nish, about 8 a.m., on the Thursday morning (March 4) we were met by the chief officers representing the various departments of the Serbian Government—namely, by the British Minister (Sir Charles des Graz); the Assistant Secretary for Foreign Affairs (M. de Grouitch), representing the Prime Minister and Foreign Secretary (M. Paschitch); the Chief of the Sanitary Department (Colonel Karanovitch); the Chief Inspector of Military Hospitals (Colonel Sondermayer), and other Serbian officers.

Two hours later, accompanied by Lieutenant-Colonel Stammers, I reported to the Secretary for War, who extended a warm welcome, and then commenced our work by a long conference with the chief officers of the Sanitary Department. Within two hours we had ascertained all the available facts regarding the epidemic conditions, the origin of the outbreak, and the numbers of sick and wounded, and the conditions of pressure and difficulty which the country had to face from the insufficiency or absence of the equipment necessary to deal with those actually sick. Still more, the entire absence of any measures for the protection of those who were well.

On the following morning we were presented by the English Minister to the Prime Minister (M. Paschitch) who, speaking in German, explained to me very fully the position of matters in the country, and their difficulties in getting all the supplies they had ordered. In the afternoon we had a long conference with the Parliamentary Sanitary Commission formed specially to co-ordinate and support the efforts of the Military and Civil authorities; and during each day we visited and inspected the hospitals in Nish—a town normally with 20,000 inhabitants—now crowded to a degree with 100,000 refugees and others driven out of the Northern war areas.

SECTION III.—MILITARY CIRCUMSTANCES PRECEDING THE EPIDEMICS.

The military circumstances under which the outbreak occurred in December, 1914, were interesting and dramatic enough. Amid the crowded events in the French and Russian war areas at that period, they drew but little attention. They can now be seen in their true perspective, and they exercised a profound influence on the course of subsequent events in all the Eastern war areas.

The Austrian declaration of war against Serbia on July 28, 1914, found Serbia exhausted by two years' fighting in the first and second Balkan wars in 1912 and 1913—first against the Turks, and secondly against the Bulgarians in 1913. Belgrade, her capital, on the opposite side of the Danube from Hungary, could be, and was at once bombarded and had to be evacuated. The Government retired to Nish; one division of troops being left behind to prevent the Austrians crossing the Danube, or the Sava, as long as possible. The defence was a very remarkable one. All the Austrian attempts to cross in this neighbourhood were driven back with heavy losses; but it was fully recognized that they were only in the nature of feints. The real Austrian attack was arranged to come from the Bosnian frontier, in the direction of Valyevo and Ujitze (*see* Map, p. 31), and the main armies of defence were grouped on the line Valyevo to Palanka.

It came in force in August from the direction of Losnica over a front of a hundred miles. They forced their way across the Sava and the Drina (at Shabatz, Leshnitza and Losnitza), along the valley of the Yadar, converging on Valyevo, with the object of capturing that place, and driving a wedge between the first Serbian Army at Valyevo and the second and third armies operating south of the Danube and Sava. The fortunes of war swayed for five days in the Battle of the Yadar, August 18, and turned eventually in favour of the Serbians. The Austrians were repulsed and had to recross the Drina, followed by the Serbians who then penetrated into Bosnia. The Battle of the Yadar was the first great battle won by the Allies on the European fronts. The Austrian losses were 8,000 dead, 30,000 wounded and 4,000 prisoners; the Serbians lost 3,000 dead and 15,000 wounded. The advance and retirement of the Austrians were attended by the greatest atrocities to the population. "Towards such a population"—so ran the official Austrian order—"there is no room for feelings of humanity or generosity." The campaign was stated to be not a war but an execution.

The second campaign of the Austrians followed in September on much the same lines—namely, across the Drina from the Bosnian frontier, but further south. For six weeks the Serbians once more held them back over a line 100 miles in length in the mountains near the frontier, but the small Serbian army was holding too long a line with inadequate forces and supplies. They had to withdraw to a shorter line (the Kolubara River). In the beginning of November the Austrians advanced in great force: the Battle of Rozhan gave them the key to Valyevo, which was evacuated by the Serbians, and the Kolubara mountains—the key to the whole district. Belgrade had to be evacuated, and by the end of November the Austrians occupied a line reaching from Chak-Chak to Belgrade. The position of the Serbian army was precarious in the extreme, with only one narrow-gauged single line railway for their supply, utmost lack of ammunition, and unsupported by any big guns. They defended as best they could the heights of Rudnik, but they had to yield them, leaving the road open to Kragujevatz, the seat of their only arsenal. With Austrian armies advancing from Belgrade, in the north, and from Valyevo in the west, there was immediate danger that the whole Serbian army would be surrounded and captured. Everything depended on the nerve and patriotism of of the Serbian armies at the critical moment, and the story is told of how their old king (King Peter) strove to encourage them at this moment. He went forward to them in their trenches, and addressed them:—

"My dear Brothers,—You have taken two oaths: one to me, your king, and one to your country. From the first, I release you; from the second no man can release you. If you decide to return to your home, and if we should be victorious, you shall not be made to suffer. As for me and my sons, we remain here."

Not a man left his post, and King Peter kept his word and stayed with them until they entered Belgrade again. Towards the end of November new guns and fresh ammunition arrived from England. General Mischitch attacked again, stormed the Suvobor mountains on December 4, taking the Austrians completely by surprise, drove their right wing in headlong flight along the road to Valyevo, and later on once more across the Drina; drove their left wing across the Sava over the mountains near Mladenovac, and finally entered Belgrade on December 13—thirteen days after it had been captured by the Austrians.

Their two invasions, it is estimated, cost the Austrians 330,000 men

(of whom 40,000 were prisoners) with enormous loss of guns, ammunition, transport and stores. The victory was so great and complete as to be almost incredible to the Serbians themselves. It was regarded by the Serbians as a "crowning mercy." The extent of their victory, little known at that time, may be judged from the reference to it by General Ludendorff in his subsequent "Memories," 1919, i, p. 111 :—

"A shadow fell on the proud satisfaction with which we contemplated the development of events on the Eastern front (1914). The Austrian army had suffered a heavy reverse in Serbia. At the end of November it had penetrated far into that country. Belgrade had been taken on December 2, 1914. Austria-Hungary rejoiced greatly. Yet, as early as the days of the capture of Lodz and the Battle of Limanova (in Poland) the Austrians were retiring from Serbia defeated. They were no longer an effective fighting instrument. At first they had underestimated their opponents; now they went to the opposite extreme and overestimated them. The enemy's numbers alone terrified them. This feeling, and a certain feeling of impotence in the face of the Russians, have proved too much for the courage of the Austrian Army."

Outbreak and Spread of Epidemics of Typhus and Relapsing Fever.

But the cup of Serbian misfortune was not yet full. The Austrians in their retirement from Valyevo left behind them a trail of disease of typhus and relapsing fever that eventually spread to the whole country, and cost the Serbians suffering, loss, and misery exceeding, if possible, even that brought on them by the losses and atrocities of the war itself. The exact extent of their losses will probably never be known. But from data at my disposal, it is within the mark to estimate that in the course of the next three months—January to March, 1915—the number of typhus and relapsing fever cases in Serbia, in a population of about 3,000,000, fell little short of 500,000 cases, and the number of deaths to at least 120,000.

Origin and Spread of the Epidemics.

The general health conditions of the Serbian army and throughout Serbia as regards prevalence of infectious fevers were fairly good up to the middle of December, 1914.

This general information, conveyed to me on my arrival on March 3, 1915, was afterwards confirmed by later data obtained by me relating to typhus mortality in the wide Kragujevatz army area from August, 1914, onwards. These showed that no deaths from typhus occurred during August, September, and for three weeks of October, 1914. In

the last ten days of October, six cases of death were recorded, followed by nineteen in November, and by fourteen cases in the first half of December (*see* Table, p. 82; Chart, p. 86).

Early in December the Serbians began to take Austrian prisoners-of-war and shortly afterwards illnesses began to appear in the following order: Relapsing fever, typhus exanthematicus, enteric (but not so badly as the above), small-pox (a few cases). The latter did not give them much trouble, as vaccination is compulsory in Serbia, both in the army and among the people. But the conditions as regards the former steadily grew worse from that time onwards up to the time of the arrival of the English Sanitary Mission on March 3, 1915.

(The Kragujevatz data above referred to showed that the number of deaths from typhus, which had been 19 in November, rose to 30 in December, 126 in January, 554 in February, and 581 in March.)

Seat of Outbreak.

The first and worst seat of outbreak was Valyevo, a small town of about 10,000 inhabitants, situated in the north-west of Serbia, near the Bosnian frontier at the end of a single narrow-gauged railway line, and about 80 to 90 miles south-west from Belgrade. When the Serbians retired from this town in the second invasion of Serbia by the Austrians there were no cases of typhus among the troops, and they left there about 200 Serbian wounded with medical officers in charge.

When they again advanced, early in December, they took more and more prisoners, up to the number of 40,000, and when they returned to Valyevo they found more than 3,000 Austrian wounded and sick with typhus and relapsing fever under the worst possible conditions. The sanitary conditions were filthy. In one building, quite a new school, they found 150 dead Austrians in the cellars; and in the courtyards adjacent both men and cattle had been buried, many of them only partially, under a foot of soil.

Spread of Disease from Valyevo.

The conditions were so bad that the Serbians were obliged to evacuate the foremost places, and to establish concentration camps along their lines; and their 40,000 prisoners were, most unfortunately, distributed throughout the country to supply the labour so much needed everywhere. Typhus and relapsing fever rapidly followed this concentration and distribution, and were distributed along the whole line of railways to all the chief towns of Serbia, as far down as Monastir and Givgeli close to the Greek frontier.

The extent of infection and rapidity of its spread were shown by the figures of typhus and relapsing fever cases in hospitals during January and February, which I afterwards obtained. These rose from 2,400 on January 2 to 6,500 on February 1, and 11,500 on March 3 —the figures at the time of our arrival; subsequently to the maximum of nearly 17,000 cases by the end of March. These totals were made up as follows:—

	Typhus	Relapsing	Total	
January 2 ...	200 ...	2,200 ...	2,400 ...	
February 1 ...	1,200 ...	5,300 ...	6,500 ...	
March 3 ...	4,100 ...	7,400 ...	11,500 ...	Arrival of English Mission
April 2 ...	8,200 ...	8,500 ...	16,700 ...	

These figures were cases in military hospitals—all men. The number of cases in the civil population was not known. From data I subsequently obtained the number was at least five times greater.

Conditions in the Serbian Medical Corps.

The position in which this great outbreak found the Serbian Medical Corps was an exceedingly difficult one. It had just gone through two great wars—first against Turkey, and immediately followed by one against Bulgaria, and it had entered on this far greater World War without having had time to recover and re-organize itself, and utilize the experience gained by its previous two wars. On account of the unceasing and uninterrupted strain put upon it, its members became, as they officially reported to me, finally, utterly insufficient to deal with this new and strenuous work placed on them by so great an epidemic. They had successfully coped with, and been able to deal with all their wounded, but when, after the last defeat of their enemy, they had to re-enter the territories recently in the possession of their enemy and found them so filthy and so infected, they felt overwhelmed by the new tasks with which they were faced.

The Serbian doctors—whose total number was always small (not more than 450 in the whole country before the war)—had bravely and courageously accepted this great new fight against epidemic disease, and they soon began to take ill themselves and die in great numbers. By the end of February, when we arrived, sixty-two had already died, 200 had been ill and were not fit for duty, and less than 200 doctors were available for the whole country. In the first army in the Valyevo area—first affected—out of sixty doctors originally available, only fifteen remained fit for duty; ten to twelve doctors had already died

there. In one of its six hospitals there had originally been five doctors, three were down with typhus and only two remained for duty. The Serbian Medical Corps had endeavoured to concentrate its forces on this place, but had not sufficient reserves for that purpose, for the epidemic which had originally started had rapidly spread to all parts of Serbia. They had made an endeavour to clear out one of its towns of all its inhabitants, and turn it into a concentration hospital camp for isolation of its epidemic cases, but this measure could not be carried out for various reasons—military and others.

Section IV.—Conditions on Arrival in Serbia, March 4, 1915.

Our departure from London on February 15—after only some forty-eight hours in which to make our final preparations—had been hastened at the express wish, I was informed, of Lord Kitchener, who was extremely desirous to bring help to Serbia as speedily as possible. The fact that he was personally much interested in its success gave great support to my subsequent work, for his interest in Serbia was fully reciprocated by the intense respect and admiration which all Serbians had for his name. That interest was continued throughout our work, as I was happy to learn from the Director-General, Sir Alfred Keogh, in a letter written on April 15, received from him early in May :—

> " We follow your work with the greatest interest. I hope you will continue to use all R.A.M.C. personnel for sanitation and administration, and not for hospitals. Plenty of men can be got for hospital work only. Continue to send me your reports on technical matters. Lord Kitchener is interested in them, and watches your work closely."

The largest number of typhus cases admitted into any fever hospital in England, Scotland or Ireland, in the years 1847 to 1870, had been 2,493 cases—viz., in the London Fever Hospital in 1864. The number of cases seen by Dr. Murchison in the period referred to—on which he based his classical accounts—was over 20,000. The mortality was 19 per cent., or about 1 in 5.

The experiences of the week after our arrival were to include many surprises, as will presently be seen, fully confirming, and going far beyond anything above described from the past history of the disease. I little knew then, that within a few days I was to be amidst conditions in which I was to see not 1,000 cases in a year, but 1,000 cases in a day ; to find a maximum not of 2,500 cases in a year, but of over 4,000

cases in the hospitals at the time, rapidly rising to over 8,000 in the course of the next three weeks, plus an unknown number among the civilian population of Serbia, probably three or four times as many, of whom there was no information.

New cases arrived in hospitals at estimated rates as high as 1,000 to 1,500 a day.

There was a mortality not of 19 per cent. (1 in 5) but of 1 in 3—viz., 30 per cent., in January and February, and rising in a week or two to nearly 1 in 2, 40 per cent., in March.

That mortality was, as usual, highest amongst the doctors, ten to twelve doctors already dead in one hospital alone; out of an original total of 450 doctors, sixty-two dead (soon rising to over 100) and 200 unfit for duty; in the army fifteen doctors to a division instead of sixty; in one hospital out of five doctors, three down with typhus, and only two at work; in the first hospital visited in Serbia, containing 956 cases of typhus, relapsing and enteric, there were only two young doctors in charge, one of them, a handsome young Swiss, dead about ten days later; my first official duty on the day after my arrival two days later in Kragujewatz being to attend the funeral of a brave young Scottish mission worker, Miss Neill Fraser, of Edinburgh.

And lastly, to find hospital conditions appallingly overcrowded and insanitary, with 13,000 wounded, over 37,000 sick, and over 16,000 fever cases; of typhus, over 4,000, soon rising to 8,200; relapsing, 7,500, rising soon to 8,500; and enteric over 2,000.

Conditions on Arrival.

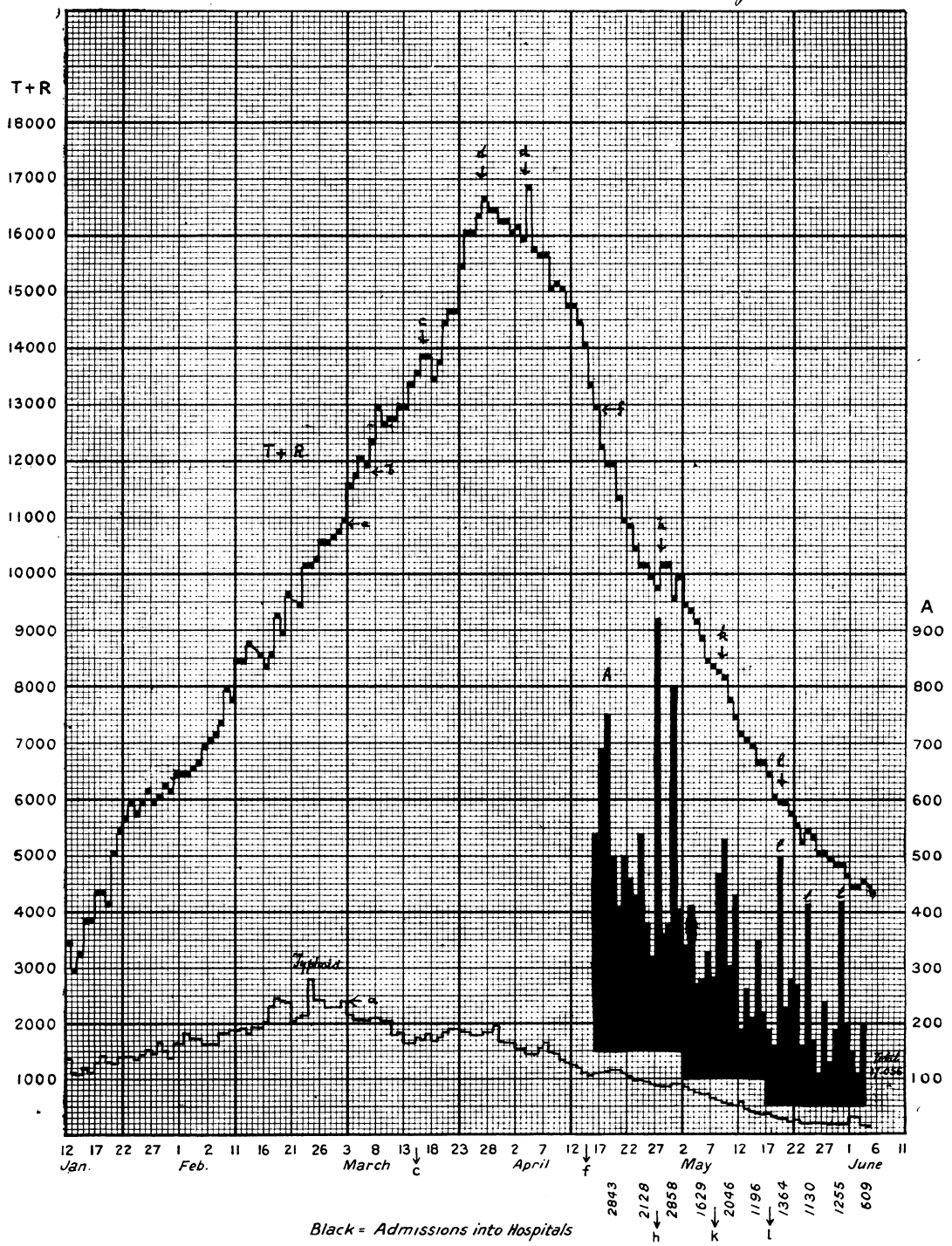
They were the following, as summarized in my official telegram and reports:—

Epidemics of typhus and relapsing fever, widespread throughout the country, in every town, village and hamlet—a raging pestilence, uncontrolled (*see* Charts, pp. 46, 47).

Cases in hospital on March 3: Relapsing fever, 7,429; typhus, 4,157; rising in the course of the next four weeks. March 31: Relapsing fever, 8,220; typhus, 8,085; estimated daily admissions of typhus, 1,000 to 1,500 cases; mortality from typhus, 40 per cent.

Conditions in hospitals, indescribably bad; overcrowded, sanitary arrangements non-existent; no disinfection arrangements. "*Urgent, urgent* need, not for surgical appliances and help and surgical measures, but for beds and blankets, bed linen, shirts and clothes for the mass of 15,000 fever patients."

Chart 1 Course of Epidemics of Typhus & Relapsing Fever in Serbia 1915.
(N° of Cases in Hospitals). A = N° of New Cases (April 17-June 4)



Black = Admissions into Hospitals

a = Arrival of Mission
b = Programme of Prevention
c = Suspension of Railway Traffic
d = Arrest in No: of Cases in Hospital 10 days after c.
f = Resumption of Railway Traffic
h = Increase of Cases in Hospital 10 days after f.
k = A Second increase 10 days after h.
L = A Third increase 10 days after k. due to evac. of F.d Ambul. (Chart 7.
m = Mission left Serbia.

Chart 2. Course of Epidemics of Typhus & Relapsing Fevers in Serbia as shewn by

T+R Nos of Cases in Hospital (Jan 1st-June
B Typhus New Cases (April 17-June
C Relapsing " " " "
A Admissions of Typhus 1st Reserve Ho
(a) Deaths " " " "

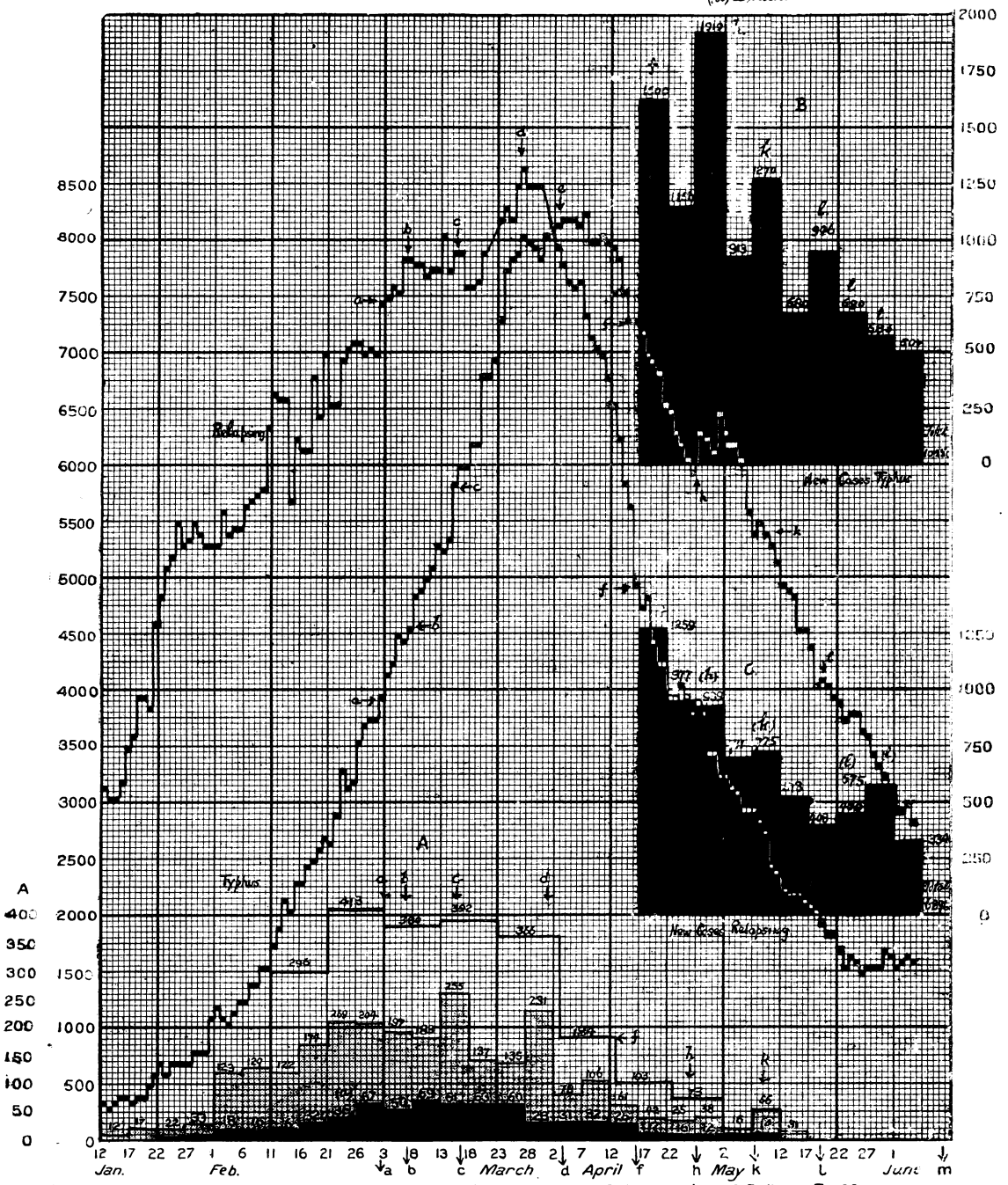
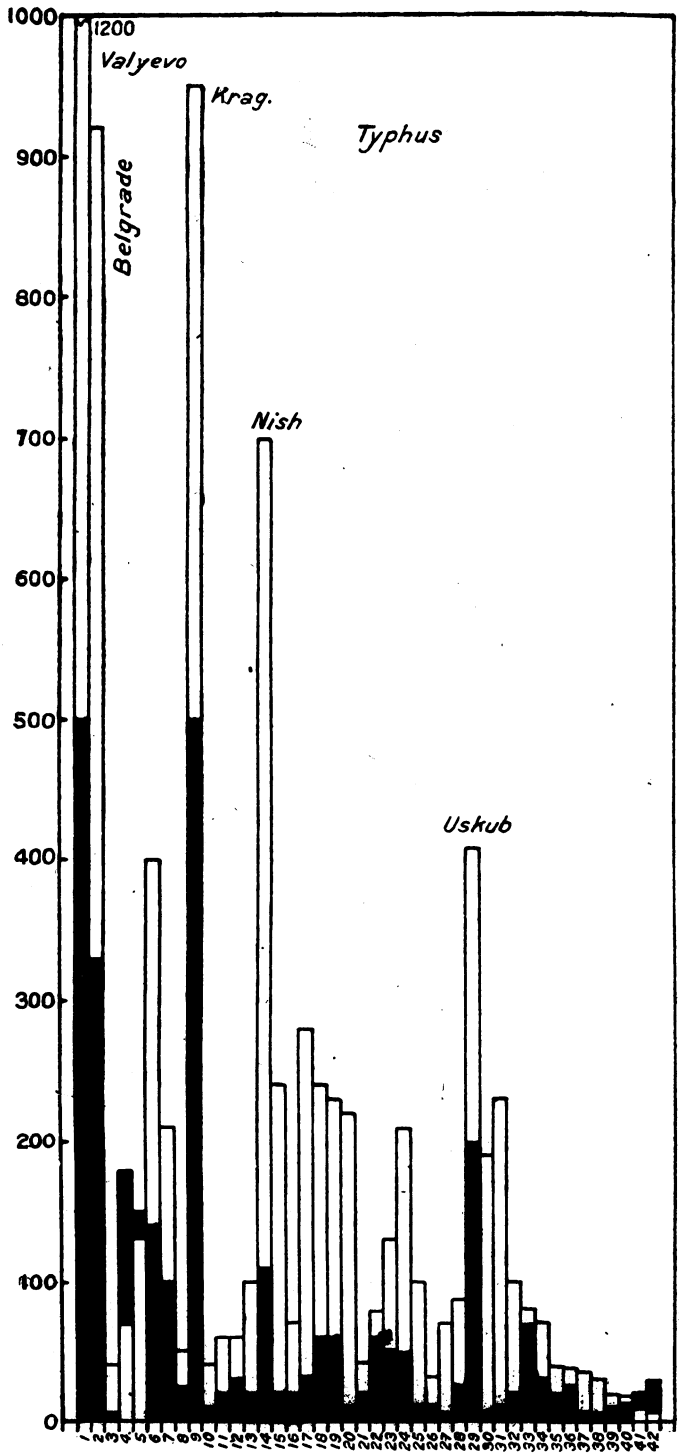
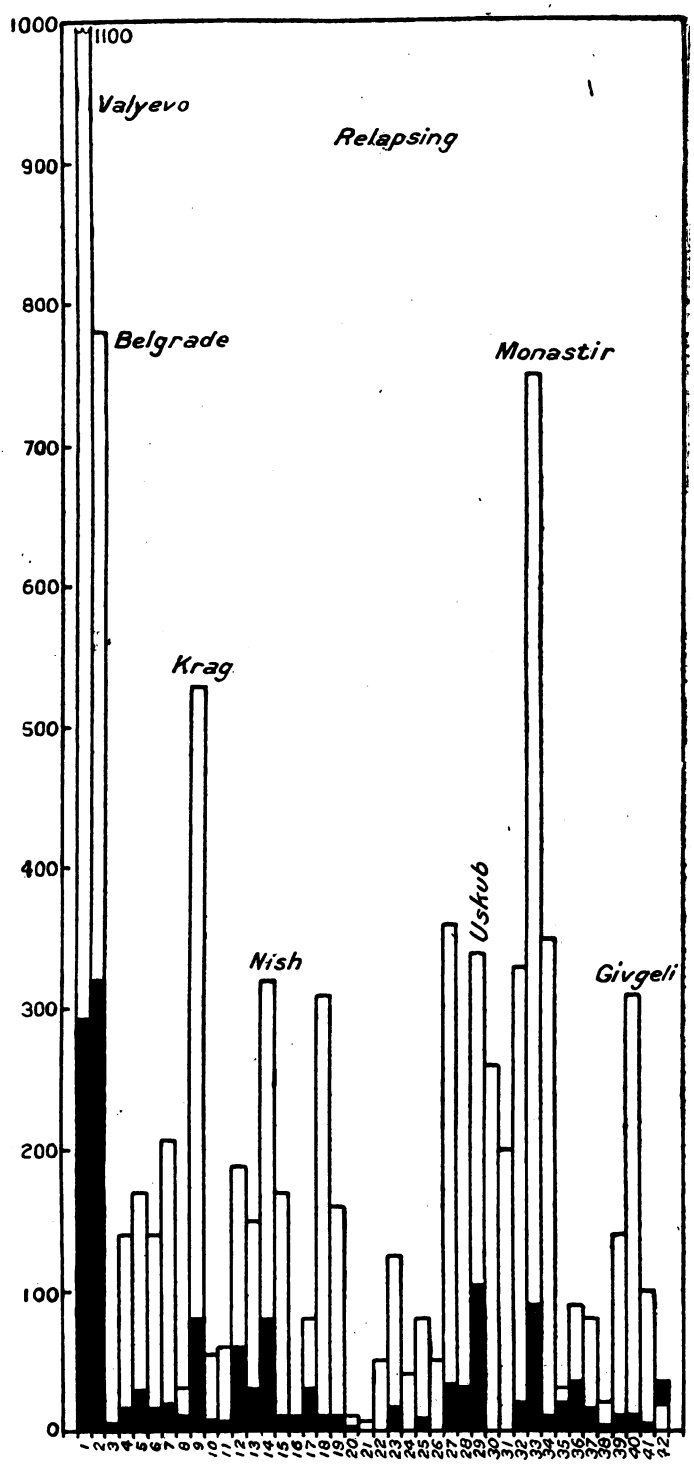


CHART A.



This chart shows the numbers and distribution of cases in forty-two hospital centres in Serbia: (*a*) at end of March (clear block) when the numbers were at their maximum—viz., 72 per cent. in war territories and 28 per cent. in central (14-16) and Southern (27-42) civilian areas; (*b*) on May 31 (dark block)—viz., 80 per cent. in war areas and 20 per cent. in civilian areas. The total fall between April 3 and May 31 was: In war areas, from 5,810 to 2,420, or 59 per cent.; in civilian areas, from 2,400 to 670, or 76 per cent. Column 4 shows the increased number of cases held up by the Quarantine and Disinfecting Station at Mladenovac.

CHART B.



This chart shows the number and distribution of cases in hospitals in forty-two hospital centres in Serbia: (*a*) at end of March when the numbers were at their maximum—viz., 44 per cent. in war territories and 56 per cent. in central (14-16) and southern civilian areas (27-42); (*b*) on May 31 (dark block)—viz., 67 per cent. in war areas and 33 per cent. in civilian areas. The chief areas of disease were Valyevo and Belgrade (1 and 2) as the result of infection conveyed after resumption of railway traffic on April 16 by refugees returning to their homes in these areas; the proportion in these areas rose from 33 per cent. on April 26 to 49 per cent. on May 31.

Hospital needs, dictated by the conditions, and immediately telegraphed by me to the War Office: Tent accommodation for 16,000 patients, blankets and bedding for 10,000, sheets for 30,000, socks for 20,000, bed gowns for 10,000, slippers for 10,000, clinical thermometers 2,000, urinals 5,000, bed pans 1,000, baths 300.

Remedial measures being carefully considered by us, exceedingly difficult; no labour and utter lack of material to provide necessary accommodation, or to carry out the simplest sanitary measures; climatic conditions (weather very cold, wet and snowy) precluded living in the open air, and no tents available. Conditions appallingly bad, widespread and quite out of control; to check them will be extremely difficult, if at all possible. Strong measures will be necessary to get things put right, as the appalling nature of existing conditions does not seem even now to be at all fully realized.

In the whole of Serbia 450 doctors originally, of whom sixty-two are dead, soon rising to over 100, and 200 unfit for duty. The Serbian Medical Authorities, as they officially wrote, utterly exhausted and overwhelmed by this terrible epidemic coming upon them after three wars in less than two years.

The warmest welcome therefore extended to the English Mission sent out in about forty-eight hours after receipt of their appeal for help—arriving in Salonica unexpected by the Serbians, who had therefore no time to make any preparations for us, and our first accommodation in Nish in empty cavalry barracks—this sudden arrival itself creating impressions favourable to our work:—

"Just like the English; we ask for 100 doctors to help; they apologize for being able to send only twenty-five, but they send them at once—and they arrive unexpectedly, provided with all their kit and asking only for empty barracks in which to sleep."

Such was the impression and comment made by the Foreign Office representative, who met us on our arrival in Nish at 8 a.m. on March 4, as he told me some three years later. And he then described to me how he had visited our barracks and seen our surroundings—and taken photographs of them—such surroundings and conditions that two of my officers were down with high fever and septic throats, which necessitated their invaliding home four weeks later.

Conditions in Hospitals on Arrival.

The above data on arrival served generally to make clear the widespread nature of the epidemics so far as the armies at least were concerned. But they represented very imperfectly the degree of stress on the whole land, the widespread gloom that existed, the fear that permeated the population inducing them to seek safety in places other than their own homes, thus spreading the disease by travelling in crowded trains; arriving in places—e.g., Nish—where no accommodation was available, and sleeping where they could get any shelter of any sort, mostly on the floors of the eating-houses, where they congregated during the day. The full extent of this was not clear to me in the first few days, but only became manifest by my experiences on travelling to Kragujevatz the following week. What was made clear, however, by these first experiences in Nish was the severity of the conditions in the hospitals in which the sick were intensely overcrowded; the utter inadequacy to meet the pressing needs, in respect of doctors, nursing attendance, accommodation, ventilation, and worst of all, sanitation and disinfection. Thus, in the first hospital visited by me in Nish—as described in my first report on March 7—there were 700 fever cases in all, with only 200 beds amongst them; only two young doctors in charge—one of them a brave young Swiss doctor, Dr. Ernst, who took typhus a few days after I saw him and died the following week. Groups of thirty, forty, fifty and sixty cases of typhus, relapsing and typhoid patients all mixed together, lay in ill-ventilated rooms, close together on wooden boards, in some cases three or four in two or three beds, with one blanket covering the whole, many of them on the floor; and some of them under the beds and in the passages between the beds.

There were no nurses: the only attendants being Austrian prisoners; no bath rooms or arrangements for washing; no sanitary arrangements. The sewage from typhoid patients and others was discharged through the floor into an open ditch just outside the ward; no arrangements existed for disinfection, either on admission or discharge. The only thing of this kind shown me was a small brick kiln capable of disinfecting one or two articles at a time. It was explained to me that this was quite good if a piece of blotting paper were placed on each article, and if the disinfection were stopped when the paper began to turn brown! The arrangements in various inns and eating-houses used for typhus patients which I afterwards visited the same day were of a similar or even

worse character. In one small inn I found a small bedroom unoccupied, and on my asking what it was for, it was explained to me that it was reserved for visitors. An instructive experience which made clear the dangers run by anyone occupying a room even for one night in any house whose previous history or freedom from infection was not guaranteed. No such place, it might be assumed, existed. One other great source of spread of infection was also made clear by these first inspections, and fully confirmed by all my later experience. This was the absence or inadequacy of all disinfection, of arrangements for washing or bathing, supply of hospital linen, blankets and sheets for the patients either on admission or discharge. Hence they infected each other while in hospital, and spread the disease to others on their discharge.

As already stated, the patients lay on straw palliasses which naturally harboured lice, and which it was impossible to disinfect, covered by dark blankets which, owing to the needs of the ward, it was impossible to spare to be washed. Therefore fresh cases, arriving in hospital for one disease—e.g., relapsing fever—were as likely as not placed in beds which had just been vacated by a patient dead from typhus or discharged for typhus. As relapsing fever and typhus were frequently mixed up in the same ward, cross infection must have continually occurred. Under these circumstances, and in the absence of any system of disinfection on discharge, the hospitals were an actual source of danger to the patients themselves, and the patients a danger to others on their discharge. This danger, as I had occasion to learn afterwards, was fully realized by the public themselves; to be sent to hospital was a dread to them; little short of a sentence of death.

The most striking and pathetic illustration of these conditions I had occasion to observe was in one instance in a large town with many hospitals, all of them without any means of disinfection. On inquiry I was always told that disinfection was carried out in a special disinfecting station. This was situated outside the town; and not very accessible to any of them. On visiting this, I found one disinfector (a Berlin pattern) which had obviously been little used, and was at the time not working. It was in charge of a caretaker who had a small house of two rooms with a kitchen. In each of the two small rooms—sufficiently large for one bed—I found twelve typhus patients, lying on the floor. There were twelve women and young children in one—one of the children lying in its mother's arms—and twelve men and boys in the other; two of the boys standing in their shirts trying to keep themselves warm near the stove. In the room occupied by the

women there was a beautiful bed with white sheets and silk counterpane in the corner. On inquiry, I learned that it was for the wife of a well-to-do officer who was expected; and, just as I was leaving, a fiacre with the lady and her husband drove up. The picture of that gentle patient, seeking refuge in that spot—in a room crowded with typhus patients, without any nursing other than could be given by the caretaker (whose official duties included the disinfection of typhus clothing), was one which drove home to me more than any other experience I had the desperate straits to which those suffering from typhus were put in Serbia at this period.

A further fertile source of infection in hospitals was supplied by the want of adequate accommodation for attendants. In the hospitals staffed by Serbians the only attendants were Austrian prisoners (mostly convalescents and a few male nurses). These attendants and other servants slept in the wards with the patients.

The Nature of the Problems.

In all these directions, and others subsequently noted, the conditions noted in these first few days of my experience in Serbia—in respect alike to the widespread character of the epidemics, and the utter absence of adequate measures or equipment to deal with them, presented problems of extraordinary difficulty. The problems were of two kinds—the clinical one of improving the hospital accommodation, necessary to deal with so many cases in the absence or lack of all the necessary nursing, clothing, bathing, disinfecting and sanitary arrangements. Secondly: the preventive problem of checking its spread to the healthy.

The Clinical Problem.

One's first desire on seeing the conditions under which these patient sufferers lay, was that of affording whatever medical help was practicable to the patients themselves.

In the absence of any proper accommodation, equipment or nursing arrangements, the amount of help possible to afford at this period was very limited. It was confined for the most part to supplying the patients with such food as was available, or with such drugs or stimulants—also limited in supply—as might enable them to pass through the crisis of their disease—one of the worst of all diseases in its severity, but one of the most gratifying in the rapidity of its recovery

and convalescence after the crisis has been reached about the fourteenth day. A patient with typhus is like a ship in a storm; neither physician nor pilot can quell the storm, but by tact, knowledge and able assistance, they may save the ship.

The mortality at this time, as I afterwards found, was about one in two cases—viz., 40 per cent.

Mortality from Typhus in Kragujevatz.

No exact figures of mortality were available at this time. It was stated to be very high: to bury the dead was itself a difficulty in the absence of labour or material. Bodies lay unburied in groups even up to 200. The estimate of mortality ranged from 30 to 50 per cent., and figures which I got at a later period (May) in Kragujevatz fully confirmed this estimate. Figures which I afterwards obtained for the chief typhus hospital in Kragujevatz (the First Reserve) and the largest one in Serbia, showed that up to this period, March 2, out of 700 completed cases (admitted between December 19 and March 2) the number of deaths had been 207—a case fatality of 30 per cent. In March the fatality in 829 completed cases (i.e., discharged or dying) was even higher—viz., 331 cases, or 40 per cent.

These data were naturally not known to me at the time now referred to—viz., early in March. They were only obtained by me piecemeal and analysed later. They are introduced at this place to indicate by actual figures the severity of the conditions presented at the time of my arrival—the arrest or amelioration of which was the problem to be faced. They indicated clearly the extreme gravity of the clinical problem of the amount of sickness and fatality of the cases and the hospital problems which had to be faced in each hospital and without the immediate resources at hand by which these needs could be met. But bad as these conditions were, contributing as they did both to the increase, spread and mortality of the disease, they were not the causes of the wide outbreak.

Prevention Problem for the Whole Country.

But urgent and pressing as these needs were, and strongly as they appealed not only to myself but to my officers to give clinical help, my instructions were not to disperse my officers amongst the hospitals for clinical work, but to form a programme of prevention which would check the epidemics in the armies and affect all parts of the country—

not merely those already stricken with disease lying in hospitals. How that problem was to be solved was the subject of intense perplexity and thought, and gave us great concern during the first days of our experience in Serbia.

Section V.—Problems and Measures of Prevention.

The preventive problems were of two classes—viz., (*a*) those relating to lice-borne diseases (typhus and relapsing fevers); (*b*) those relating to water or sewage-borne diseases (typhoid, now prevalent; and contingently, cholera, the outbreak of which, early in the summer, was anticipated by all).

The most pressing of these was that connected with lice-borne diseases. It was of two kinds. First and foremost, there was the immediate urgent need of devising some simple method of disinfection with the materials at hand capable of being easily improvised by every one, and put into use at once both in hospitals and the houses of the people. The necessity was urgent and pressing, and never was the old adage, "necessity is the mother of invention," better illustrated than by the "barrel disinfector" contrived within forty-eight hours by the capable sanitary officer of the Mission—Lieutenant-Colonel Stammers.

The second necessity was to drive home to the people themselves the facts regarding the lice-borne mode of spread of these diseases, and the urgent need for them to combat these by their own individual efforts. This was equally well met by the communication No. 5 (of March 7, 1915) and by the suggested pamphlets and posters (in communication No. 6) of the same date.

The Serbian authorities, essentially practical in their outlook, and made keenly alive to the necessities of the situation, quickly appreciated the practical nature of these measures and recommendations, and put them into effect as speedily as possible. They recognized that they changed the entire aspect of the problems with which they were faced. It was made clear to me that the chief problem which they had put before themselves up to the time of our arrival was to provide hospital accommodation and equipment for the patients—their appeal had been for doctors. The other aspect now put before them by the arrival of our Mission and our recommendations, was the even more urgent necessity of preventing the spread of the diseases by concerted measures of prevention fitted by their simplicity and their wide applicability to

check that spread, and thereby relieve the pressure on the hospitals by diminishing the number of new cases.

It was, then, by preventive measures—disinfection against typhus and relapsing fevers, improved sanitation and water control against the existing typhoid, and preventive inoculation against the expected cholera, or against typhoid—that these epidemics could best be checked or controlled, or in the case of cholera altogether prevented.

Therefore these three classes of measures were recommended in the seven communications sent in on Monday, March 8, within three days of our arrival, as our first endeavour to meet the needs of prevention, and brought prominently to the notice of the Serbian authorities and of the Parliamentary Sanitary Commission formed specially to meet the needs of the situation. I met this Commission in a long interview on the day after our arrival, and the communications referred embodied our chief recommendations and many others of a practical nature which we had placed before them on that occasion. These related first and foremost to the lice-borne nature of the diseases—typhus and relapsing fever—and a strong appeal called on every man and woman in Serbia to help to the utmost in the war against disease just as they had fought successfully against their human foes.—"Death to all vermin; how to wage this new war; how to kill lice, bugs and vermin by simple practical domestic measures."

The Measures that should be adopted by Government, Town and Hospital Authorities to prevent the spread of Typhus and Relapsing Fevers.

(1) By compulsory notification, isolation, and disinfection, in the case of hospitals.

(2) System of notification in towns and villages—and by householders.

(3) Personal cleanliness of patients and of destruction of vermin in all bedding, clothing, bedsteads.

(4) Removal to hospital where possible.

(5) Personal interest of each individual in combating these diseases.

(6) Public interest to be aroused by pamphlets and newspapers.

(7) Supplies of disinfectants and arrangements for disinfection by public authorities.

(8) Formation of public disinfecting stations; and lastly,

(9) *The formation of the newly improvised steam or "barrel disinfector"* devised by Lieutenant-Colonel Stammers, so simple in

character, so inexpensive, and so easily made, that they could be formed in any number required in every village, and even in every household in the country.

Sequel to the Preventive Measures taken.

How far that decision was wise, the sequel will show. Following the measures advised and taken on March 16 the numbers of new cases of typhus contracting the disease, which prior to March 16 had been 1,000 to 1,500 a day, were reduced in the course of ten to fourteen days by March 29 to one half, and in the course of one month, by April 16, to 230 daily, and by May 15 to 115 a day. The hospital staffs thereby obtained what they most needed at this trying period—viz., some time and opportunity to put the hospitals into better order, and infinite credit is due to the officers in charge of such hospitals for the improvements, amounting in some cases to transformation, which when thus relieved they carried out without additional medical help in the course of four to six weeks.

But of even more importance was the fact that the measures we left in force ("barrel disinfectors," railway van disinfectors, a disinfecting station at Mladenovac, cleansing and bathing stations, hospital accommodation at Mladenovac) on the departure of the Mission from Serbia in June were of such a nature as to be permanently applicable to the prevention and control of the recurrence of the epidemics—should such occur (see *postea*). These measures dealt with in the first seven communications related specially to the civil population and civil authorities. The response to them on the part of the Parliamentary Sanitary Commission was immediate and practical. Within a week they came up to Kragujevatz (G.H.Q.) to which we had gone forward on the following day (Monday, March 8) and they immediately formed a "State Sanitary Commission for Prevention of Disease" to act as their executive and give effect by financial and other means to the recommendations and measures.

With this body I was afterwards in close relation in connexion with the hospital and disinfecting arrangements we recommended in Kragujevatz, and equally applicable to all other towns in Serbia. The result was that, although our duty lay specially with the armies (not with the civil population), the conferences and discussions held with the Commission were rendered of advantage to the whole country by the application to it of the measures employed in Kragujevatz.

Propaganda.

An extensive propaganda was undertaken to make these barrel disinfectors known throughout the army and the country generally, urging their production and use. "The 'Columbus Egg' of simplicity and efficiency" they were enthusiastically described by the director of the railway works at Nish, where I had taken one and demonstrated it in the Parliament House, and also in the Prefecture before the Medical Society of Nish. It was also seen by M. Paschitch, the Prime Minister, who gave orders that a hundred should be made at once and sent out as samples to the prefects in all towns, with instructions to get others made in each place.

In the Arsenal, at Kragujevatz, I urged their formation in as great a number and as quickly as was possible. I sent out some to each of the English Missions at work, and in season and out of season I continually came into conversation with all officials with whom I could converse in German; I spoke of them in strongest terms of recommendation.

A course of instruction was formed by Major Protitch, the Director of the Central Military Hospital at Kragujevatz and P.M.O. of the Schumadia Division of the Army, ten to fifteen non-commissioned officers from the different regiments being brought at a time to Kragujevatz for three or four days, receiving for eight to ten hours daily practical instruction in their use. The course was a most successful one, as shown by the following report furnished to me by Major Protitch on April 14, a week or two after the course was started:—

"At your personal request, I have the honour of informing you that I have terminated the teaching of forty-nine men how to disinfect. These were sent to me from corresponding units of Kragujevatz Garrison. I have further terminated the teaching of 117 persons about disinfection. These were sent to me by several communities of the Kragujevatz district: for the Kragujevatz community, seven persons; to each other commune, one to two persons. Besides this I have proposed to the chief of the Kragujevatz district:—

"(1) That each commune and village should be provided with one improvised 'barrel disinfector' (barrel and boiler), a Vermorel spray, and a hair-cutting machine.

"(2) That each village council shall at any time have a large store of lime for distribution for disinfecting purposes.

"(3) That men who have been instructed in disinfection shall be freed from any other work, and be used only for carrying and disinfection.

"(4) That the chief of each district shall be supplied with a larger quantity of carbolic acid (about 1,000 kilos) or creolin to each council.

"(5) To every one employed in disinfecting, small booklets will be sent ('Instructions for Disinfection') which will be printed in a few days and edited by the Sanitary Commission."

In acknowledging this and congratulating him on his work, I expressed my warm appreciation of the good work he was doing in regard to disinfection: the teaching measures he had taken and was carrying out were precisely those that would be most helpful in preventing the spread of infective disease.

Programme for the Army.

The practical measures for cleanliness and disinfection, especially the provision of "barrel disinfectors," applied equally to the army—the disinfectors, indeed, specially to the army, since one barrel disinfector to each company of 250 men sufficed amply and efficiently for their complete disinfection every two weeks. But these measures were of a character which would necessarily take some little time to be put in force: and the immediate need of the moment was for some more general measures —applicable at once—that would serve to control the raging epidemics then in force, and check their further distribution throughout the country.

During our first few days in Nish our observations related to conditions, causes and factors which we had been able to observe in visiting its hospitals, and our recommendations, as above summarized, related to their prevention. The factors responsible for the wide spreading of infection throughout the whole country were made clear to myself and my colleague Lieutenant-Colonel Stammers on our journey north to Kragujevatz the next day (Monday, March 8). This was the first journey we had made in daylight since our arrival in the North of Serbia. The conditions observed on our journey, in the carriages of the train and in the stations through which we passed, were those of extreme pressure and overcrowding, crowds of peasants in their sheep skin coats—the friendly homes of countless lice—being seen everywhere trying to get seats in the train. The carriages of the train reeked with the smell of naphthalin and camphor used in a vain attempt to prevent infection. The conditions were clearly such as to favour the spread of infection to an extreme degree. The whole railway system was acting —as I described it in my report—as "rivers of infection conveying infection up and down the country"—from the army areas to the civilian areas, and from the latter back to the army.

TABLE I.

Course of the Epidemic of Typhus, Relapsing Fever, and Enteric in Serbia, January to June, 1915, in relation to the work of the British R.A.M.C. Sanitary Mission, as shown by numbers of Cases in Hospitals on the dates specified.

Date	Typhus	Relapsing	Enteric
January 1	113	1,776	496
,, 6	124	2,184	753
,, 11	243	2,981	1,246
,, 16	378	3,532	1,116
,, 21	622	4,506	1,260
,, 26	730	5,233	1,491
,, 31	1,107	5,122	1,677
February 5	1,256	5,458	1,658
,, 10	1,557	6,347	1,880
,, 15	1,782	6,715	1,851
,, 20	2,587	6,449	2,411
,, 25	3,125	7,072	2,405
March 2 (*a*) ...	3,964	6,997	2,383
,, 7 (*b*) ...	4,569	7,874	2,099
,, 17 (*c*) ...	5,997	7,894	1,818
,, 22	6,797	7,904	1,878
,, 27 (*d*) ...	8,040 (*e*)	8,661 (*e*)	1,856
April 1	7,952	8,114	1,641
,, 6 (*e*) ...	8,024	7,550	1,527
,, 11	7,984	6,791	1,295
,, 15	7,300	5,663	1,075
,, 16 (*f*) ...	7,324	4,960	1,100
,, 17	7,219	4,748	1,115
,, 18	6,984	4,861	1,126
,, 19	6,947	4,451	1,160
,, 20	6,779	4,230	1,120
,, 21	6,604	4,253	1,114
,, 22	6,555	3,930	1,041
,, 23	6,317	3,918	979
,, 24	6,209	4,039	985
,, 25	6,054	3,967	937
,, 26 (*g*) ...	5,979 (*g*)	3,808	858
,, 27 (*h*) ...	6,314 (*h*)	3,904	878
,, 28	6,249	3,815	849
,, 29	6,158	3,455	846
,, 30	6,475	3,463	882
May 1 (*i*) ...	6,343 (*h*)	3,265	865
,, 2	6,260	3,250	857
,, 3	6,263	3,166	797
,, 4	6,107	3,110	751
,, 5	5,938	2,941	722
,, 6 (*l*) ...	5,598	2,943	694
,, 11	5,138	2,398	505
,, 16	4,529	2,149	381
,, 21 (*m*) ...	3,957	1,870	221
,, 26	3,635	1,516	198
,, 31	3,098	1,642	188
June 4 (*n*) ...	2,860	1,609 (*n*)	160
	(Patients in Hospitals mostly convalescent.)		
,, 10	Mission left Serbia for Salonika.		
,, 14	Mission left Salonika for Malta.		

TABLE I—(*continued*).

(*a*) Arrival of Mission.

(*b*) Programme of prevention and disinfection. "Barrel Disinfector" devised.

(*c*) Railway traffic suspended and leave from army stopped. "Railway Van Disinfector" devised (*d*).

(*d*) Mladenovac Disinfecting Station sanctioned and formation commenced. "Railway Van Bath" devised (*e*).

(*e*) Number of cases in hospitals at their maximum twelve days after (*c*); (= incubation period of cases infected before March 17).

(*f*) Railway traffic resumed and leave from army permitted. Inoculation and Disinfecting Train completed.

(*g*) Steady fall in number of cases since April 3: Typhus, 27 per cent.; relapsing, 52 per cent.

(*h*) Recrudescence of typhus twelve days after (*f*), (= incubation period).

(*i*) Mladenovac Disinfecting Station developed to meet this recrudescence.

(*l*) In full action (1,700 men in one day).

(*m*) Two base hospitals transferred to Mladenovac.

(*n*) Mladenovac as a great disinfecting station with two base hospitals connected with it.

These observations and conclusions pointed to the most urgent chief preventive measures called for by the occasion:—

(1) The temporary suspension of all railway passenger traffic, and, above all, in the case of the army, the stoppage of all leave.

(2) The formation of some quarantine and disinfecting station on the railway close behind the chief armies, that would serve to check the spread of infection between the army and the civil areas.

Such then were the measures and the scheme of prevention which we deemed applicable to the situation, and which we submitted in our "Scheme of Work" sent in to G.H.Q. two days later (March 10).

The measures of suspension of railway traffic and stoppage of leave —not a light decision in the condition of public alarm throughout the country—were decreed to take effect on Tuesday, March 16, and were put in force on that date, the duration to be for fifteen days—i.e., until March 31. As will presently be seen, the end of the month was a very critical one as regards the course of the epidemic—calling, in our opinion, for a continuance of these measures. They were absolutely necessary, not only in the state of the epidemics at that time, but also to give time for the formation and completion of our disinfecting station at Mladenovac and the English sanitary train for inoculation and disinfection. At a critical moment these measures were therefore continued for another fifteen days until April 15 (*see* p. 140).

The results, as will afterwards be seen, were most striking—viz., sudden arrest of the epidemics on March 30. The results of the resumption of traffic on April 16 were no less striking, and even more instructive as regards the effect of railway traffic in spreading the

disease. For a sharp rise and spread of the disease followed on April 27, and but for the establishment of our cleansing station at Mladenovac the original conditions favouring the spread might have been largely reproduced. The nature of this recurrence and spread of the disease will be dealt with in a later section.

Section VI.—Summary of Nature, Object and Results of Chief Measures of Prevention.

(*a*) Suspension of railway traffic.
(*b*) Stoppage of leave from the army.
(*c*) Mladenovac quarantine and cleansing station.
(*d*) Formation of "English sanitary disinfecting train."
(*e*) "Barrel disinfector" devised.
(*f*) Railway van disinfectors devised.
(*g*) Railway van douche baths devised.
(*h*) Cleansing of railway stations and rolling stock, disinfecting and bathing stations.

The first wide measures of prevention placed in the foreground of our programme submitted March 10, and put in force at once, March 16, were suspension of railway traffic and stoppage of leave from the army. Their object was to check the spread of infection by the railway all over the country, particularly from the army areas, A, B, C, D, E, to the middle and southern civilian areas F (*see* Map, p. 31), or from these latter areas back to the armies.

The particular area which we had selected as the sphere of our work (B) was the largest area infected, with, as I afterwards found, its total of 4,166 cases of typhus and relapsing fever on April 3. Its particular importance was that it lay between the first army heavily infected area (A) with its total of 2,264 cases, and the rest of Serbia (*see* Table, pp. 62-65).

The particular object we had in view in the establishing of a big quarantine and disinfecting station at Mladenovac, the junction of the first army area (A) with the army areas (B) was to shut off army area A from B, and to hold up all infection coming from the two great army areas (A and B), and to prevent its spread southwards to areas F, even after the railway traffic was resumed.

If our disinfecting station and sanitary disinfecting train could not be formed and got into action before the railway traffic was resumed,

the position of affairs would be largely the *status quo antea*—viz., infection would once more spread southwards. Hence our great anxiety to get the station in hand, and the regret to us occasioned by the delay of two or three weeks from March 10 to 27 in getting the formation started.

The sequel was to show that the events above anticipated were precisely those that happened. It was a neck to neck race between the completion of our disinfecting station at Mladenovac on April 21 and the resumption of railway traffic on April 16. The latter won by five days on the start, and owing to difficulties met with by my officers at Mladenovac—which were only overcome by my arrival at that place on May 1, as will be afterwards described—it may be said to have got the advantage of another seven days on the course up to May 3. But it was overtaken by a great spurt which the disinfecting station was able to make on May 3, two days after my arrival, with the result that the Mladenovac disinfecting station came fully into action just at the time (May 2-6) it was urgently needed, and most effectively arrested or controlled the spread of infection which had again set in after the resumption of railway traffic on April 16. But for the existence of this station the original conditions would have been reproduced—i.e., infection would have passed unchecked from the armies to the civilian areas.

The data furnished by my analyses (Tables, pp. 62-65) and represented graphically in the accompanying Charts, pp. 66, 67, show that, immediately following the resumption of railway traffic two streams of infection began to flow—(*a*) one of typhus conveyed from the army areas, especially army area A, to other areas—principally B and civilian areas F, by troops going and returning on leave; (*b*) one of relapsing fever conveyed from the civilian areas into the army areas—especially area A —by refugees returning north to the areas A and B, whence they had been driven on the invasion of the Austrians.

To meet these conditions the troops and refugees were detrained and temporarily detained for disinfection at our station in Mladenovac. The numbers dealt with rose rapidly from 50 up to as many as 1,700 daily. (*See postea*, p. 127.)

TABLE H (CHART, p. 66).

Course of Epidemic of Typhus in Serbia as shown by number of Admissions, Deaths, and Cases in Hospitals, April 14 to May 31, in (1) War areas A, B, C, D, E; (2) Civilian areas, F; (3) All Serbia, S. Showing increased infection conveyed by troops on leave in all areas except Area A, whence the chief infection was conveyed.

Date	War Territories						Civilian	Totals		
	A	B	C	D	E	Total	F	Admissions	Cases in hospital	Deaths
Cases in hospital April 3 (*d*)	1,221	2,789	216	1,013	571	5,810	2,403	—	8,213	—
April 14 ...								155		50
,, 15 ...								289		48
,, 16 (*f*) ...	Percentage fall in cases in hospital, April 3—26							419		80
									7,320	
								863		178
,, 17 ...								464		63
,, 18 ...			+					369		63
,, 19 ...	4·0	42·0	17·0	23·0	24·0	27·0	28·0	304		57
,, 20 ...								256		80
,, 21 ...								227		53
									6,600	
								1,620		316
,, 22 ...								242		48
,, 23 ...								228		58
,, 24 ...								236		63
,, 25 ...								217		35
,, 26 (*g*) ...	89	56	11	21	10	187	41	228	27·0	32
Cases in hospital	1,126	1,692	244	771	431	4,264	1,715	1,151 (*g*)	6,000	236
,, 27 (*h*) ...	89	114	31	43	7	284	327 (*h*)	611 (*h*)		40
,, 28 ...	38	104	15	29	9	195	39	234		35
,, 29 ...	32	59	19	15	12	137	107	244		54
,, 30 ...	54	417 (*h*)	18	20	13	522 (*h*)	48	570		41
May 1 ...	36	60	20	60	5	181	79	260		51
	249	754 (*h*)	103	167	46	1,319 (*h*)	600 (*h*)	1,919 (*h*)	6,475 (*h*)	221
,, 2 ...	15	24	44	35	18	136	58	194		67
,, 3 ...	48	72	30	23	5	178	82	260		51
,, 4 ...	—	24	9	5	40	78	70	148		37
,, 5 ...	64	32	21	8	8	133	32	165		34
,, 6 ...	—	15	22	83	9	129	22	151		40
	127	167	126	154	80	554	264	918	5,560	235
,, 7 ...	8	54	—	7	1	70	42	112		31
,, 8 (*k*) ...	18	252 (*k*)	48	15	7	340 (*k*)	28	368 (*k*)		45
,, 9 ...	162 (*k*)	86	22	12	3	285	58	343		56
,, 10 ...	44	44	38	43	4	173	48	221		37
,, 11 ...	—	52	13	6	3	74	153	227		34
	232	488	121	83	18	942 (*k*)	329	1,271 (*k*)	5,140	203

TABLE H (*continued*).

Date	War Territories						Civilian	Totals		
	A	B	C	D	E	Total	F	Admissions	Cases in hospital	Deaths
May 12 ...	—	23	14	4	9	50	42	92		31
,, 13 ...	—	25	19	3	5	52	104	156		31
,, 14 ...	—	89	14	14	4	121	17	138		27
,, 15 ...	—	73	6	4	1	84	65	149		32
,, 16 ...	35	58	9	9	4	115	30	145		44
	35	268	62	34	23	422	258	680	4,530	165
,, 17 ...	9	27	7	12	8	63	52	115		36
,, 18 ...	27	18	7	14	2	68	48	116		31
,, 19 (*l*) ...	30	292 (*l*)	15	1	5	343 (*l*)	24	367 (*l*)		30
,, 20 ...	—	97	1	2	17	117	47	164		16
,, 21 ...	—	54	31	27	26	138	46	184		35
	66	488	61	56	58	729	217	946 (*l*)	3,960	148
,, 22 ...	26	40	25	2	9	102	71	173		19
,, 23 ...	—	34	8	7	2	51	43	94		23
,, 24 (*l*) ...	—	182 (*l*)	1	16	2	201 (*l*)	12	213 (*l*)		38
,, 25 ...	—	36	3	15	49	103	23	126		26
,, 26 ...	18	9	3	19	1	50	23	73		34
	44	301	40	59	63	507	172	679	3,630	140
,, 27 ...	28	78	4	9	5	124	14	138		30
,, 28 ...	—	24	1	5	1	31	24	55		9
,, 29 ...	—	2	3	13	5	23	52	75		21
,, 30 (*l*) ...	7	168 (*l*)	3	7	8	193 (*l*)	19	212 (*l*)		26
,, 31 ...	20	31	5	3	7	66	37	103		20
	55	303	16	37	26	437	146	583	3,090	106
Cases in hospital May 31	502	1,437	129	174	187	2,420	670		3,090 (*m*)	
Total percentage fall since April 3	58·0	47·0	40·0	82·0	67·0	59·0	76·0		63·0	
								10,630		1,948
Percentage distribution—										
April 3	14·0	35·0	2·0	11·0	7·0	72·0	28·0			
,, 26	18.0	28·0	4·0	13·0	7·0	72·0	28·0			
May 31	16·0	46·0	4·0	5·0	6·0	80·0	20·0			

(*d*—*g*) Fall in numbers of cases in hospitals and in admissions during suspension of railway traffic (up to *f*) and for ten days after (*f*); the greatest fall in War area B, least in War area A.

(*h*) Sudden rise in admissions twelve days after resumption of railway traffic on April 16, as the result of infection conveyed from Area A by men going on leave—shown in all areas *except Area A*.

(*k*) Second rise twelve days later, twelve days after return of men on leave to the armies. Shown in all army areas *including Area A*. (*See* Charts, pp. 66, 67.)

(*l*) Rise in admissions seen in all War areas, *not in Civilian areas F*, specially in War area B, due to evacuation of field ambulances in that area, preparatory to forward movement of troops. (*See* Charts, pp. 96, 97, 98, 101.)

(*m*) Patients in hospital mostly convalescent.

TABLE K (CHART, p. 67).

Course of Epidemic of Relapsing Fever in Serbia as shown by numbers of Admissions and Deaths in hospitals (April 14 to May 31) in (1) *War areas* A, B, C, D, E; (2) *Civilian*, F; (3) *All Serbia*, S. *Showing increased infection conveyed by Refugees back to War area* A *and Civilian areas* F, *after resumption of railway traffic on April* 16—21; *most marked in War area* A *and Civilian areas F.*

Date	War Territories.						Civilian	Totals		
	A	B	C	D	E	Total	F	Admissions	Cases in hospitals	Deaths
Cases in hospital April 3 (*d*)	1,043	1,377	407	416	237	3,480	4,330	—	7,810	—
April 14 ...								117		49
,, 15 ...								253		16
,, 16 ...	Percentage fall in cases in hospital, April 3—26							268		16
								638	4,960	81
,, 17 ...								284		26
,, 18 ...								354		13
,, 19 ...								197		11
,, 20 ...								149		12
,, 21 ...								275		12
	71·0	30·0	+ 27·0	13·0	57·0	36·0	65·0	1,259	4,250	74
,, 22 ...								217		12
,, 23 ...								206		9
,, 24 ...								304		14
,, 25 ...								161		3
,, 26 ...	—	8	3	14	14	39	50	89	52·0	13
Cases in hospital (*g*)	305	965	520	361	102	2,253	1,547	977	3,800	51
April 27 ...	150 (*h*)	6	20	—	—	176 (*h*)	128 (*h*)	304 (*h*)		11
,, 28 ...	30	11	5	12	—	58	68	126		9
,, 29 ...	34	47	6	1	4	92	41	133		4
,, 30 ...	31	80 (*h*)	1	1	1	114	117 (*h*)	231		8
May 1 ...	25	51	18	—	2	96	49	145		15
(*h*)	270	195	50	14	7	536	403	939	3,260	47
,, 2 ...	42	4	7	18	1	72	72	144		10
,, 3 ...	28	23	26	9	4	90	63	153		8
,, 4 ...	24	28	7	22	4	85	39	124		9
,, 5 ...	27	24	10	15	11	87	27	114		9
,, 6 ...	14	21	10	2	21	48	128 (*h*)	176		8
(*h*)	135	100	60	66	21	382	329	711	2,940	44
,, 7 ...	34	30	15	13	1	93	76	169		12
,, 8 ...	8	8	17	3	5	41	58	99		11
,, 9 ...	26	25	7	10	21	89	93	182		11
,, 10 ...	16	10	10	5	17	58	26	84		10
,, 11 ...	34	13	10	4	1	62	149 (*k*)	201		10
(*k*)	118	86	59	35	45	343	392	735	2,340	54

TABLE K—(*continued*).

Date	War Territories						Civilian	Totals		
	A	B	C	D	E	Total	F	Admissions	Cases in hospitals	Deaths
May 12 ...	11	4	6	2	1	24	30	54		11
,, 13 ...	—	9	21	15	1	46	57	103		4
,, 14 ...	—	11	8	9	1	23	63	76		2
,, 15 ...	—	2	5	9	2	18	193 (*k*)	211 (*k*)		15
,, 16 ...	17	11	11	7	2	48	24	72		9
	28	37	45	42	7	159	357	516	2,150	41
,, 17 ...	9	4	7	6	—	26	36	62		4
,, 18 ...	3	11	6	2	—	22	24	46		3
,, 19 ...	55 (*l*)	14	4	7	1	81	49	130		6
,, 20 ...	—	18	—	29	6	53	20	73		3
,, 21 ...	—	20	12	1	—	33	64	97		3
	67	67	29	45	7	215	193	408	1,870	19
,, 22 ...	—	4	15	3	1	23	75	98		4
,, 23 ...	—	25	2	2	6	35	32	67		4
,, 24 ...	125 (*l*)	16	2	7	—	150 (*l*)	54	204		9
,, 25 ...	—	16	5	8	—	29	14	43		9
,, 26 ...	5	13	2	13	—	33	6	39		4
	130	74	26	33	7	270	181	451	1,510	30
,, 27 ...	25	9	3	4	9	50	50	100		3
,, 28 ...	—	22	1	1	1	25	50	75		—
,, 29 ...	78	6	—	5	—	89	27	116		5
,, 30 ...	17	191 (*l*)	5	5	—	218 (*l*)	68	286		1
,, 31 ...	9	54	1	4	—	68	22	96		3
	129	282	10	19	10	450	223	673	1,640	12
Cases in hospital June 4	308	480	210	68	22	1,088	522	—	1,610	
Total percentage fall since April 3	71·0	65·0	48·0	84·0	90·0	69·0	88·0	—	80·0	
							Total ...	7,327		463
Percentage distribution—										
April 3	13·0	17·0	5·0	5·0	3·0	44·0	56·0	—		
,, 26	8·0	25·0	13·0	9·0	2·0	60·0	40·0	—		
June 4	19·0	30·0	13·0	4·0	1·0	67·0	33·0	—		

(*d*—*g*) Fall in numbers of cases in hospitals during suspension of railway traffic (up to *f*), and for ten days after its resumption (*g*) ; this fall greatest in area A.

(*h*) Sudden rise in admissions twelve days after (*f*) ; seen in all areas, but most marked in Army area A, Civilian areas F, and continuing for ten days.

(*k*) Increase continued, but most marked in Civilian areas F.

(*l*) Rises in War areas A and B, due probably to return of civilian refugees—absent in civilian areas F.

Chart 12.

Typhus shewing Increased Admissions (h) in different Areas (Except Area A) on April 27-May 1, twelve days after resumption of traffic on April 16, conveyed by Troops going on leave (k) also on returning (k) including War Area A.

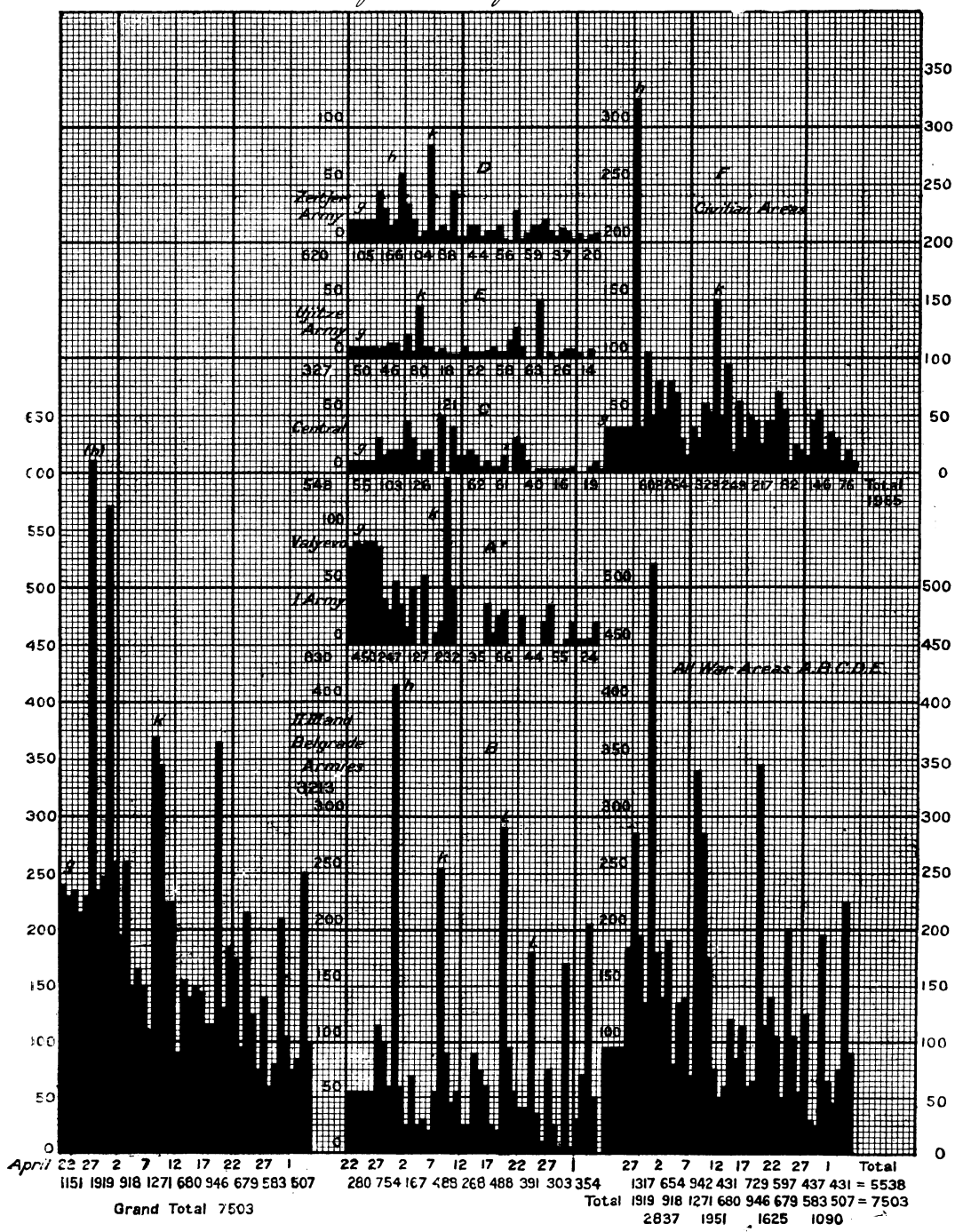
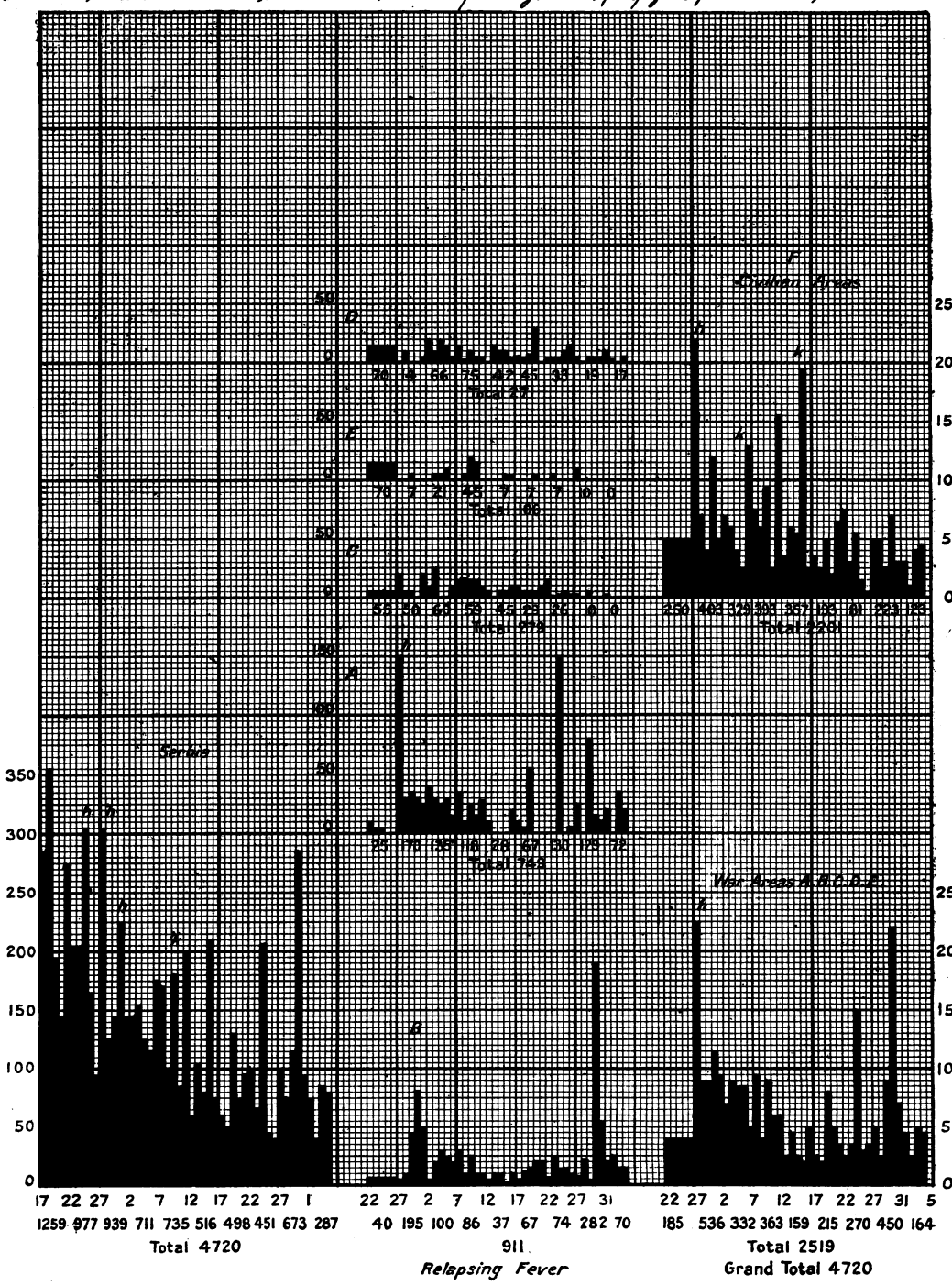


Chart 13. Increased Admissions in War Area A, also in B, following return of Refugees April 16-21. also in Civilian Areas F.



Section VII.—Comparison of Course of Serbian and Other Great Typhus Epidemics.

Summary—(*Charts, pp.* 73, 74).

The break of the epidemic thus occurred suddenly on March 16, following the chief great administrative measures recommended and immediately put in force within ten days of our arrival in Serbia. The effect of them was immediate—and lasted four weeks—viz., for the month of actual suspension of traffic.

The effect of resumption was equally immediate, and from point of view of ætiology even more instructive, since its details could be subsequently clearly analysed. That effect was a sharp recrudescence of infection, which set in exactly ten to twelve days after the resumption; was definitely related to movements of troops and civilians, and occurred in areas and places chiefly affected by such movements.

The whole experience pointed to the importance of such definite administration measures, affecting the country as a whole, in arresting epidemics of this kind, in addition to and far more effective than the usual measures adopted locally in individual towns or hospitals for the prevention of the spread of these diseases.

The effect was out of all proportion far greater than the measures of this latter kind. Both have the same object, viz., to prevent spread of lice. But while in the latter, the object aimed at is to limit the movement or spread of infected lice in hospitals to other patients or other people outside, the object aimed at by the general administrative measures we urged in Serbia, was to limit or *prevent the movement of people*, both of the healthy and of potential carriers of infection, from one area of infection to another.

The effect of the measures adopted in suddenly arresting the epidemic, may be judged by the data of the largest fever hospital in Serbia, in Kragujevatz. The number of cases of typhus admitted into this hospital in January had been 118, in February 961, and in March 1,138; the death-rate was 30 per cent. in January and February, rising to 40 per cent. in March. (The ten day figures for February were 252, 296 and 413 cases; for March 380, 392 and 366 cases.) In April this total of 1,138 fell suddenly to 360—the ten day figures being 184, 103 and 73; and during May it fell to about 200, the figures for the first ten days being 72 cases. The daily admissions which had averaged 4 in January, 32 in February and 38 in March fell suddenly to 12 in

April and 7 in May. The number of deaths which had been 22 in January, 185 in February, and 331 in March, fell to 131 in April and 26 for the first ten days in May. (Charts, pp. 71, 72; Tables, pp. 70, 80.)

Allowing twelve days for incubation of the disease, the number of these cases contracting infection in forty days before March 18 was 1,551; the number contracting it in forty days after was 432 (*see* Table, p. 70).

Comparison of Serbian Typhus Figures with those of previous Epidemics.

This comparison is interesting, and can now be made as seen in its perspective (Charts, pp. 73 and 74).

(1) *Irish Epidemic of* 1846-48. — The best known of previous epidemics were those of the Irish famine, which, starting in 1846, went on to 1848, a period of nearly two years; the maximum lasting continuously for a year, 1847. This epidemic was one of typhus and relapsing combined, the relapsing preponderating at the outbreak of the epidemic, the typhus at the end, precisely as was the case in the Serbian epidemics. The number of cases admitted into the Glasgow Royal Infirmary in 1847 were typhus 2,399, relapsing 2,333.

(2) *English Epidemic of* 1863-65. — The second great epidemic of typhus was that which occurred in England in 1863-65, during which 5,752 cases were admitted into the London Fever Hospital. (Charts, pp. 73, 74.) Of these, 2,493 cases were admitted in 1864, the highest figure of admission of typhus into any hospital between 1848 and 1870.

(3) In the *Serbian Epidemic* of 1915, the epidemic was one of relapsing and typhus combined, breaking out in December, 1914. The first in origin was relapsing, the numbers of cases in hospitals at the end of December being 2,184, as compared with only 200 cases of typhus (but the figures at this period were very incomplete—especially those for typhus). By the end of January the numbers were 5,122 and 1,100 respectively; end of February, 7,000 and 4,000 respectively; by the end of March, 8,100 and 8,000 respectively. Thereafter the proportions altered. At the end of April, they were 3,260 and 6,300 respectively; and by the end of May 1,600 and 2,860 respectively. During this period, the number of cases of typhus admitted (January 1 to May 14), into the largest fever hospital in Serbia, in Kragujevatz, with which I was in close touch, was 2,686. (*See* Chart, p. 71.)

TABLE C.

Course of Epidemic of Typhus as shown by number of Admissions and Deaths in 1st Reserve Hospital, Kragujevatz, January 1 *to May* 11, 1915 (B); *and Number of Cases in Serbian Hospitals* (A).

(A) ALL SERBIA Number of cases in hospitals on date specified			(B) 1ST RESERVE HOSPITAL, KRAGUJEVATZ				(C) Infection contracted (12 days' incubation)		
Relapsing fever	Typhus		Admissions 5 days	10 days	Deaths 5 days	10 days	5 days ending		
2,184	200	January 5 ...	13	34	—	3	December 23 ...		
3,153	243	,, 11 ...	21		3		,, 28 ...		34
3,532	378	,, 16 ...	12	29	3	6	January 2 ...		
4,586	622	,, 21 ...	17		3		,, 7 ...		29
5,233	730	,, 26 ...	22	55	3	12	,, 12 ...		
5,122	1,107	,, 31 ...	33		9		,, 17 ...		55
		Total (30 days)	...	118	...	21	...	...	118
5,458	1,256	February 5 ...	123	252	18	34	January 22 ...		
6,347	1,557	,, 10 ...	129		16		,, 27 ...		252
6,266	2,336	,, 15 ...	122	296	16	48	February 1 ...		
6,450	2,587	,, 20 ...	174		32		,, 6 ...		296
7,072	3,125	,, 25 ...	209	413	36	103	,, 11 ...		
7,000	3,964	March 2 (*a*)	204		67		,, 16 ...		413
		Total (30 days)	...	961	...	185	...	...	961
7,874	4,569	March 7 (*b*)	197	380	50	119	February 21 ...		
7,740	5,293	,, 12 ...	183		69		,, 26 ...		380
7,900	5,997	,, 17 (*c*)	255	392	61	124	March 3 ...		
7,700	6,969	,, 22 ...	137		63		,, 8 ...		392
8,681	8,040	,, 27 (*d*)	135	366	60	88	,, 13 ...		
8,114	7,952	April 1 ...	231		28		,, 18 (*c*)		366
		Total (30 days)	...	1,138	...	331	...	...	1,138
7,550	8,245	April 6 ...	78	184	31	63	March 23 ...		
6,780	7,984	,, 11 ...	106		32		,, 28 ...		184
4,960	7,324	,, 16 (*f*)	61	103	28	45	April 2 ...		
4,253	6,604	,, 21 ...	42		17		,, 7 ...		103
3,800	5,980	,, 26 ...	35	73	11	23	,, 12 ...		
3,265	6,475	May 1 (*h*)	38		12		,, 17 (*f*)		73
		Total (30 days)	...	360	...	131	...	...	360
2,943	5,600	May 6 ...	16	72	12	26	April 22 ...		
2,400	5,138	,, 11 ...	56		14		,, 27 ...		72
2,150	4,530	,, 16							
1,870	3,957	,, 21							
1,516	3,635	,, 26							
1,642	3,089	,, 31							
1,600	2,860	June 4							

(*a*) Arrival of Mission.
(*b*) Programme of Prevention submitted.
(*c*) Suspension of railway traffic and leave from army stopped.
(*d*) Maximum numbers in hospitals.
(*f*) Resumption of railway traffic and leave from army permitted.
(*h*) Recrudescence of infection ten days after (*f*).

C = Number of cases contracting infection forty days prior to March 18 = 1,551.
,, ,, ,, ,, ,, after March 18 = 432.

Chart 10

Course of Epidemic of Typhus in Serbia as shewn by Number of Daily Admissions and Deaths, in 1st Reserve Hospital, Kragujevatz Jan. 1 - May 13, 1915.

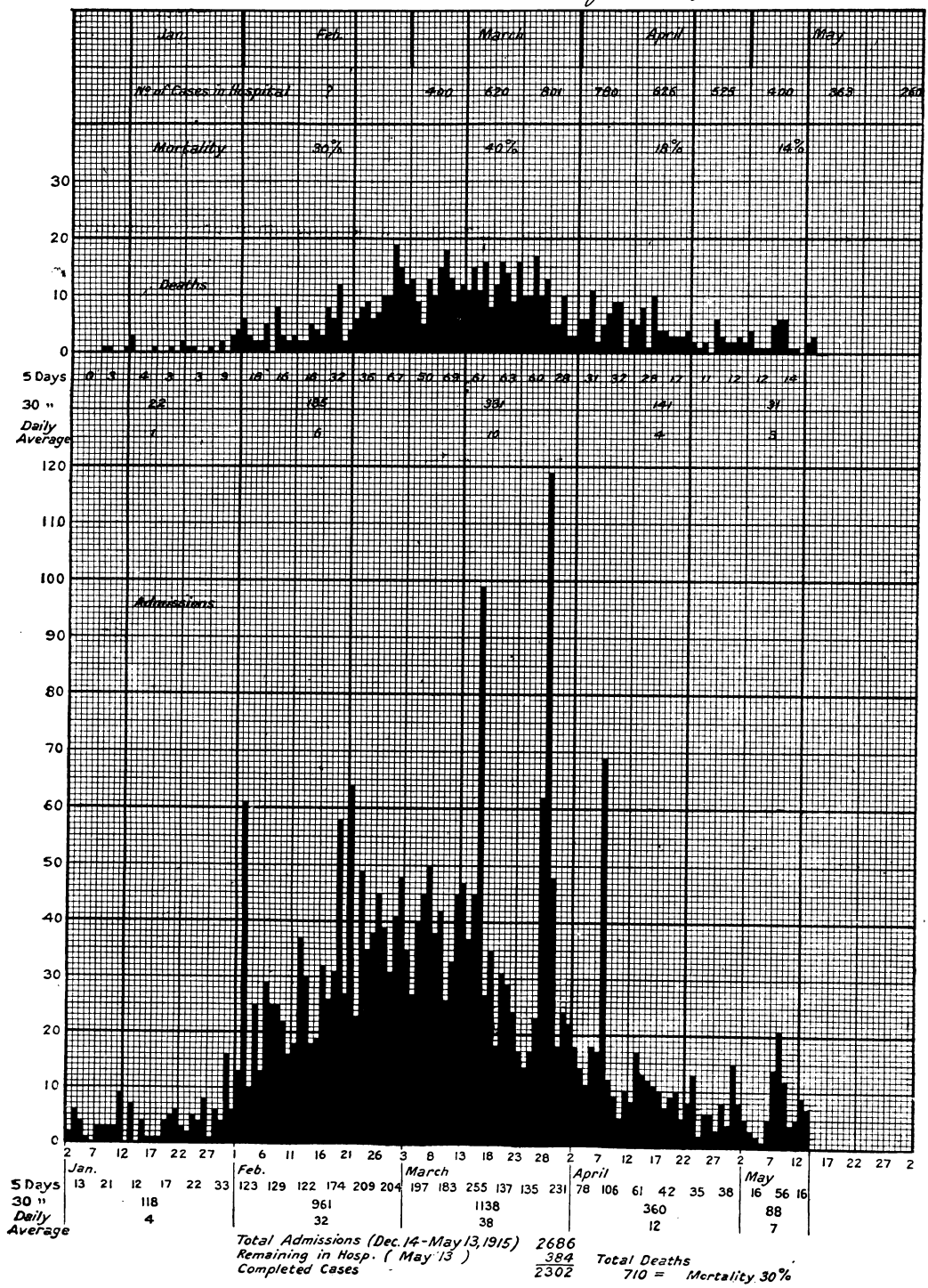
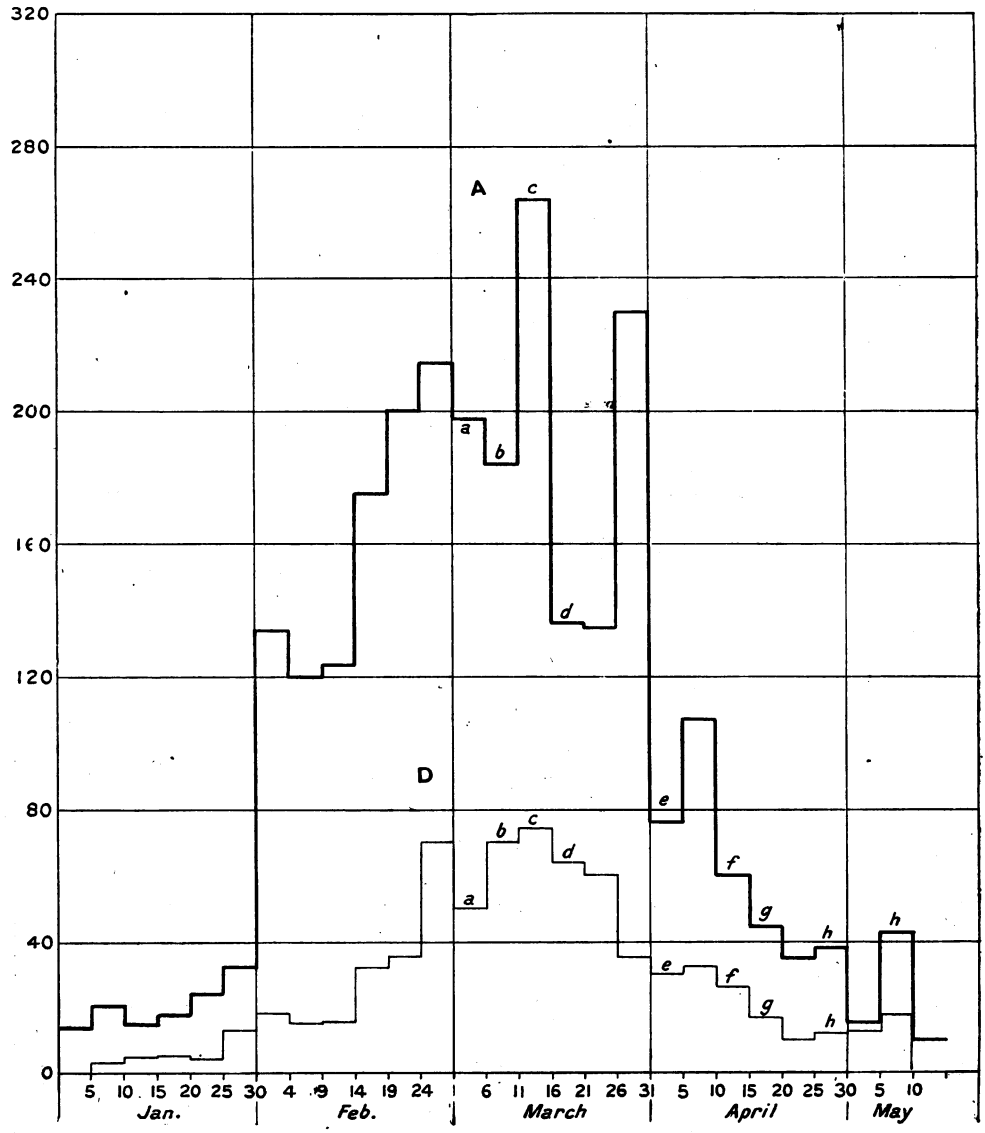


CHART 10 (*a*).

Course of Typhus Epidemic in Serbia in 1915, *as shown by Admissions and Deaths in one large Hospital.*



Number of cases in First Reserve Hospital in Kragujevatz, January to May. (Five-day totals.)

a, March 5, arrival of Mission; *b*, barrel disinfector put into use; *c*, suspension of railway traffic (March 15); *f*, resumption of railway traffic (April 15); *h*, arrest in fall, April 20-25 and May 5 (ten to fourteen days after *f*).

This group of hospitals served especially the active armies in the field, and included the largest typhus hospital in Serbia (the First Reserve). Their importance as a whole may be judged from the circumstance that at the height of the epidemic at the end of March they contained 1,000 cases of typhus (850 of them in the First Reserve Hospital), or 12 per cent. of the total cases in all the hospitals in Serbia, in addition to 500 cases of relapsing fever, or nearly 6 per cent. The chart shows the striking fall which occurred after March 30. (*See* text, p. 68.)

Chart 14.

Shewing Relative Magnitude, Course, & Duration of Three Historical Epidemics of Typhus, as shewn by Admissions into three Chief Hospitals.

1. Irish Epidemic 1846-48.
2. English " 1863-65.
3. Serbian " 1915.

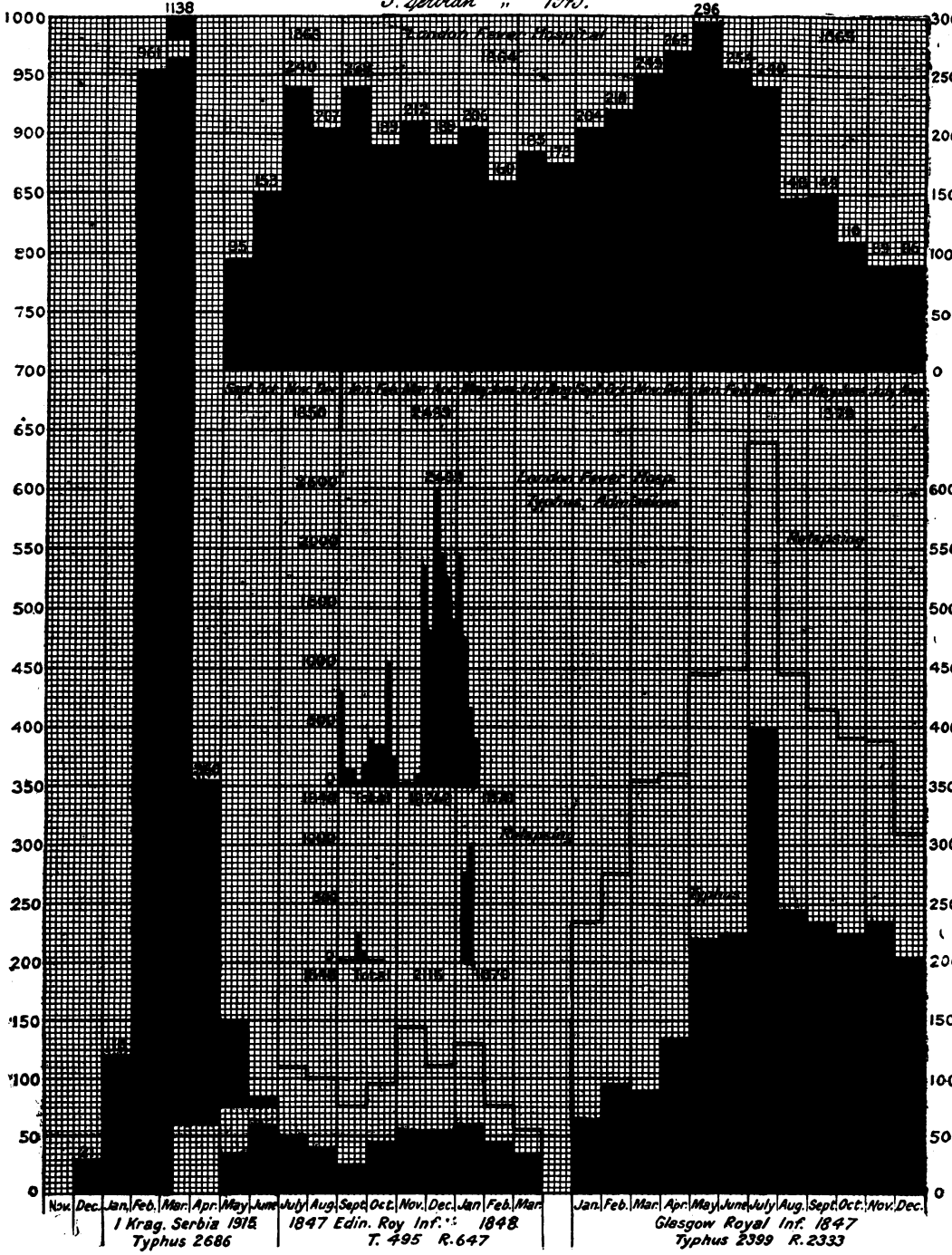
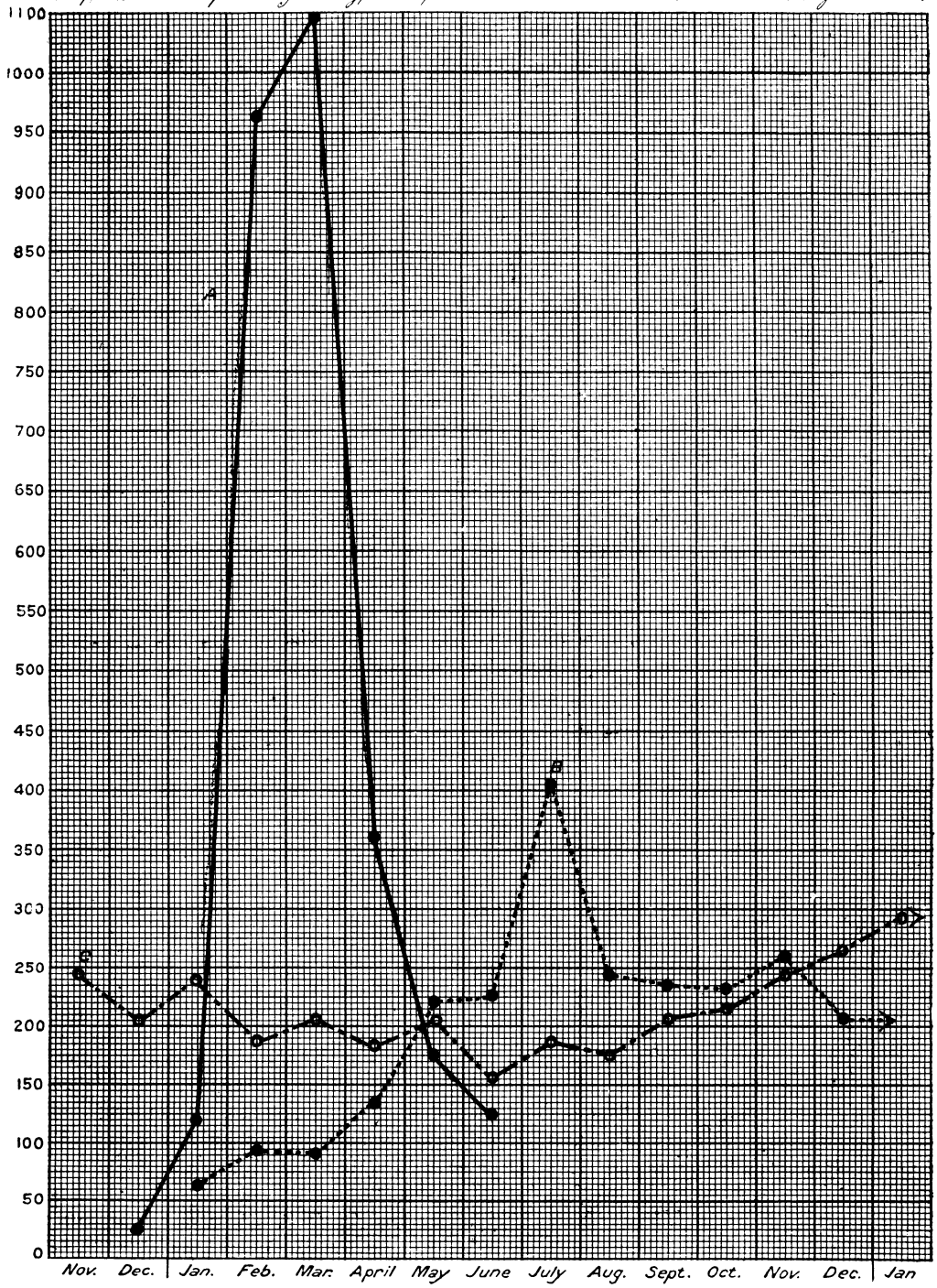


Chart 15.

Comparison Course of Three Great Typhus Epidemics. A. Serbian 1915. B. Irish 1847. C. English 1864.



The figures of typhus for comparison in the three great epidemics referred to are those of three chief representative hospitals—viz. :

Epidemic	Hospital	Number of cases of typhus	Duration of epidemic
Irish (1847) ...	Glasgow Royal Infirmary ...	2,399 ...	Two years
English (1863-5)...	London Fever Hospital ...	5,752 ...	Three years
Serbia (1915) ...	Kragujevatz Fever Hospital ...	2,686 ...	Six months

The monthly figures of admission in the three hospitals were :—

	Glasgow Royal (1847)	London Fever (1864)	Serbia (1915)
December ...	— ...	(207) ...	(18)
January ...	66 ...	239 ...	118
February ...	93 ...	189 ...	961
March	88 ...	212 ...	1,138
April	135 ...	189 ...	360
May	218 ...	206 ...	72
June	226 ...	160 ...	—
July	400 ...	185 ...	—
August	246 ...	173 ...	—
September ...	235 ...	204 ...	—
October... ...	227 ...	218 ...	—
November ..	262 ...	249 ...	—
December ...	203 ...	269 ...	—
	2,399	2,493	2,649

The Serbian epidemic was thus the most sudden in origin, most rapid in rise, greatest in extent, and most quickly arrested of any epidemic of a like kind in history. The curve of its origin, rise and decline, differs in character from that of any previous epidemic. It lasted from start to finish about a period of six months, and maintained its maximum for only two months. Other epidemics have lasted one and a half to three years, and maintained their maximum for periods of twelve (Irish) or eighteen months (English epidemic).

The interest of this result is that it was the first great epidemic, which had arisen and been dealt with, since the lice-borne nature of typhus and relapsing fever had been established a few years previously by the researches of Nicolle, in 1911. The suddenness of its arrest —dating from a particular day—was directly related to measures for *stopping movement of people ;* its recurrence dating from a particular day was directly related to the resumption of such movements. The two events together—and all the circumstances connected with them— were too alike and too striking to be mere coincidences.

APPENDIX.

TABLE II (CHARTS, pp. 44, 45, 95, 102).

Course of Epidemics of Typhus, Relapsing, Enteric Fevers in Serbia, March 26 to June 4, as shown by numbers of cases in Hospitals and Admissions, Deaths, and Discharges (April 14 to June 4).

Date	TYPHUS				RELAPSING				ENTERIC			
	No. in Hospital	New Cases	Deaths	Discharges	No. in Hospital	New Cases	Deaths	Discharges	No. in Hospital	New Cases	Deaths	Discharges
Mar. 27	8040(*d*)				8661(*d*)				1856			
28	7980				8504				1865			
29	7974				8532				—			
30	7814				8520				1673			
31	8085				8220				1648			
		Mortality	40%									
Apr. 1	7952				8114				1641			
(*e*) 2	8176				7983				1548			
3	8213				7810				1549			
4	8199				7675				1457			
5	8198				7503				1443			
6	8124				7550				1527			
7	8245				7348				1635			
8	7971				7177				1487			
9	8009				7065				1464			
10	8077				6993				1352			
11	7984				6791				1295			
12	7991				6548				1230			
13	7867				6251				1219			
14	7530	155	50	289	5867	117	49	313	1112	27	13	34
15	7300	289	48	471	5663	253	16	437	1075	71	10	95
(*f*) 16	7324	419	80	316	4960	268	16	655	1100	67	14	28
17	7219	464	63	506	4748	284	26	470	1115	12	9	29
18	6984	369	63	516	4861	354	13	528	1126	135	8	116
19	6947	304	57	284	4451	197	11	596	1160	54	3	17
20	6779	256	80	364	4230	149	12	348	1120	12	6	46
21	6604	227	53	357	4253	275	12	237	1114	42	7	41
22	6550	242	48	243	3930	217	12	528	1041	40	11	102
23	6311	228	58	408	3918	206	9	209	979	43	9	96
24	6209	236	63	289	4039	304(*h*)	14	169	985	51	11	37
25	6054	217	35	257	3967	161	3	230	937	82	4	126
(*g*) 26	5979(*g*)	228(*g*)	32	271	3808	89	13	225	858	26	14	91
(*h*) 27	6314(*h*)	611(*h*)	40	235	3904	304(*h*)	11	197	878	55	9	26
28	6249	234	35	264	3815	126	9	206	849	22	11	40
29	6158	244	54	281	3450	133	4	494	846	26	8	21
30	6475	570(*h*)	41	212	3463	231(*h*)	8	210	882	112	9	67

TABLE II (*continued*).

Date	Typhus				Relapsing				Enteric			
	No. in Hospital	New Cases	Deaths	Discharges	No. in Hospital	New Cases	Deaths	Discharges	No. in Hospital	New Cases	Deaths	Discharges
May 1	6343	260	51	336	3265	145	15	328	865	32	6	43
2	6260	194	67	216	3250	144	10	149	837	34	6	56
3	6263	260	57	191	3166	153	8	229	797	17	10	47
4	6107	148	37	267	3110	124	9	171	751	11	7	50
(*i*) 5	5938	165	34	300	2941	114	9	274	722	20	14	35
6	5598	151	40	451	2943	176(*k*)	8	166	694	20	7	41
7	5420	112	31	259	2955	169	12	145	613	28	3	106
8	5488	368(*k*)	45	255	2834	99	11	209	600	49	7	55
9	5416	343(*k*)	56	359	2767	182(*k*)	11	238	581	47	4	62
10	5315	221	37	285	2472	84	10	369	533	36	6	78
(*k*) 11	5138	227(*k*)	34	370	2398	201(*k*)	10	265	505	30	6	52
12	4941	92	31	258	2251	54	11	190	540	64	2	26
13	4881	156	31	185	2220	103	4	130	462	3	2	79
14	4843	138	27	149	2186	76	2	108	438	5	2	27
15	4564	149	32	396	2197	211(*k*)	15	185	391	18	1	64
16	4529	145	44	136	2149	72	9	111	381	7	2	15
17	4376	115	36	232	2120	62	4	87	341	18	4	54
18	4064	116	31	417	2072	46	3	91	299	6	2	46
(*l*) 19	4104	367(*l*)	30	297	1965	130(*l*)	6	221	280	12	2	29
20	4043	164	16	210	1862	73	3	173	257	3	1	25
21	3957	184	35	235	1870	97	3	86	221	10	—	46
22	3887	173	19	224	1685	98	4	279	242	38	1	16
23	3770	94	23	187	1566	67	4	18	216	8	2	32
24	3784	213(*l*)	38	152	1673	204(*l*)	9	88	203	5	2	16
(*m*) 25	3780	126	26	104	1609	43	9	98	205	11	2	7
26	3635	73	34	194	1516	39	4	128	198	15	2	20
27	3583	138	30	100	1535	100	3	78	206	23	3	12
28	3434	55	9	195	1558	75	—	52	196	8	1	17
29	3334	75	25	175	1558	116	5	111	184	12	—	24
30	3266	212(*l*)	26	233	1675	286(*l*)	1	148	167	17	—	34
31	3089	103	20	251	1642	96	3	126	188	35	2	12
June 1	2968	76	11	196	1578	77	2	139	316	155	1	22
2	2960	85	15	88	1581	37	—	34	311	27	—	32
3	2996	248	19	183	1621	86	2	44	164	9	2	154
4	2860	98	21	213	1609	87	4	95	160	12	—	16

(*d*) No. of cases in hospital at their maximum ten days after suspension of traffic (*c*) on March 16.
Railway Van Disinfector devised.
(*e*) Inoculation and Disinfecting Train ordered and commenced.
"Van Douche Bath" devised.
(*f*) Railway Traffic resumed.
(*g*) Continued fall in Cases for 10 days after (*f*).
(*h*) Sudden rise in Number of Cases 11 days after (*f*).
(*i*) Work of Quarantine Station greatly developed to check spread of Infection to South.
(*k*) Second spread of Infection.
Spread of Infection checked.
(*l*) Increase of cases in Hospitals due to evacuation of Field Ambulances in Northern Armies.
(*m*) Serbian Base Hospital removed to Mladenovac.
Scottish Mission Fever Hospital removed to Mladenovac (Dr. Elsie Inglis).
Order for Mission to proceed to Malta.

TABLE III (CHARTS, pp. 96, 97, 98, 101).

Course of Epidemics of Typhus in Serbia in 1915, *as shown by numbers of Cases in Hospitals.* S, *all Serbia;* A, B, C, D, E, *Army areas; F, Civilian areas respectively from April* 3 *to May* 31.

Date	S All Serbia		A 1st Army		B 2nd, 3rd and Belgrade Armies		C Railway Towns		D Zeitjer Army		E Ujitze Army		F Civilian Areas.	
	No. in Hosp.	New Cases	No. in Hosp.	New Cases	No. in Hosp.	New Cases	No. in Hosp.	New Cases	No. in Hosp.	New Cases	No. in Hosp.	New Cases	No. in Hosp.	New Cases
Apr. 3	8213		1221		2789		216		1013		571		2403	
8	7971		—											
13	7867													
14	7530	155												
15	7300	289												
(*f*) 16	7324	419												
17	7219	464												
18	6984	369												
19	6947	304												
20	6779	256												
21	6604	227												
22	6550	242												
23	6311	228	—		—		—		—		—		—	
24	6209	236	—		—		—		—		—		—	
25	6054	217	1075		1747		261		804		458		1709	
(*g*) 26	5979	223	1126	89	1692	56	244	11	771	21	431	10	1715	41
	Fall 29%		Fall 4%		Fall 42%		Rise 17%		Fall 23%		Fall 24%		Fall 28%	
27	6314	611(*h*)	1128	89	1710	114(*h*)	255	31(*h*)	813	43(*h*)	436	7	1972	327(*h*)
28	6249	234	1134	38	1757	104(*h*)	265	15	735	29	425	9	1933	39
29	6158	244	1079	32	1779	59	250	19	719	15	407	12	1924	107(*h*)
30	6475	570(*h*)	1098	54	2096	417(*h*)	240	18	713	20	405	13	1923	48
May 1	6343	260	1078	36	2058	60	227	20	656	60(*h*)	387	5	1937	79(*h*)
2	6260	194	1071	15	2280	24	251	44(*h*)	674	35	392	18	1592	55
3	6263	260	1069	48	2033	72	258	30	684	23	381	5	1838	81(*h*)
4	6107	148	987	—	1921	24	266	9	667	5	365	40	1871	68
5	5938	165	971	64	1949	32	263	21	647	8	374	8	1734	32
6	5598	151	776	—	1830	15	261	22	669	83	396	9	1666	13

7	5420	112	763	8	1817	54	228	—	615	7	329	1	1669	42
8	3488	368(*k*)	745	18	1935	252(*k*)	266	48(*k*)	614	15	324	7	1604	28
9	5416	343(*k*)	858	162(*k*)	1954	86	277	22	492	12	310	3	1525	58
10	5315	221	891	44	1871	44	306	38	506	43	299	4	1442	48
11	5138	227	776	—	1807	52	294	13	568	6	323	3	1370	153(*h*)
12	4941	92	758	—	1780	23	293	14	396	4	284	9	1430	42
13	4881	156	759	—	1803	25	292	19	381	3	282	5	1364	104(*k*)
14	4943	138	754	—	1743	89(*k*)	291	14	379	14	285	4	1391	17
15	4564	149	650	—	1774	73	271	6	314	4	256	1	1299	65
16	4529	145	775	35	1771	58	271	9	303	9	254	4	1155	30
17	4376	115	671	9	1660	27	267	7	294	12	258	8	1226	52
18	4064	116	626	27	1444	18	259	7	290	14	233	2	1212	48
19	4104	367(*l*)	636	30	1608	292(*l*)	257	15	232	1	233	5	1138	24
20	4043	164	632	—	1651	97	209	1	223	2	206	17	1122	47
21	3957	184	586	—	1636	54	230	31	245	27	227	26	1034	46
22	3887	173	624	26	1699	40	232	25	216	2	190	9	1016	70
23	3770	94	624	—	1575	34	274	8	198	7	185	2	914	43
24	3784	213(*l*)	597	—	1698	182(*l*)	205	1	197	16	181	2	906	12
25	3780	126	580	—	1687	36	202	3	203	15	218	49	890	23
26	3635	73	579	18	1604	9	196	3	218	19	205	1	833	20
27	3583	138	597	28	1590	78	189	4	215	9	205	5	768	14
28	3434	55	597	—	1575	24	126	1	201	5	196	1	739	44
29	3334	75	546	—	1513	2	136	3	201	13	191	5	756	52
30	3266	212(*l*)	515	7	1556	168(*l*)	130	3	195	7	193	8	677	19
31	3098	103	502	20	1437	31	129	5	174	3	187	7	669	37
Total Fall since Apl. 3.	63		58%		47%		40%		82%		67%		76%	

(*f*) Resumption of Railway Traffic, April 16.
(*g*) Continued Fall in Cases for 10 days till April 26.
(*h*) Sharp Rise in Number of New Cases 12 days after (*f*).
(*k*) Another Rise about 10 days later.
(*l*) An increase of New Cases in Army areas B owing to evacuation of Field Ambulances preparatory to forward movement.

TABLE IV (CHART, pp. 71, 72).

Course of Epidemic of Typhus in Serbia, 1915, *as shown by Number of Admissions and Number of Deaths in 1st Reserve Hospital, Kragujevatz, December* 14, 1914, *to May* 14, 1915.

Date	No. Admitted	5 days	30 days	Deaths	5 days	30 days	Date	No. admitted	5 days	30 days	Deaths	5 days	30 days
1914													
Dec. 14	—			—			Jan. 22	3			1		
15	—			—			23	2			1		
16	—			—			24	5			—		
17	—			—			25	4			—		
18	—	—		—	—		26	8	22		1	3	
19	2			—			27	1			—		
20	2			—			28	6			2		
21	—			—			29	4			—		
22	—			—			30	16			3		
23	—	4		—	—		31	6	33	118	4	9	22
24	—			—				Daily	Average 4				1 –
25	4			—									
26	1			—			Feb. 1	13			6		
27	2			—			2	62			3		
28	1	8		—	—		3	10			2		
							4	25			2		
29	3			—			5	13	123		5	18	
30	3			—									
31	3			—			6	29			—		
	—			—			7	26			8		
	—	9	21	—	—	0	8	26			3		
							9	22			2		
	Daily	Average 1					10	16	129		3	16	
							11	18			2		
1915							12	37			2		
Jan. 1	2			—			13	30			5		
2	6			—			14	18			4		
3	4			—			15	19	122		3	16	
4	1			—									
5	—	13		—	—		16	32			8		
							17	26			6		
6	3			1			18	31			12		
7	3			1			19	58			2		
8	3			—			20	27	174		4	32	
9	3			—									
10	9	21		1	3		21	64			6		
11	—			—			22	23			8		
							23	49			9		
12	—			3			24	35			6		
13	7			—			25	38	209		7	36	
14	—			—									
15	4			—			26	45			10		
16	1	12		1	4		27	39			10		
							28	31			19		
17	1			—			Mar. 1	41			15		
18	1			—			2	48	204	961	12	67	185
19	4			1				Daily	Average 32				6
20	5			—									
21	6	17		2	3				Total	1100		Total	207

TABLE IV (*continued*).

Date	No. in Hosp.	No. Admitted	5 days	30 days	Deaths	5 days	30 days
Mission	arrived						
Mar. 3	400	35			13		
4		27			9		
5		40			5		
6		45			13		
7		50	197		10	50	
8	400	37			15		
9		42			18		
10		26			13		
11		33			11		
12		45	183		12	69	
13	580	47			11		
14		37			15		
15		45			11		
16		99			16		
17		27	255		8	61	
18	620	35			12		
19		18			16		
20		31			14		
21		29			5		
22		24	137		16	63	
23	780	17			10		
24		14			10		
25		17			17		
26		23			10		
27		62	135		13	60	
28	784	119			4		
29	801	48			5		
30	767	18			10		
31	759	24			3		
April 1	709	22	231	1138	6	28	331
		Daily	Average 38				10+
2	697	18			7		
3	683	14			6		
4	685	11			11		
5	708	18			2		
6	717	17	78		5	31	
7	779	69			7		
8	770	12			9		
9	757	9			9		
10	759	6			1		
11	719	10	106		6	32	

Date	No. in Hosp.	No. admitted	5 days	30 days	Deaths	5 days	30 days
April 12	618	8			5		
13	682	17			8		
14	694	13			1		
15	667	12			10		
16	640	11	61		4	28	
17	626	10			4		
18	619	7			3		
19	607	9			3		
20	593	10			3		
21	580	6	42		4	17	
22	583	8			2		
23	595	13			1		
24	571	2			2		
25	563	6			—		
26	548	6	35		6	11	
27	525	3			3		
28	508	8			2		
29	475	4			2		
30	427	15			3		
May 1	428	8	38	360	2	12	141
		Daily	Average 12				4
2	424	5					
3	421	3			4		
4	402	2			1		
5	395	1			1		
6	394	5	16		1	12	
7	400	14			5		
8	391	21			6		
9	401	12			6		
10	399	4			1		
11	390	5	56		1	14	
12	384	9			—		
13	384	7	16	88	2	5	31
14	385				3		
15	364						
16	365						
		Daily	Average 7				3—
17	363						
18	359						
19	359						
20	357						
21	353						
			Total	1586		Total	503

Total Admissions Dec. 14, 1914, to May 13, 1915 2686 Total Deaths 710
Remaining in Hospital, May 13, 1915 384

Total completed cases ... 2302 Total Deaths 710
Mortality = 30 per cent.

TABLE V (CHART, p. 86).

Course of Epidemic of Typhus in Serbia, 1914-15, as shown by Table of Mortality from Typhus in Kragujevatz Garrison, August 14, 1914, to May 13, 1915.

Date		5 Days	30 Days
1914.			
Aug. 14-31			
Sept. 1-30			
Oct. 1-21			
22	2		
23	—		
24	—		
25	—		
26	1	3	
27	—		
28	1		
29	—		
30	2		
31	—	3	6
Nov. 1	—		
2	1		
3	—		
4	—		
5	1	2	
6	—		
7	—		
8	—		
9	—		
10	—		
11	1		
12	2		
13	1		
14	2		
15	—	6	
16	—		
17	—		
18	1		
19	—		
20	—	1	
21	—		
22	2		
23	2		
24	—		
25	—	5	
26	1		
27	1		
28	—		
29	1		
30	2	5	19
	Daily	Average	1—

Date		5 days	30 days
Dec. 1	—		
2	1		
3	2		
4	—		
5	2	5	
6	—		
7	—		
8	1		
9	—		
10	—	1	
11	1		
12	1		
13	1		
14	2		
15	3	8	
16	2		
17	—		
18	—		
19	3		
20	—	5	
21	2		
22	2		
23	1		
24	—		
25	—	5	
26	1		
27	1		
28	2		
29	1		
30	1	6	30
	Daily	Average	1

Date		5 Days	30 Days
Dec. 31	3		
1915.			
Jan. 1	—		
2	4		
3	3		
4	3	13	
5	3		
6	3		
7	1		
8	1		
9	—	8	
10	—		
11	10		
12	8		
13	3		
14	—	21	
15	—		
16	7		
17	4		
18	4		
19	6	21	
20	3		
21	9		
22	6		
23	5		
24	3	26	
25	7		
26	3		
27	8		
28	8		
29	11	37	126
	Daily	Average	4
30	14		
31	13		
Feb. 1	8		
2	13		
3	16	64	
4	18		
5	31		
6	21		
7	23		
8	19	112	
9	13		
10	17		
11	12		
12	28		
13	11	81	

TABLE V (*continued*).

Date		5 days	30 days
Feb. 14	21		
15	22		
16	11		
17	25		
18	12	91	
19	16		
20	18		
21	16		
22	16		
23	27	93	
24	20		
25	18		
26	21		
27	23		
28	31	113	554
	Daily	Average	18
Mar. 1	21		
2	25		
3	29		
4	20		
5	16	111	
6	19		
7	16		
8	26		
9	25		
10	21	107	
11	21		
12	20		
13	23		
14	22		
15	20	106	
16	20		
17	11		
18	15		
19	19		
20	21	86	
21	17		
22	21		
23	21		
24	19		
25	14	92	
26	15		
27	20		
28	16		
29	15		
30	13	79	581
	Daily	Average	20

Date		5 Days	Days
Mar. 31	14		
Apr. 1	14		
2	20		
3	6		
4	14	68	
5	5		
6	9		
7	10		
8	13		
9	11	48	
10	4		
11	6		
12	6		
13	10		
14	1	27	
15	11		
16	6		
17	8		
18	5		
19	7	37	
20	7		
21	5		
22	3		
23	1		
24	4	20	
25	1		
26	8		
27	3		
28	4		
29	2	18	218
	Daily	Average	7
30	4		
May 1	4		
2	6		
3	—		
4	2	16	
5	1		
6	4		
7	1		
8	5		
9	4	15	
10	2		
11	2		
12	4		
13	5		
14	—	15	46
	Daily	Average	3

Date		5 days	30 days
1914	SUMMARY.		
Aug.			—
Sept.			—
Oct.			6
Nov.			19
Dec.			30
1915			
Jan.			126
Feb.			554
Mar.			581
April			218
May (13 days)			46
		Total	1580

PART II.

Section VIII.—State of Epidemic Conditions at end of March.

During March the numbers in hospital increased by leaps and bounds—typhus from 3,743 up to 8,040 cases in hospitals—an increase of 4,297 cases; relapsing from 7,009 to 8,661 cases—an increase of 1,658 cases. Enteric alone had fallen from 2,314 to 1,856—a fall of 458 cases. In typhus and relapsing combined there had been an increase of, roughly, 7,000 cases (*see* Chart, p. 44, Table, p. 58).

The first measure of prevention—suspension of railway traffic—had been put in force on March 16 for a fortnight. In the *fifteen* days before suspension the numbers of typhus had increased by 2,447 cases (Chart, p. 45), of relapsing by 874 cases (Chart, p. 45), a total increase of 3,121 cases (Chart, p. 44). In the next *ten* days after the suspension the numbers had increased—typhus by 2,050 cases (Chart, p. 45), relapsing by 778 cases (Chart, p. 45), a total of 2,828 cases (Chart, p. 44).

Up to this time (March 27) the epidemic appeared to have been in no way affected by the suspension of railway traffic. This had been put into force on March 16, and was due to expire on March 30. I had by this time also got the figures of cases in hospitals, so far as this could be obtained, from the commencement of the epidemic in December, 1914, up to the time of our arrival in March. They were the following, the figures in the earlier period being only approximate as were indeed the later figures (Table, p. 58).

Course of Epidemic, December, 1914, to March 27, 1915, as shown by Numbers of Cases in Hospitals on date specified.

Position of Epidemic.—The data as to numbers of cases in hospitals were the only data available at the time; they related to forty-two chief places in Serbia, and were supplied and analysed by me each night, separate data of a similar kind relating to Kragujevatz being also received.

The degree of increase of the *typhus epidemic* was well shown in the Kragujevatz data (Table, p. 85, Chart, p. 86). Between March 3 to 28 the number of typhus cases in the eight hospitals had risen from about 450 cases up to 1,000 cases (Chart, p. 86); in the largest hospital (first Reserve) the number had increased from about 400 up to 780 cases (Table, p. 80).

TABLE B (CHARTS, pp. 86, 87).

Course of Epidemics as shown by General Hospital figures of Sick and Wounded in Eight Kragujevatz Hospitals on dates specified, March 14 to June 5, 1915. (Chart 9, p. 87.)

	March 14	March 27	April 3	April 26	April 27	May 3	May 17	May 31	June 5
A									
Number in hospital	4,052	3,376	2,865	2,902	2,862	2,360	2,615	2,262	1,989
Wounded ...	1,391	974	743	725	683	586	645	596	576
Sick	2,661	2,402	2,122	2,177	2,179	1,774	1,970	1,666	1,413
Serbian sick ...	1,790	1,483	1,162	1,079	1,066	973	1,187	1,005	888
Prisoners sick ...	871	919	960	1,098	1,113	801	783	661	525
B									
Fever cases ...	1,477	1,523	1,209	849	830	751	710	592	474
Typhus ...	607	973	854	690	668	572	596	484	387
Relapsing ...	668	497	321	114	117	139	100	78	52
Enteric ...	132	16	6	8	8	6	2	2	1
Dysentery ...	27	7	5	21	21	22	2	14	14
Other fevers ...	43	30	23	16	16	12	10	14	20

	October	November	December	January	February	March	April	May 1-14	Total
C									
Total deaths from typhus in Kragujevatz area	6	19	30	126	554	581	218	46	1,580
Daily average ...	1	1	1	4	18	20	7	3	—
D									
Admissions ...	—	—	21	118	961	1,138	360	88	2,686
Deaths ...	—	—	—	22	185	331	141	31	710
Case mortality from typhus in 1st Reserve Hospital	1	—	—	30 per cent.	30 per cent.	40 per cent.	18 per cent.	14 per cent.	30 per cent.

This table shows the striking fall in numbers, admissions and deaths, of typhus in hospitals, which set in at the end of March, exactly twelve days after suspension of railway traffic and stoppage of leave from army.

A = Total number of cases and deaths in hospitals from all causes (*see* Chart 9, p. 87).

B = Number of fever cases, especially typhus and relapsing (*see* Chart 9).

C = Total deaths from typhus in Kragujevatz area (*see* Chart 11).

D = Admissions, deaths, and case mortality of typhus in 1st Reserve Fever Hospital, the largest fever hospital in Serbia (*see* Table IV and Chart 10).

Chart 8.

Course of Epidemics of Typhus & Relapsing Fever as shewn in Kragujevatz
A + B = Nos of Cases in Hospitals; C & D = Admissions; E = Deaths from Typhus.

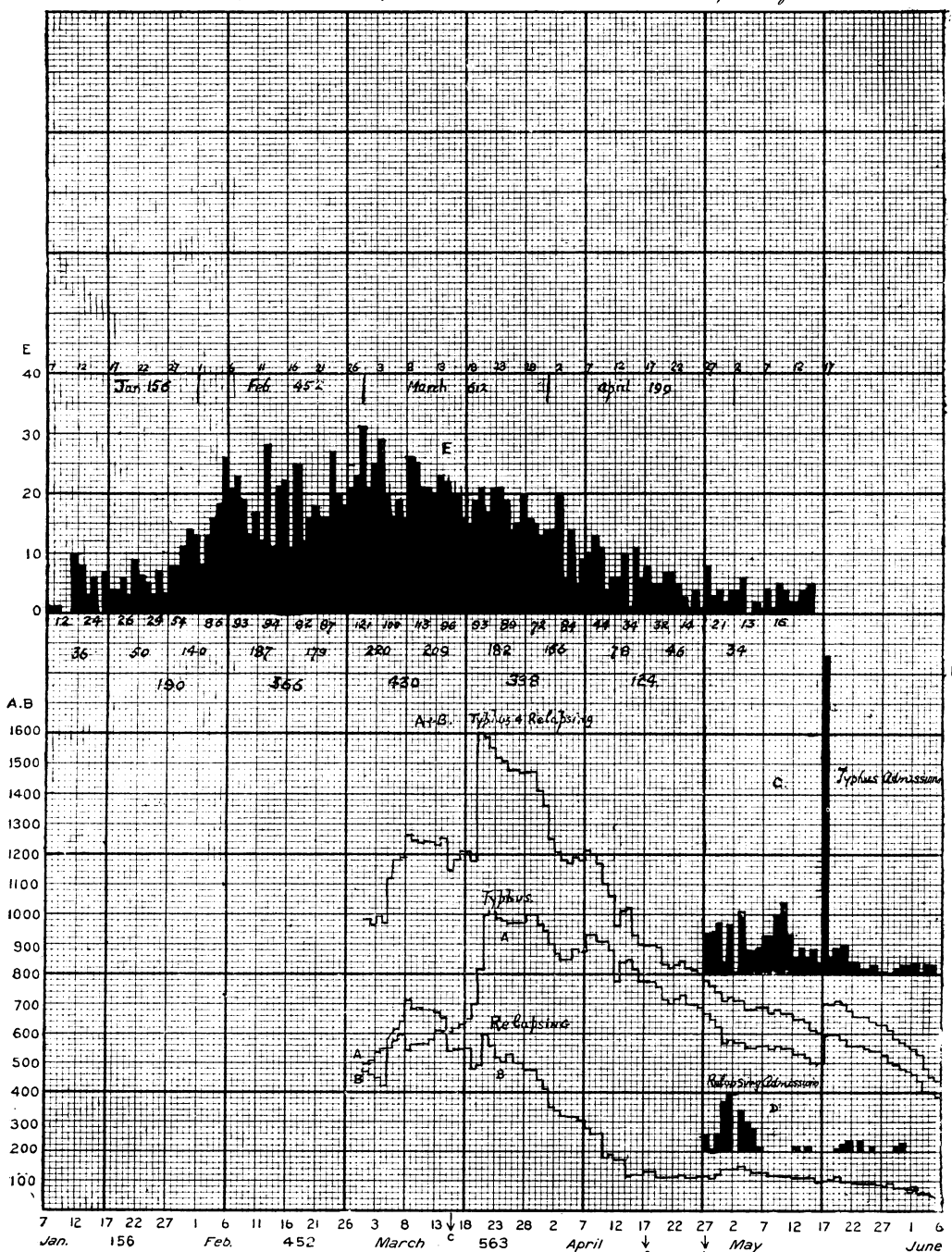
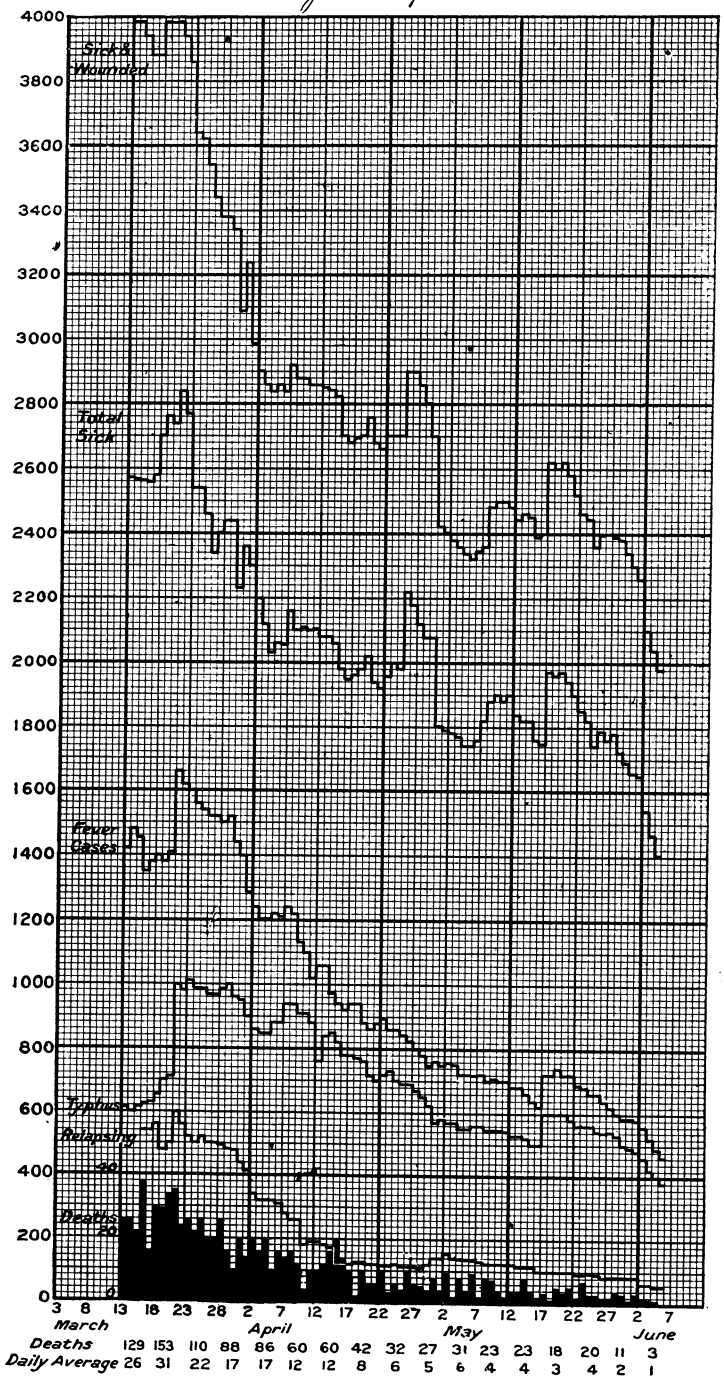


Chart E Deaths Oct. 6 cases (1st Case Oct. 22)
Nov. 15
Dec. 32
Jan 156
Feb. 452
March 612
April 199

Chart 9

Numbers of Sick & Wounded, & Total Sick, Fever Cases, Typhus & Relapsing, & Deaths in Kragujevatz Hospitals March 13 – June 3, 1915.



Figures of admission or mortality were not, at this time, obtainable. When at a much later period (in May) I obtained these for this hospital, they showed (Table, p. 80; Chart, p. 71) that in the fifteen days before suspension (March 3 to 17) the number admitted had been 635 cases, number of deaths 180; while in the fifteen days of the suspension period (March 18 to 31) the number admitted had been 503 cases, the number of deaths 151—a total of 1,138 new cases in thirty days; with 331 deaths (Table, p. 85).

The *mortality* was also very high. The total of cases completed (by discharge or death) during the thirty days, March 3 to April 1, had been 829 cases, and the number of deaths among these had been 331 cases or 40 per cent. (Table, p. 70; Chart, p. 71). The corresponding admissions figures (December 19 to March 2) had been 1,100 new cases and 207 deaths; the number of completed cases had been 700 cases with 207 deaths—a mortality of 30 per cent.

Both the incidence of the disease and its mortality had therefore greatly increased. Its mortality was very high, from a proportion of one in three cases, it had risen, at this period (March 28) to nearly one in two cases (p. 139).

Distribution of Typhus and Relapsing in Northern and Southern Serbia on March 27 (Charts A and B, pp. 46, 47).

The distribution at end of March showed how extensively the army area was infected, both with typhus and relapsing fever, viz., a total of over 10,000 cases, as compared with a little over 6,000 cases in the rest of Serbia (Tables, pp. 62-64). It showed also how deeply infected the Valyevo area (first army) was; the original source of all the trouble with its total of 2,356 cases (Area A); how wide the epidemics also were in the second and third and Belgrade army areas, with their total of 4,978 cases (Area B); as, also, the Western (Ujitze), and Eastern (Zeitjer) war areas (D and E) with their totals of 2,381 cases. A grand total of 10,280 cases in the war areas, as compared with 6,329 cases in civilian areas. (Tables, pp. 62-64.)

This latter figure, it was to be borne in mind, did not in any way include the incidence of the diseases in the civilian population, men, women and children, for whom no kind of hospital isolation or even notification was possible. That incidence was widespread. From data relating to mortality from typhus in Kragujevatz area, October 22, 1914, to May 15, 1915, which I afterwards obtained (Chart, p. 86), the number of deaths

from typhus in that area during January, February and March had been 1,220, as compared with 538 cases in the chief Fever Hospital (first Reserve) which contained four-fifths of all the cases in hospitals. During January the number was 156 and 78 respectively. During February the numbers were 452 and 185 respectively; during March 612 and 331 respectively. There was a large mortality from typhus in cases outside the hospitals.

At a later period (May 1 to 14) when the epidemic was completely broken, out of a total of 937 cases treated in the Roadside Dispensary of Mrs. Stobart's mission in Kragujevatz, 319 were surgical cases and 618 medical cases. These 618 medical cases were constituted: digestive, 205; respiratory, 109; circulatory, 26; renal, 22; nervous, 20; anæmia, 46; skin diseases, 26; general diseases, 83; and infectious diseases, 118 (about 20 per cent.). This latter included typhus 18 and post-typhus complications 12 (5 per cent.); relapsing, 11; a total of 41 —about 7 per cent.

Period 2 (*April* 1 *to* 26).—*Progress of Typhus Epidemic.*

The course of the epidemic after the end of March was a most interesting one. The "black" period as it appeared at the end of March proved to be the darkness before the dawn. It was never blacker than on the date April 3. The numbers in hospitals were then at their very highest, viz., 8,213 typhus, and the pressure was greatest. Nevertheless, I reported to the War Office in my telegram of that day, that I estimated that the typhus outbreak had reached its maximum about two weeks before, i.e., about March 20. This opinion was based on the fact that the net increase of typhus cases in the hospitals for the past week (March 28 to April 3) had been only 233 as compared with 1,183 one week before.

Between March 1 and 7 the numbers in hospital had risen from 3,743 to 4,569—an increase of 826.

Between March 7 and 14 they had risen from 4,569 to 5,361, an increase of 792.

Between March 14 and 21 they had risen from 5,361 to 6,797—a net increase of 436.

Between March 21 and 28 they had risen from 6,797 to 7,980—a net increase of 1,183.

Between March 28 and April 3 they had risen from 7,980 to 8,213 —a net increase of 233.

The admissions of cases into hospitals had thus reached their maximum on March 21 to 28. Allowing an incubation period of twelve days this represented a maximum period of contraction of infection about twelve days before, viz., March 16. Suspension of railway traffic had commenced on March 16. During the week before, contraction of infection had been at its very highest.

The conclusion I expressed in my telegram of April 3 was that I attributed this lessening largely to the suspension of railway traffic and stoppage of all leave from the army, so strongly urged by us on our arrival, and put into force on March 16. And in spite of the large numbers of cases in hospitals, I stated that I was glad to report improvement in the general conditions.

In my telegram a week later (April 11) I stated that my opinion expressed in my previous telegram had been confirmed by what I had seen of the conditions of hospitals visited by me in Uskub (April 6 to 8) and Nish during the past week—most notably in the fever hospital in Nish in which the conditions were so terribly bad four weeks before at the date of our arrival. A great transformation had been effected there by the energy of the Serbian officer in charge, everything being now clean and well ventilated and in surprisingly good order—the most striking change noted by me in any hospital in Serbia.

April 3 *to* 10.—The actual position of the epidemic at this date (April 11) was that the number in hospitals had fallen from 8,213 on April 3 to 8,077 on April 10, a net fall of 136 cases instead of a net rise of 233 cases the preceding week. This denoted that the numbers admitted were now for the first time being exceeded by those discharged or dying.

April 10 *to* 18.—The position a week later was still better. The number had further fallen from 8,077 on April 10 to 6,984 on April 18—a further net fall of 1,093 cases in hospitals.

April 18 *to* 26.—And lastly, a week later, the numbers had still further fallen from 6,984 on April 18 to 5,979 on April 26, a net fall of 1,005 cases. Altogether since April 3 there had been a net fall of 2,234 cases of typhus in hospital—*a fall of* 27 *per cent.*; and a still greater fall of 4,002 cases of relapsing fever in hospitals—*a fall of* 52 *per cent.* (*see* Tables H and K, pp. 62-64).

The new data (of cases admitted) which I had asked for on April 2 were furnished in the daily reports from April 14 onwards (*see* Tables H and K). These showed that in the five days, April 22 to 26, the number of new cases admitted daily had been 1,151 cases.

Allowing for an incubation period of twelve days, this meant that this was the number of cases contracting infection during the five days, April 10 to 15, immediately preceding the resumption of railway traffic on the 27th. On April 16, exactly ten days after resumption of railway traffic, the number of admissions suddenly rose to 611 cases, and in the following five days, April 27 to May 1, it totalled 1,919 cases, (average 400 daily). The infection of these cases must have been contracted at least ten days before—i.e., in the first five days, April 17 to 22, after railway traffic was resumed.

COURSE OF EPIDEMICS AS SHOWN BY NUMBERS OF CASES IN HOSPITAL AND NUMBERS OF DEATHS AT DIFFERENT DATES AT VARIOUS PERIODS (JANUARY 1 TO JUNE 4).

(*A*) All Serbian hospitals (Table, p. 92).
(*B*) Kragujevatz hospitals (Chart, p. 87).
(*C*) Kragujevatz First Reserve Fever Hospital, the largest in Serbia.

The data here given are the official figures of the returns in forty-two hospital centres in Serbia which I received nightly. They are incomplete, especially for the earlier periods, January and February, and by no means represent the prevalence of cases of typhus and relapsing in the country—probably five times greater than the figures here given. They accurately represent, however, the relative prevalence in the different periods.

(*A*) *All Serbia.* (Table, p. 92.)

The total number of cases in hospital on March 1 at time of our arrival stood at 46,000. By the end of April it had fallen to 31,000, and June 5 to 18,000. Every available place was used to accommodate patients. There was need of beds for 16,000 patients. By April 27 there were over 6,000 empty beds available, and by June 4 over 13,000.

Number of wounded: On March 7 there was over 11,000; by the end of April this had fallen to 5,700, and by June 4 to 4,200.

Total sick: On March 7 this was 36,300; by the end of April this had fallen to 25,800, and by June 4 to 13,000.

Number of typhus cases: On January 1 this was stated to be about 113, but figures at this period were very incomplete. By February 1 it had risen to 1,200; by March 1 to 3,700; by April 2 to 8,200 (maximum). It then fell to 6,000 on April 26, rose sharply to 6,300 on April 27, remained for a week, then fell to 2,800 on June 4.

Numbers of relapsing fever: On January 1 this stood at over 1,700. By February 1 it had risen to 5,300; by March 1 to 7,000; by March 27 to 8,600 (maximum). It fell to 5,000 by April 16, and 3,800 by April 26, and thereafter to 1,600 cases on January 4.

Enteric: The number of cases in hospitals on January 1 was about 900; it rose to 1,800 by February 1; to 2,380 on March 1 (maximum). It then fell to 1,500 on April 3, and thereafter to 160 on June 4.

TABLE A.

General Hospital figures of Sick and Wounded in Serbian Hospitals, March 1 to June 5.

	March 1	March 7	March 27	April 3	April 16	April 26	April 27	May 3	May 17	May 31	June 5
Number in hospital	—	46,000	—	—	—	—	31,000	29,000	23,000	19,000	18,000
Wounded ...	—	11,037	—	—	—	—	5,747	3,175	4,575	4,208	4,277
Sick ...	—	35,351	—	—	—	—	25,895	23,818	18,407	14,703	13,781
Fever cases	—	15,000	—	17,916	—	10,888	11,268	10,528	7,153	5,088	4,788
			(*d*)	(*d*)	(*f*)	(*g*)	(*h*)	(*h*)			
Typhus ...	3,750	4,570	8,050	8,213	7,324	5,979	6,314	6,263	4,376	3,092	2,860
Relapsing ...	7,050	7,850	8,650	7,810	4,960	3,808	3,904	3,166	2,120	1,643	1,609
Enteric ...	2,300	2,174	1,900	1,549	1,100	900	878	797	341	188	160
Dysentery ...	400	375	—	221	—	201	193	178	124	100	84
Other fevers	—	147	—	123	—	—	69	124	192	60	76
Number of deaths (all causes) on day specified	—	—	—	—	—	115	117	132	65	50	48
Empty beds	—	—	—	—	—	(7,000)	6,243	7,265	9,329	11,870	13,261

(*d*—*g*) This table shows the fall in numbers of cases of typhus and relapsing fever in hospitals, which occurred from the end of March (*d*), when they were at a maximum, up to April 26 (*g*).

(*h*) The increase of cases in hospitals which suddenly occurred on April 27, exactly twelve days after resumption of railway traffic on April 16.

Dysentery: The number of cases on March 1 was stated to be 400, and thereafter fell to 84 on January 4.

Other fevers: The number of these in hospitals was very small, but they do not represent the prevalence of other fevers, especially diphtheria, in the civil population.

(*B*) *Kragujevatz Hospitals.*

The numbers in Kragujevatz hospitals at different periods are shown in Table, p. 85, Chart, p. 87. They were on an average about one-tenth of the whole cases in Serbia. The total number fell from over 4,000 on March 14 to 2,000 on June 4. The number of wounded from 1,400 to 580. The number of sick from 2,600 to 1,400—made up of Serbians and prisoners, viz., 1,800 Serbians and 800 prisoners on March 14; 900 Serbians and 500 prisoners on June 4. The number of deaths daily fell from twenty-six on April 8 to eighteen on April 3; seven on April 26, and one on June 4. The total fever cases rose from 1,400 on March 14 to 1,600 on March 27, and then fell to 470 by June 4. The number of typhus cases on March 14 stood at 600 cases. It rose sharply to 1,000 cases on March 27 (maximum), fell sharply to 660 on April 27, and then afterwards to 370 by June 4. The number of relapsing fever cases on March 14 was 670, fell to 600 on March 27, and then rapidly to about 120 by the end of April. They showed a slight rise about May 3 and afterwards fell to fifty cases on June 2.

(*C*) *Course of Typhus Epidemic in Kragujevatz.*

The figures in Table, p. 85, Chart, p. 86, give very interesting information regarding the course of the typhus epidemic in Kragujevatz area. The first deaths were recorded on October 22, 1914, and the numbers thereafter were 6 in October, 19 in November, and 30 in December. They then rose to 126 in January, 554 in February and 581 in March. Then a marked fall occurred, viz., to 218 in April and 46 in the first two weeks of May—a total altogether of 1,580 cases between October 22 and May 14, of which 1,135 were in February and March.

The course is shown (D) by number of admissions and deaths in the First Reserve Hospital, the largest fever hospital in Serbia, which throughout the epidemic had about one-twelfth of all the cases in Serbian Hospitals (Table, p. 70; Chart, pp. 71, 72). The admissions in December were 21; they then rose to 118 in January, 961 in February, and 1,138 in March. A sharp break then occurred, viz., to 360 in April, and 88 in the first two weeks of May—a total altogether of 2,686 admissions between December 19 and May 14, of which 2,100 were in February and March. The deaths were: *Nil* in December, 22 in January, 185 in February, and 331 in March. They then fell to 141

in April and 31 for the first two weeks of May—a total of 710 cases between January 6 and May 14, of which 516 were in February and March. The case mortality in January and February was 30 per cent., in March 40 per cent. In April it fell to 18 per cent., in May to 14 per cent.; the average mortality of 2,302 completed cases for the whole period being 30 per cent.

(*D*) *Course of Typhus Epidemic in all Serbia.*

This is shown in Charts, pp. 45, 95, and Tables, pp. 58, 76. The epidemic began in December. By the end of January, the number of cases in hospitals was about 1,100. By the end of February it had risen to over 3,700 cases, and by March 28 to over 8,000 cases. In the first fifteen days of March the numbers rose from 3,700 to 5,800 cases—an increase of nearly 2,000 cases. In the second fifteen days they rose to 8,000, a further increase of 2,200 cases.

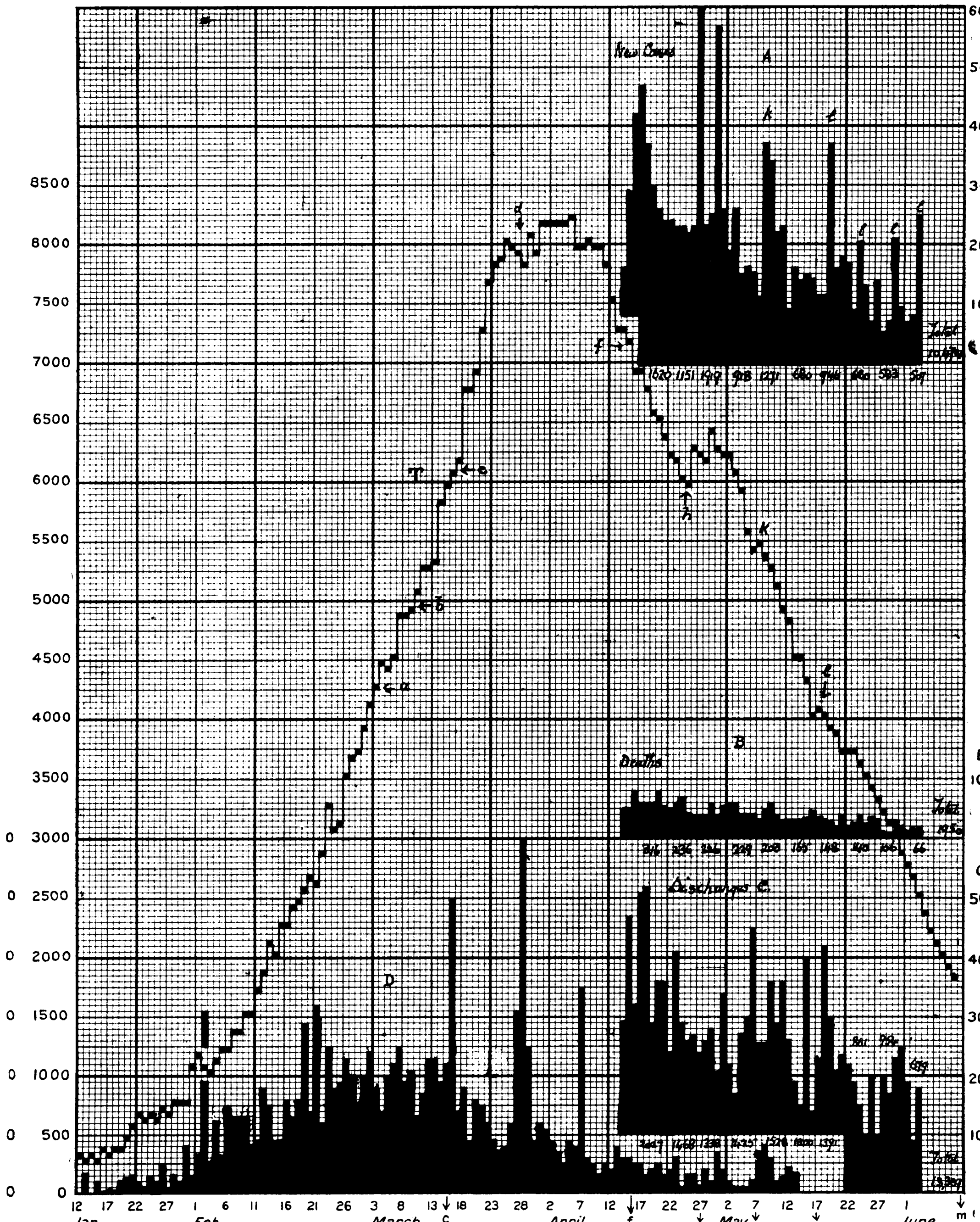
April.—They remained at a level of 8,000 to 8,200 cases for a period of fifteen days (March 28 to April 12), indicating that the numbers of admissions had greatly fallen off, only equalling the discharges and deaths instead of largely exceeding them. A most rapid fall then occurred from 8,000 on April 12 to 6,000 on April 26. The fall in admissions during the period April 17 to 26 was from 464 cases to 228 cases. The percentage fall in number of cases in hospitals from April 3 to 26 was 27 per cent. both for the army and the civilian areas (Table, p. 62). But in the army areas the percentage fall in army area A was only 4 per cent., whereas in area B it was 42 per cent. (Chart, p. 96.)

May.—Then followed a sudden sharp rise (*h*) between April 27 and May 1, exactly ten to twelve days (incubation period) after resumption of railway traffic and leave from the army on April 16 to 20. The admissions rose from 228 on April 26 to 611 on April 27 and 570 on April 30—a total of 1,919 cases in five days, as compared with 1,151 cases in the preceding five days. (*See* Chart, p. 66.)

After the first rise there followed a fall from 6,580 on May 1 to 5,500 on May 6, when another rise occurred (*k*) due to increased admissions of 368 and 343 on May 8 and 9; then a further more rapid fall to 4,000 cases on May 16 and finally to below 2,800 cases on June 4. The total fall since April 3 was 63 per cent. (Table, p. 62).

The fall in the latter fourteen days was interrupted by slight rises in admissions (*l*) on certain days. These were connected with sudden

Chart 3 Course of Epidemic of Typhus in Serbia in 1915, as shewn by { T No. of Cases in Hospital; A " " New Cases (April 17–June 4); B " " Deaths; C " " Discharges

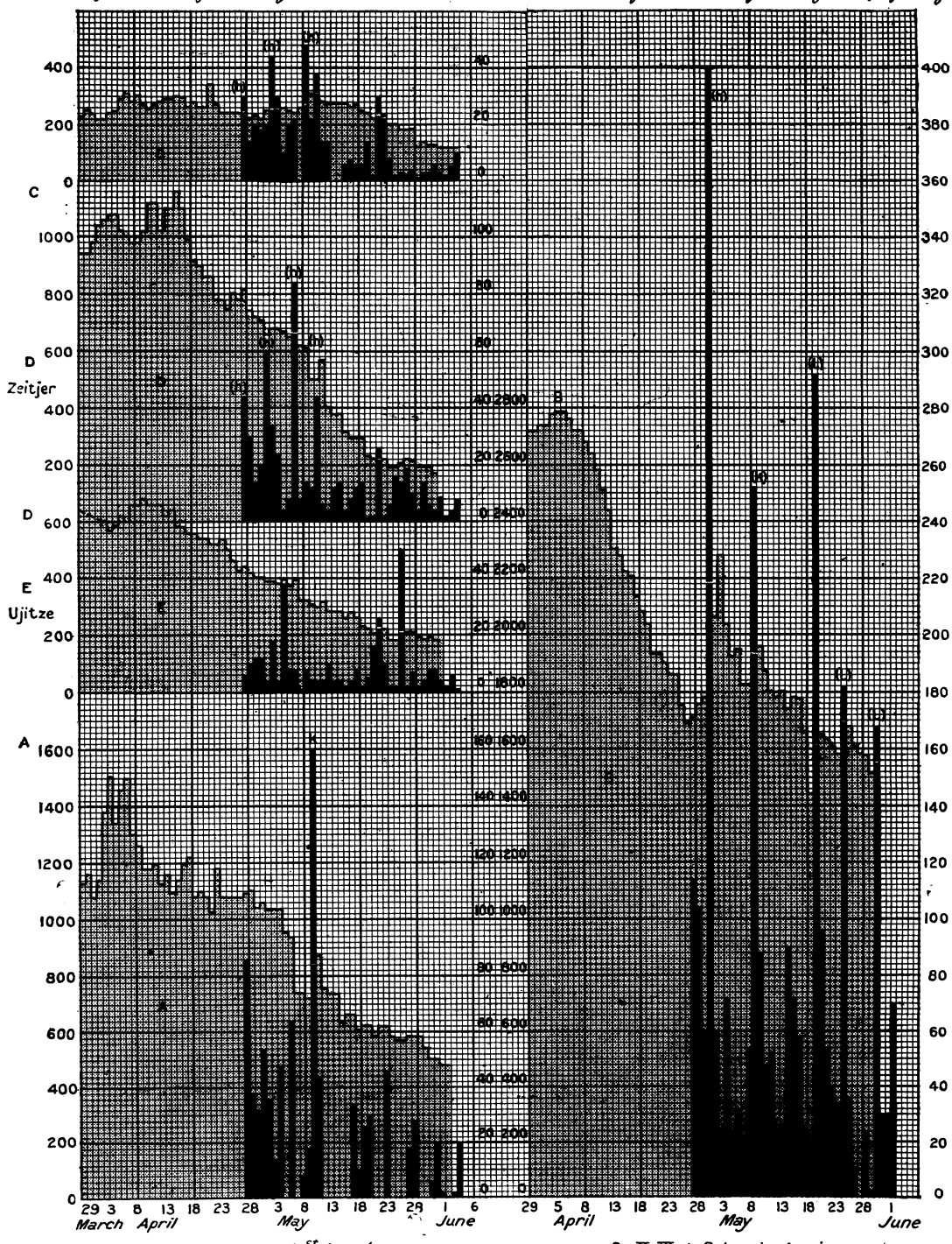


New cases	12 17	22 33	123 129	122 174	209 204	197 183	255 137	135 231	78 106	61 42	35 38	16 56
	29	55	252	296	413	380	392	366	184	103	73	72
D	84		548		793		756		287		145	
Deaths	20		82		222		232		108		49	

D = Daily Admissions of Typhus in 1st Reserve Hosp. Kragujevatz.

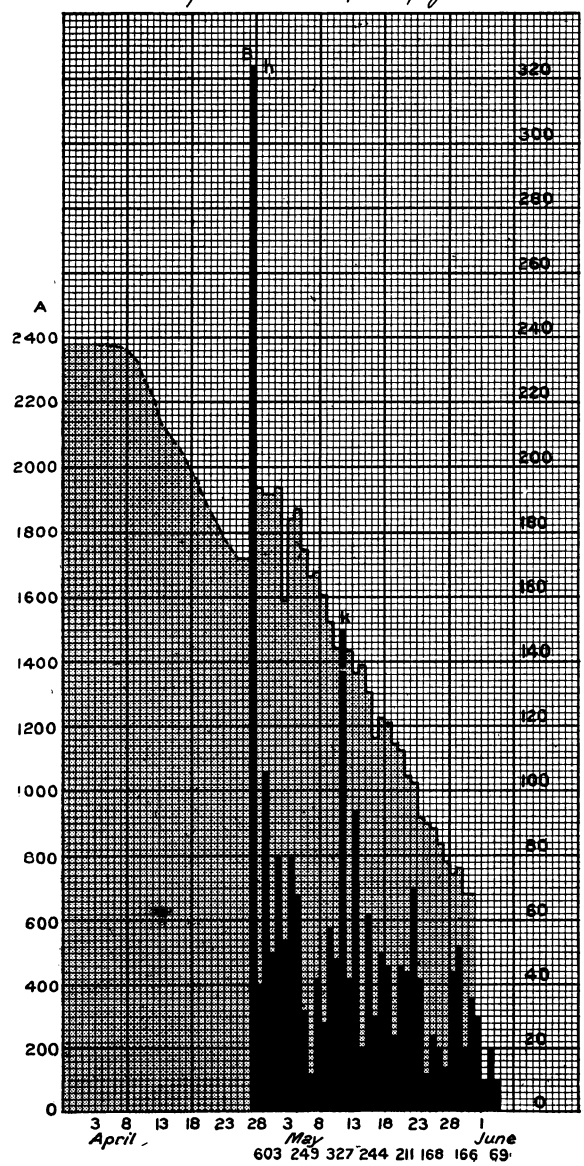
a = *Arrival of Mission*
b = *Programme of Prevention*
c = *Suspension of Railway Traffic*
d = *Arrest in No. of Cases in Hospital 10 days after c.*
f = *Resumption of Railway Traffic*
h = *Increase of Cases in Hospital 10 days after f.*
k = *A Second increase 10 days after h.*
l = *A Third increase 10 days after k. due to evac. of Fd Ambul. (Chart 7)*
m = *Mission left Serbia.*

Chart 5: Course of Epidemic of Typhus in Serbia in different War Areas.
A. Valyevo (1st Army); B. Belgrade + Danube (2nd + 3rd Armies); C. Railway Towns; D. Zeitjer Army; E. Ujitze Army.



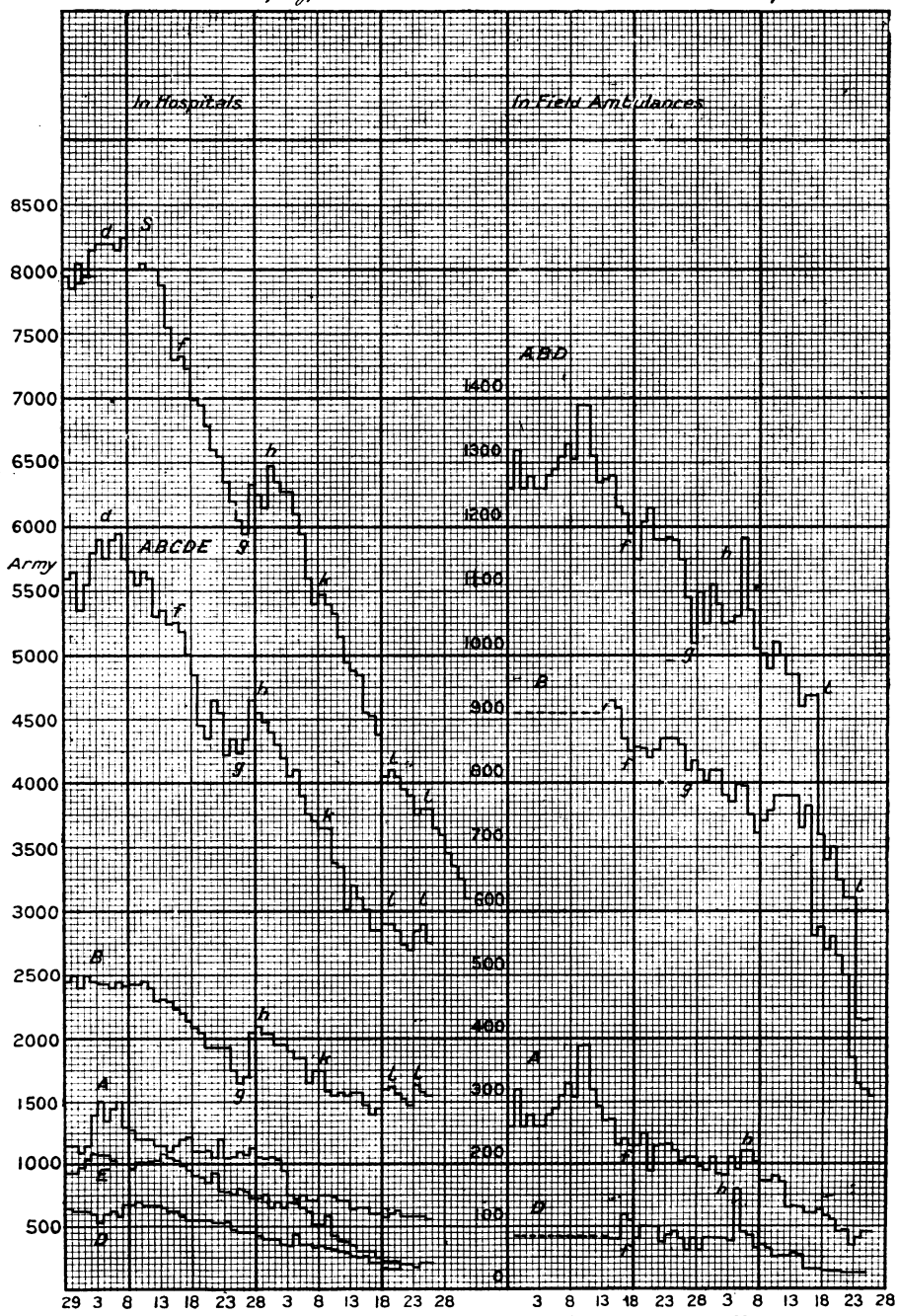
Black Blocks = Nº of Admissions Daily (April 27 - June 4). Shewing recrudescences (h & k) of New Cases on April 27 - May 13, commencing 12 days after resumption of Railway Traffic on April 16.

Chart 6. Course of Typhus Epidemic in Circlian Areas in Serbia, as shewn by; A. N°. of Cases in Hospitals; B. N°. of New Cases (April 17 - June 4).



Black Blocks = N° of Admissions Daily (April 27 - June 4). Shewing recrudescences (h & k) of New Cases on April 27 - May 13, commencing 12 days after resumption of Railway Traffic on April 16.

Chart 11. No. of Cases of Typhus in War Territories (A.B.C.D.E.) & in whole of Serbia (S).



(d-g) Shews sudden fall in Cases in Hospitals and Ambulances during suspension of Railway Traffic, and 10 days after its resumption at (f).
(h) Sudden increase of Cases with Hospitals and Field Ambulances 10-12 days after resumption of Railway Traffic at (f).
(k) A second increase 10 days later.
(l) Sudden Evacuation of Field Ambulances in Army area B. on May 16 & 26 and rise in number of Cases in Hospitals on these dates.

evacuations of field ambulances in war area B, preparatory to forward movement of troops (May 17 to 31), which by this time were once more in full fighting order. (*See* Chart 11, p. 98.)

The figures of admissions, deaths and discharges for this period (April 14 to May 31) are given in Tables, pp. 76, 62, and represented graphically in the black blocks in Chart, p. 95.

TABLE D (CHART, p. 98).

Distribution of Typhus Cases in Hospitals and Field Ambulances, March 27 to May 31.

(*a*) Army areas, A, B, C, D, E.
(*b*) Civilian areas, F.

In Hospitals	March 27	(*d*) April 3	(*g*) April 26	(*h*) April 27	May 3	May 17	May 31
Army area A ...	1,240	1,221	1,126	1,120	1,069	671	602
,, ,, B ...	2,868	2,789	1,692	1,710(*h*)	2,033	1,660	1,437
,, ,, C ...	229	216	244	255	252	267	129
,, ,, D ...	896	1,013	771	813(*h*)	684	294	174
,, ,, E ...	650	571	431	436	381	258	187
	5,883	5,810(*d*)	4,264(*g*)	4,342(*h*)	4,425(*h*)	3,150	2,429
Civilian area, F ...	2,167	2,403	1,715	1,972(*h*)	1,838	1,226	669
Total ...	8,050	8,213	5,979	6,314(*h*)	6,263	4,376	3,098

Field ambulances	March 30	April 7	April 26	April 27	May 3	May 17	May 25
1st Army, area A	316	329	207	208	206	205	127
2nd ,, ,, B	(200)	(200)	163	163	198	43	67
3rd ,, ,, B	(500)	(500)	388	393	357	281(*l*)	101
Belgrade ,, B	(400)	(400)	271	279	215	252(*l*)	147
Total B area ...	(1,100)	(1,100)	822	835(*h*)	770	586(*l*)	315(*l*)
,, E	(100)	(100)	58	78	162(*h*)	33(*l*)	23
,, D							
	(1,500)	(1,500)	1,087	1,121(*h*)	1,138	746(*l*)	428
Grand total of cases in hospitals and field ambulances	(9,500)	(9,700)	7,066	7,435(*h*)	7,401(*h*)	5,122	3,526

This Table shows :—

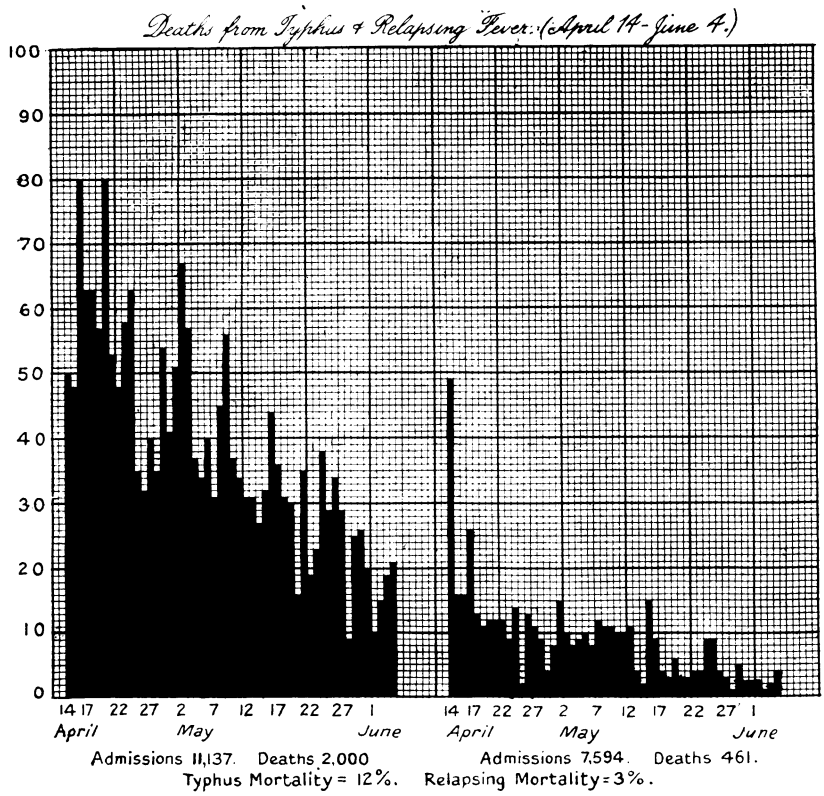
(*d*) and (*g*) the fall which occurred in cases in hospital between April 3 and April 26.

(*h*) The rise which suddenly occurred on April 27, exactly twelve days after resumption of railway traffic on April 16, affecting both the army and the civilian areas. This rise also occurred in the field ambulances at this period (April 27 to May 3). (Chart, p. 98.)

(*l*) Between May 17 and 31 sudden evacuations of cases took place from the field ambulances of area B, keeping up the number of cases in hospitals (*see* Chart 11).

The chart of admissions shows very clearly the steady fall between April 17 to 26, and the sudden rises (*h*) on April 27 and 30, and (*k*) on May 7 to 11, and then the more gradual fall, varied by incidental rises (*l*) connected mostly with evacuation of field ambulances (*see* Charts, pp. 95, 98).

CHART 16.



Total Admissions and Deaths from April 14 to May 31.

The total admissions in thirteen days, April 14 to 26, had been 3,634 cases, an average of 280 cases daily. The total admissions April 27 to May 31, a period of thirty-five days, was 6,996, a daily average of 200 cases. Altogether between April 14 and May 31, a period of forty-eight days, the total admissions into hospitals were 10,630, a daily average of 221, and the total deaths 1,948, a daily average of 40 cases. The total completed cases during this period was 15,070, representing a mortality of 12·2 per cent. (Chart 16; Table, p. 62).

Chart 7 Number of cases of Typhus in Armies in Serbia, detained in Field Ambulances, shews sudden evacuations in 2nd Army (May 15) & 3rd Army (May 20) preparatory to forward movements.

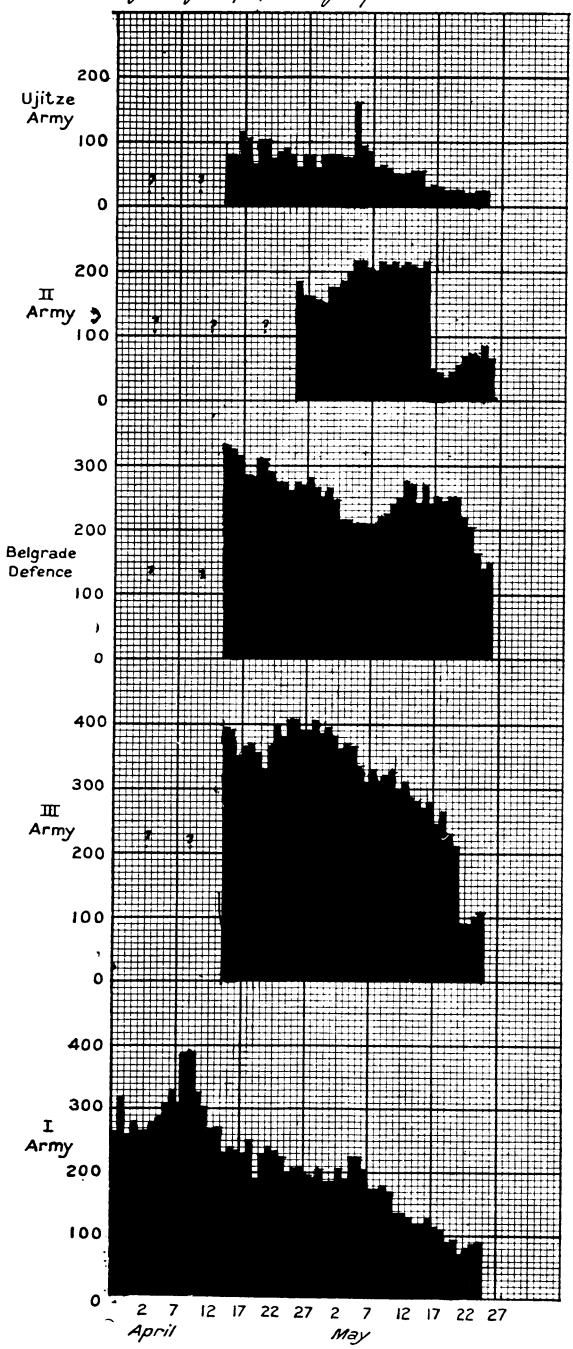
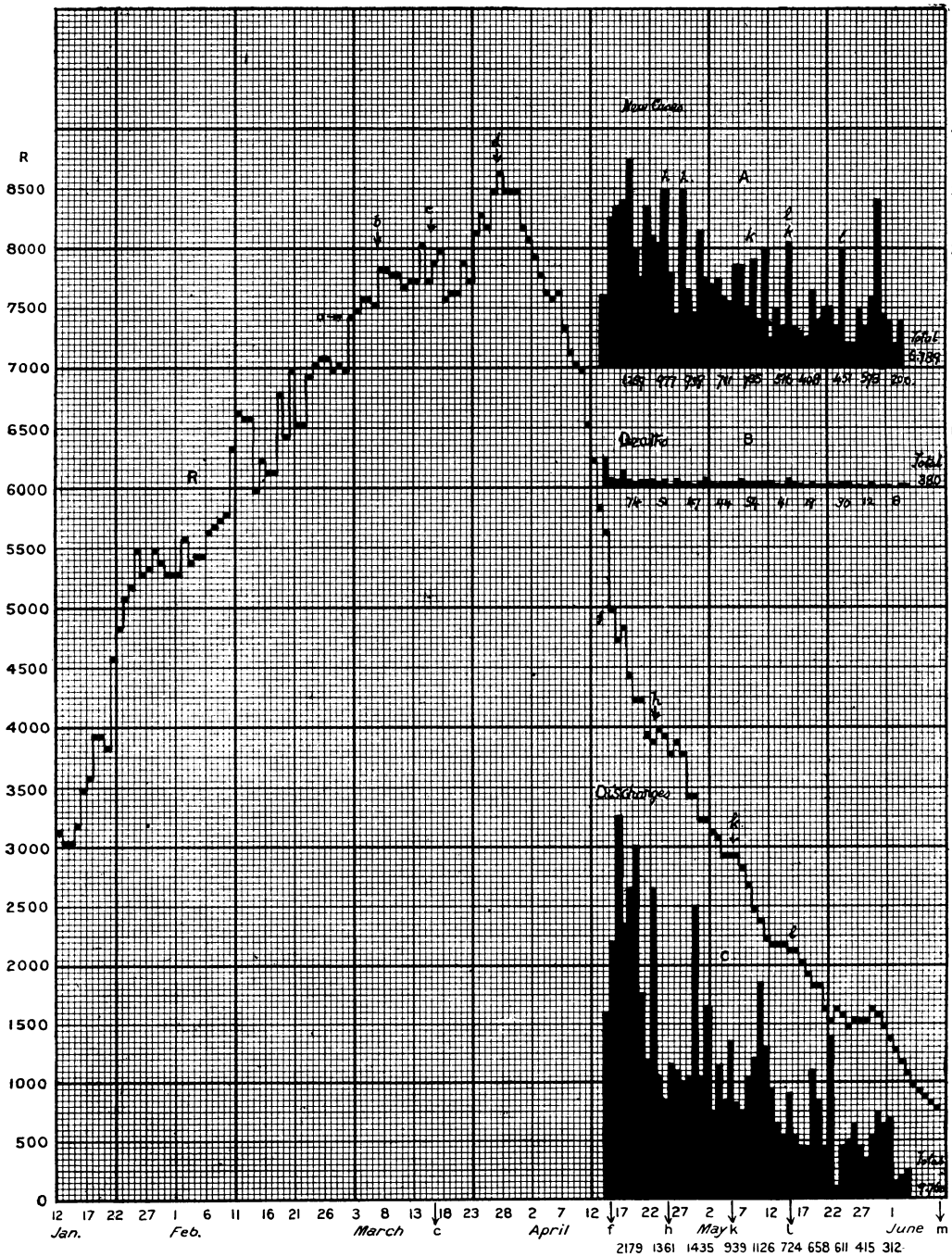


Chart 4. Course of Epidemic of Relapsing Fever in Serbia 1915, as shewn by { R No. of cases in Hospitals; A " " New cases (Ap. 17–June 4); B " " Deaths; C " " Discharges



a = Arrival of Mission
b = Programme of Prevention
c = Suspension of Railway Traffic
d = Arrest in No. of Cases in Hospital 10 days after c.
f = Resumption of Railway Traffic
h = Increase of Cases in Hospital 10 days after f.
k = A Second increase 10 days after h.
L = A Third increase 10 days after k. due to evac. of Fd Ambul. (Chart 7)
m = Mission left Serbia.

The mortality corresponded very closely with that shown in the more detailed figures for the First Reserve Hospital in Kragujevatz—viz., 18 per cent. in April and 14 per cent. for the first half of May, as compared with a mortality of 30 per cent. during January and February and 40 per cent. during March (*see* Chart, p. 71). The fall in the epidemic was thus accompanied by a marked fall in mortality in its later periods.

The mortality for 2,302 cases in First Reserve Hospital over the whole period January 1 to May 14 was 30 per cent.

(*E*) *Course of Relapsing Fever Epidemic* (*see* Chart facing; Tables, pp. 58, 64, 76).

This was the first to show itself—preceding the typhus epidemic by several weeks (*see* Chart, p. 45); largely exceeding it in numbers up to the end of January (5,500 and 1,000 cases respectively in hospital), also up to the end of February (7,000 and 3,500 respectively), and finally caught up by the typhus at the end of March—viz., 8,500 and 8,000 respectively.

It will be seen from the curve of cases in hospital that the relapsing fever maintained itself at a high but steadily increasing figure of 6,000, 7,000 and up to 8,500 from February 10 to April 2, a period of fifty days, whereas the typhus curve of cases rose steeply in this period from 2,000 cases up to 8,000 cases and then maintained this latter level only for fifteen days.

The two epidemics were broken about March 28, the relapsing beginning to fall on April 2, the typhus on April 12. The subsequent fall as shown by cases in hospital was very rapid in both, but always greater and about ten days in advance in the case of the relapsing fever. In the three weeks between April 3 (*d*) and April 26 (*g*) the numbers in hospitals fell from 7,810 to about 3,800—a total of 4,000 cases, a fall of 52 per cent. (Table, p. 64).

The figures of admissions (shown in Table, p. 64) show that the daily average in the period April 14 to 17 was 213 cases, 252 in the next five days (April 17 to 21) and then down to 195 in the period April 22 to 26. In the next period, April 27 to May 1, there was a sudden rise in admissions to 304 cases, keeping up the numbers in hospital (*h*).

The fall in numbers continued from 4,000 cases down to 3,000 on May 7, when a slight further check was shown May 2 to 7 (*k*) precisely as was the case in the typhus curve. Then to 2,200 on May 17, when another slight check occurred (*l*), then to 1,500 and finally to about 1,600 on June 4—a total fall of 80 per cent. (Table, p. 64).

The curve of admissions (Block A, Chart, p. 102—also Block C, Chart, p. 45) shows that, on the whole, the fall in the case of relapsing fever between April 26 and June 4 was not so regular or so striking as in the case of typhus fever.

TABLE E.

Distribution of Relapsing Fever cases in Hospitals in Army areas (A, B, C, D, E) and *Civilian* (F).

Army area	March 27	April 3	April 26	April 27	May 3	May 17	May 31
1st Army A	1,116	1,043	305	419	412	294	298
2nd ,, 3rd ,, Belgrade B	2,002	1,486	661	687	685	314	512
C	393	414	267	290	216	156	121
D	561	516	336	331	251	144	59
E	384	291	128	125	90	55	32
Total	3,456	3,750	1,696	1,852	1,654	673	1,022
Civilian, F	5,194	4,050	2,112	2,052	1,512	1,447	620
Grand total	8,650	7,800	3,808	3,904	3,166	2,120	1,642
Total of Typhus and Relapsing ,, ...	16,700	16,013	9,757	10,218	9,429	6,496	4,740

Total Admissions and Deaths (*April* 14 *to May* 31). (Table, p. 64.)

The total admissions in the thirteen days, April 14 to April 26, was 2,874 cases, an average of 221 cases daily. The total subsequent admissions, April 27 to May 31, was—a period of thirty-five days—4,453, an average daily of 127 cases. Altogether the numbers of cases admitted, April 14 to May 31, was 7,327 cases, with 463 deaths. The total completed cases during the period was 11,552 cases representing a mortality of 4 per cent. This case mortality (relatively high for this disease), shows that although much fallen in incidence, it still retained its virulence. (*See* Chart 16, p. 100.)

Summary.

The period April 27 to May 11 was then marked by a definite recurrence of both infections. This was not great in amount having regard to the extent of infection which had existed at the end of March, when the combined total of admissions of typhus and relapsing reached probably (on estimate) a daily average of 2,000 to 2,500 cases. But it was of extreme interest from an epidemiological and ætiological

point of view. For it occurred at a time when the weather conditions were those of summer, whereas the preceding great fall which set in suddenly at the end of March occurred while the conditions were those of winter—and very bad at that. Moreover, it was not due to periodicity—e.g., typhus: for, as I afterwards found, it occurred only in certain areas—chiefly in Area B, in which the previous fall had been most marked (42 per cent.); and it did not occur in the area where the disease was most marked and prevalent (Area A); and relapsing fever chiefly in Area A in which the previous fall had been greatest (71 per cent.).

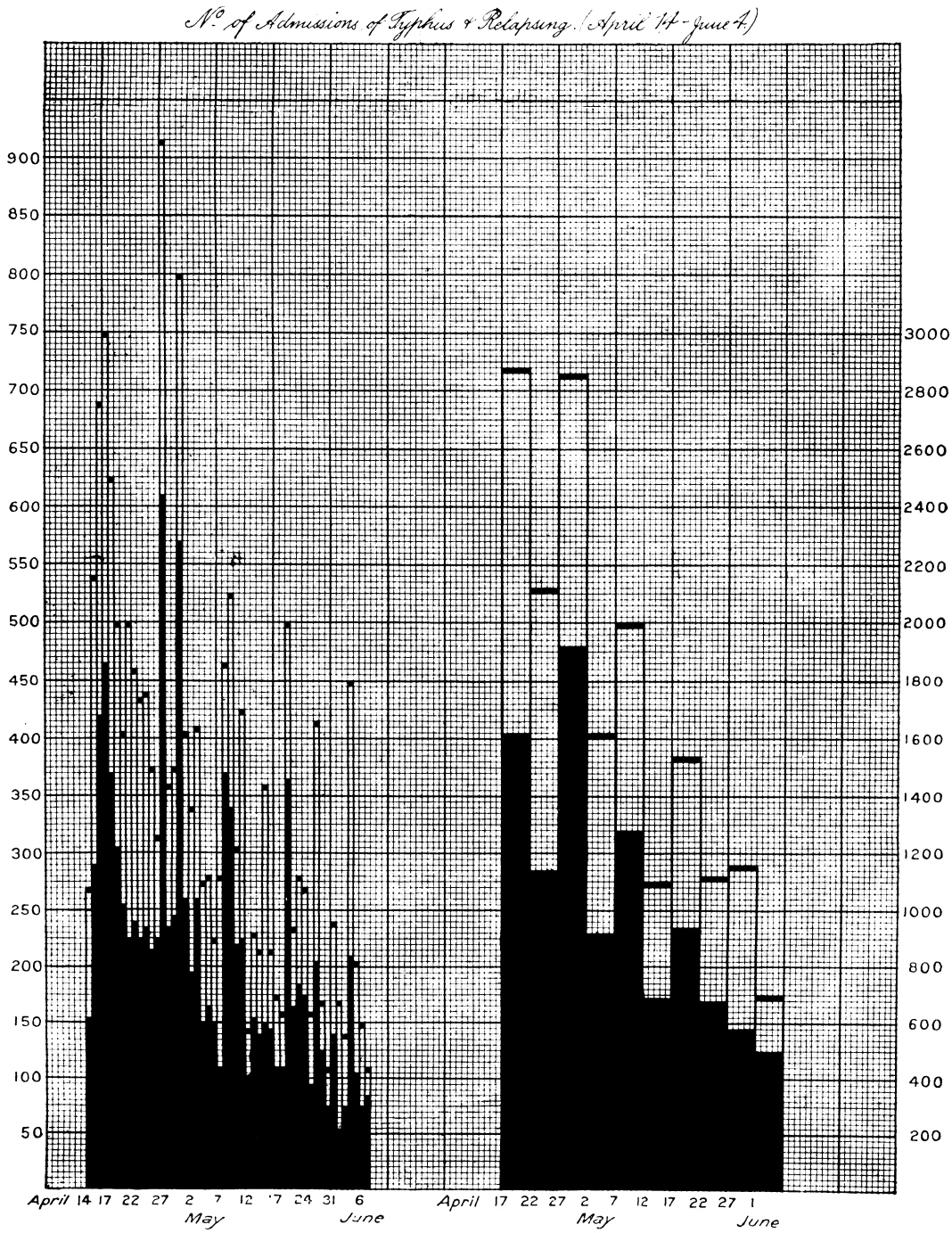
The features of this recurrence have therefore been made by me the subject of a very close study, relating to daily figures of its incidence in forty-two places in Serbia, with results which have proved the most interesting of all my experiences in Serbia from the ætiological point of view; for the result shows that the recurrence was definitely due to, and was in direct relation to, the movements of soldiers and civilians following the resumption of railway traffic on April 16.

Suspension of all passenger railway traffic (only one train up and down Serbia daily) and stoppage of all leave from the armies had been the first measures we advised and urged five days after our arrival in Serbia on March 4 to meet the overwhelming pestilence then prevailing. They had been put in force on March 16—originally for a period of fifteen days up to March 30. But again on our urgent advice ("it is absolutely necessary") in order to give our other chief measures of prevention a chance (viz., formation of our great disinfecting station at Mladenovac and of our special sanitary train for disinfection and inoculation) it had been extended for another fifteen days, viz., to April 15. The original sudden check in the epidemic had set in on March 16 as shown by arrest in numbers of cases in hospitals on March 28, and by rapid fall in numbers of cases in hospitals and in admissions.

Traffic had been resumed on April 16, by which time the number of admissions had fallen (*see* Chart, p. 106) to 707 cases daily. The fall continued for another ten days—down to 317 cases daily—i.e., during a period corresponding to the average incubation period of the disease. Thereafter on April 27, i.e., following the necessary incubation period, the numbers rose suddenly to 915 cases; and there were daily averages (five-day periods) of 570, 400 cases, and then, interrupted by rises, eventually 250 cases daily.

These subsequent rises did not occur over the country as a whole, but were confined to certain areas and places specially affected by movement of soldiers on leave or of civilian traffic.

CHART 17.


No. of Admissions of Typhus & Relapsing. (April 14 - June 4)
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50
3000
2800
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
April 14 17 22 27 2 7 12 17 24 31 6
May
June
April 17 22 27 2 7 12 17 22 27 1
May
June

Conditions in Railway Stations during Suspension of Traffic.

The chief towns passed through on the way to Nish included Lapovo (the junction for the Kragujevatz branch railway), Jagodina (the centre of railway administration for army areas); Tupria; Parachin (the junction for the Zeitjer, Eastern branch line); Stalac (the junction for the Ujitze, Western branch line; Alexinatz; and then Nish.

From the study of reports which I received nightly I came to be well acquainted with the number of fever cases in all these, and forty-two other, places in Serbia. When on my journeys I was able to take note of the striking change in the appearances presented by all stations passed as compared with those I had observed on my first journey to Kragujevatz (on March 8) after our arrival. The changes were similar in character to those observable in Kragujevatz railway station—viz., an entire absence of travelling public, instead of the presence of crowds of peasants; the cleanliness of the station precincts and buildings; all station woodwork, stonework and waiting rooms whitewashed; and above all the quiescence everywhere prevailing.

This increased and increasing cleanliness was beginning to be, and soon afterwards became, noticeable in the case of the restaurants, very few in number, seen in Kragujevatz and Nish. In Nish, the chief café-restaurant in which we had our first meals on the day of our arrival, on March 4, was then a dirty, ill-kept place, and the same applied to the restaurant in Kragujevatz. From this time onward there began to appear greater efforts of cleansing, whitewashing, distempering, and painting. The result finally was that when it was once more opened to the public, some of its old habitués, it was reported, were so astounded at its brightness and transformation that at first they hesitated to enter it—but only for a moment. The same change was effected in the chief restaurants in Kragujevatz, and doubtless similar changes were carried on elsewhere. For the Serbian is nothing if not a sportsman, and nothing appeals to him more than to outrival, or surpass if possible, the efforts of his neighbours in well doing.

Section IX.—Suspension of Railway Traffic as a Preventive Measure against Epidemic Disease.

(Tables, pp. 58, 62, 78. Charts, pp. 44, 45, 95-98.)

This measure, immediately recognized by us as a great necessity on the first journey we made on March 8, after our arrival in Nish on March 4, and strongly urged, and no less strongly applied by the Serbian authorities, was put in force a week later, March 16, the period of suspension to be for fifteen days. It was due to terminate on March 30, by which time under ordinary circumstances traffic would in all probability have been resumed, to the great relief of all concerned. For the inconveniences caused by the suspension were very great, and felt by all, and by no means least of all by myself in connexion with my work. On our strong representation at a critical period (March 30) the suspension was continued for another fifteen days, with the most important results. The stoppage of leave from the army particularly affected the home living, domesticated peasant soldier folk. Their lot—fighting as they had been almost continuously in three great wars over a period of nearly three years—was indeed one which only intense patriotism and self sacrifice of the Serbian soldier could have endured.

March 16—*April* 16.—*Effect of Suspension of Railway Traffic.*

(Charts, pp. 96, 97; Table, p. 62.)

These Charts show in a most instructive way the course of the epidemic of typhus from April 3, when the number of cases in hospitals were at their height, up to April 26, ten days after traffic was resumed on April 16.

Army Area (*April* 3 *to* 26).—In the first (Valyevo) army area (A), completely shut off from the rest of Serbia by the suspension of railway traffic the epidemic had continued. The number of new cases had equalled the discharges and deaths, and the figures in hospital had kept up to nearly their original highest mark. On April 26 the fall in the number from the highest mark was only 4 per cent., the number of new cases had fallen to 89.

Army Area B.—In the second and third and Belgrade army areas (B), comprising three-fourths or more of the whole armies, through the

middle of which the railway passed through the chief Northern towns, the fall by April 26 in the number of cases was very striking, viz., 42 per cent.; number of new cases (admissions) had fallen to 56.

Army Areas D and E.—In the other two war areas (D and E) the fall was only about the same, 23 and 24 per cent. respectively, viz., D from 1,013 to 771 and E from 571 to 431; number of new cases only 21 and 10 respectively.

Army Area C.—The only group not showing any fall was the small group of four or five railway towns (C) south of the war areas (B). Their numbers in hospital had risen from 216 to 261 (17 per cent.); number of new cases 11. The total percentage fall for all army areas was 27 per cent.

Civilian Area F.—The fall in number of cases in hospitals had been from 2,403 to 1,715—a fall of 28 per cent., and number of new cases daily only 41.

April 27 to May 1.—Effect of Resumption of Railway Traffic.

Railway traffic was resumed and leave from army again permitted on April 16, and during the next week, as I learnt afterwards, the traffic of soldiers returning to their homes was very heavy. The effect was very strikingly shown on April 27 to May 1, exactly ten to twelve days later, and during the next ten days. The number of admissions in all hospitals which had steadily fallen since April 3 down to 228 cases (an average of 230 cases on April 22 to 26), suddenly rose to 611 cases on April 27, and to a daily average of 380 for the next five days (*h*). This was due to a sudden and definite rise in new cases in the war areas, B, C, D, from a daily average of 88 new cases on April 22 to 26 to an average of 205 for next five days; and in the civilian areas F from a daily average of 41 new cases on April 22 to 26 to an average of 120 for next five days (*see* Table, p. 62).

The whole sudden rise might have been due to periodicity of the disease, affecting all parts of Serbia. But if so, it was an extraordinary freak on the part of the disease to wake up once more all in one day.

Area A, First Army.—The area over which such a rise, if due to periodicity, might have been expected was area A, where the disease from the first had been virulent. I found, as a matter of fact, it was the only one where the sudden rise on April 27 to May 1 was absent. Its daily number of new cases April 22 to 26 had been 89, and this fell during the next five days to a daily average of 49 new cases. Periodicity

therefore could not explain the rise. The other possible factor was the passage of soldiers on leave on resumption of railway traffic from the first army area (A) southwards into the other areas; contracting infection during the two or three days of their railway journey to their various destinations in remote parts of Serbia.

Army Area B, Second, Third and Belgrade Armies.—The area immediately adjacent to this first army area (A) was that of the second and third and Belgrade armies in area B, the junction for the two areas being at Mladenovac, which we had selected as the seat of our quarantine and disinfecting station. This was the area most likely to be affected by such a transit of troops on leave. As a matter of fact such proved to be the case, and my first detection of this break through of infection from the first army area was made by me at the very moment (May 1) when it first manifested itself, and I immediately took measures to rectify it by observation of the conditions which I found there on my visit to Mladenovac on May 1, as fully described elsewhere (*vide* p. 119). As has been seen, the fall in the epidemic had been greatest in this area—the number of cases in the hospitals serving it having fallen from 2,789 on April 3 to 1,692 on April 26—a fall of 42 per cent.; and the daily number of new cases admitted on April 26 had been only 56 cases, or 280 in the preceding five days. The reinfection of this area was so definite that the number of new cases (as low as 56 on April 26) suddenly rose to 114 on April 27, and two days later to 417, altogether to a daily average of 151 or a total of 754 cases in the next five days (April 27 to May 1), exactly, be it noted, ten days from the resumption of railway traffic and passage of troops on leave (April 16 to 23). The average daily number of new cases admitted in the following six periods of five days (May 2 to 31) was 33, 98, 54, 60, 60.

The result was that during the next month the number of cases in the hospitals was maintained pretty much at the level obtaining on April 26, falling only from 1,692 cases to 1,437—a total fall of 47 per cent. since April 3, and only a further fall of 5 per cent. since April 26.

This increase of cases in this area after May 11 was due, however to other factors than mere increased incidence. For this area from middle of May became the seat of a great concentration and movement of troops from other areas and evacuation of field ambulance (*see* Chart p. 101) preparatory to advance being made by the armies once more restored to fighting strength. It was also partly due to the important strategic policy which we had laid down from the first, and which was

now being carried out—viz., of breaking the line of infection between the armies in the North and the civilian areas of Serbia, and of retaining as many fever cases as possible in this area B, and not allowing them to be transferred south to other areas. (*See* Chart, p. 46.)

The result finally was that while on April 3 when the epidemic was at its height, this area had 2,789 cases in its hospitals, or 34 per cent. of the total cases in hospital in Serbia; on May 31 it had 1,437 cases or 46 per cent. of the total cases. It was thus holding up 12 per cent. more of the total cases than before, and as will afterwards be seen 5 per cent. of this total 12 per cent.—nearly one half, was being held up in Mladenovac, the seat of our quarantine station. The re-infection also occurred in other war areas south of area B, viz., in the railway towns (C) in the Zeitjer army (D) and the Ujitze army (E).

Army Area C (Railway Towns).—These towns (Jagodina, Parachin, Tupria and Alexinatz) were the chief stations on the railway line south of army area B. The numbers of cases in hospitals were few—between April 3 and 25 they had risen from 216 to 260. The number of new cases on April 26 was eleven. On April 27 this number suddenly rose to 31 cases and for the next five days averaged 21 cases; and the next ten days 24 cases. During the following twenty days (up to May 31) it fell to an average of only 9 cases. The number of cases in hospitals, which had not fallen between April 3 and 26 (had actually risen 17 per cent.), now fell from their previous highest total of 260 on April 25 to 129 on May 31—a fall of 40 per cent.

Army Area D (Zeitjer Army).—This army lay to the east of the main line along the Bulgarian frontier. The number in its hospitals on April 3 had been 1,013 cases, and this had fallen to 771 cases on April 26—a fall of 23 per cent. The number of new cases on April 26 was 21 cases. On April 27 this suddenly rose to 43 cases; and in the following five days (April 7 to May 1) averaged 33 cases, and in the next ten days averaged 24 cases. In the following twenty days it fell to an average of 10 cases. The final result was a fall in the total cases in hospital from 1,013 on April 3 to 174 cases on May 31—a fall of 82 per cent.

Army Area E (Ujitze Army).—This army lay to the west of the main line close to the Bosnian frontier. The number of cases in the hospitals on April 3 was 571; and this had fallen on April 26 to 431 cases—a fall of 24 per cent. The number of new cases admitted on April 26 was 10 cases. No rise occurred here during the first five days (April 27 to May 1), the number of new cases averaging only 9; but a definite rise

occurred in the next five days (May 2 to 6), the daily average being 16 cases—the chief rise occurring on one day (May 4) when 40 cases were admitted. Allowing ten to twelve days for incubation this meant that infection had been contracted about April 25 to 27, i.e., in the second batch of men sent home on their ten days' leave, after resumption of railway traffic on April 16. Thereafter for the next twenty-five days the average daily number of cases admitted was only 5; but on one day (May 25) the number admitted was no fewer than 49 cases, pointing to contraction of infection about May 13. The total number of cases in hospital fell from 571 on April 3 to 187 on May 31—a total fall of 67 per cent.

Civilian Area F.—The rise that occurred here was the most definite and interesting of all. The area referred to extended from the level of Nish down to the south of Serbia. It included hospitals in twenty towns. The number of cases in these hospitals on April 3 was 2,403, and this had fallen to 1,715 cases on April 26, a fall of 28 per cent. The number of new cases on April 26 was only 41. On April 27 this number suddenly rose to no fewer than 327 cases, the number of cases in five days averaging 121. The next five days it averaged 50 cases, the next 61 cases, and the next twenty days it averaged 40 cases or about the same as it was five weeks before. This number of new cases scattered over so wide an area was very small, viz., about two cases a day in each town. The total number of cases in hospital fell from 2,403 on April 3 to 669 on May 31, a fall of 76 per cent. (*See* Chart, p. 97.)

Total Result.—The total result shown in all areas was a definite break through and spread of infection following the resumption of railway traffic on April 16 to 23, manifesting itself by an increase of new cases in nearly all areas ten to twelve days later, viz., on April 27 to May 6. This increase was most marked and earliest shown in Southern Serbia by an admission of no fewer than 327 cases on April 27, instead of a previous admission of 41 cases (punctually to the incubation period), and a total admission of 1,159 cases in the next fifteen days—an average of 77 cases daily instead of a previous and subsequent average of about 40 cases daily. It was also most marked and shown within twelve days' time in the second and third armies (area B) by an admission of 114 new cases on April 27 from an average of 56 cases on April 26, and a total admission of 1,409 cases in the next fifteen days—an average of 94 cases, instead of a previous daily admission of 56 cases, and subsequent average of about 68 cases daily.

Effect of Resumption of Traffic.

The effect of resumption on April 16 was thus marked and sudden, for it was followed by a sharp recurrence. The most interesting points revealed by this recurrence in the case of typhus were the following (Charts, pp. 66, 96, 97).

(1) The persistence of infection in army area A up to that date. The fall in number of typhus cases in hospitals since April 3 had been only 4 per cent., whereas in the adjacent army area B the fall had been no less than 42 per cent. It was this area A that was intended to be and was very successfully cut off from all Serbia by the suspension of railway traffic on March 16.

(2) After the resumption of railway traffic and grant of leave to the troops, the traffic from this remote area A was very great. Fresh infection was thereby conveyed and contracted, and exactly twelve days later (April 27) this was shown by a very sharp sudden rise in number of admissions into hospitals—viz., from a daily average of 230 cases in the previous five days to 611 cases on April 27, and 370 on May 30 —or a total of 1,919 cases for the five days, as compared with 1,151 in the preceding five days. The greater number of these new cases were in civilian Serbia (Chart, p. 97). The outbreak here was quite sharp. The admissions, which had been as low as 41 cases daily, rose suddenly on April 27 to 327 cases, and averaged 150 daily during the next five days—a total of 600 cases. They fell the following five days to 254.

A second recrudescence occurred ten to twelve days later (May 7 to 11), but on this occasion the increase of cases was mostly in the army areas. The explanation of this, as I interpret it, was the following: In the case of men going on leave from the army areas (e.g., A and B) on April 16 to 20 in the north to distant parts of Serbia (e.g., Uskub), the increase of cases if infection were contracted during this journey would be chiefly in the civilian areas most remote. Allowing for an incubation period of twelve days, their illness would fall due about April 27 to May 1. This is exactly what happened. An increase occurred in all army areas at this period (except area A—which was the chief seat of the disease, and the area of the first army, from which most of those on leave were travelling), and it commenced exactly on April 27—i.e., twelve days later, and most of all in the civilian areas (*see* Table, p. 62). In the case of men returning on leave from their homes on the expiration of their ten days' leave (April 26 to 30) the increase of cases, if infection were contracted on their journey, would be chiefly in the

hospitals of the army areas, and this illness would fall due May 7 to 11. This is exactly what happened.

TABLE V.

(A) Effect of Resumption of Traffic on Typhus Admissions (see Table, p. 62; Charts, pp. 66-96).

(a) First Recrudescence.

		Army areas		Civilian		Total
April 26	... ...	187	...	41	...	228
April 27	... ...	284	...	327	...	611
April 28	... ...	195	...	39	...	234
April 29	... ...	137	...	107	...	244
April 30	... ...	522	...	48	...	570
May 1	... ...	181	...	79	...	260
	Total	1,319	...	600	...	1,919
	Average	264	...	120	...	384
	(b)					
May 2 to 6	Average	151	...	50	...	201

(c) Second Recrudescence.

May 7	... ...	70	...	42	...	112
May 8	... ...	340	...	28	...	368
May 9	... ...	285	...	58	...	343
May 10	... ...	173	...	48	...	221
May 11	... ...	74	...	153	...	227
	Total	942	...	329	...	1,271
	Average	188	...	66	...	254

(B) Effect on Relapsing Fever Admissions (see Table, p. 64; Chart, p. 67).

The effect was equally marked. The number of admissions on April 26 in all areas had been only 89 cases—viz., 39 in the army areas and 50 in the civilian. On April 27 the total numbers suddenly rose to 304—viz., 176 in the army areas and 128 in the civilian areas. The chief seat of this rise was army area A—viz., 150 cases, and civilian areas F with 128 cases.

SECTION X. — THE RECRUDESCENCE OF INFECTION ON APRIL 27, TWELVE DAYS AFTER RESUMPTION OF RAILWAY TRAFFIC ON APRIL 16.

I had left my headquarters at Kragujevatz on April 26, and was absent between that period to May 2 on visits to Nish, to our inoculating train near Belgrade and our disinfecting station at Mladenovac. At the time I left on April 26 the number of admissions was steadily

falling, viz., down to 228 cases of typhus and 89 cases of relapsing for the whole of Serbia—a most satisfactory state of matters.

During my visit to Mladenovac on May 1, I observed conditions that were extremely unsatisfactory. This was the junction station for the Valyevo line (army area A). The conditions referred to were that large numbers of peasants and refugees were congregated for hours in and around the station waiting for trains; my officers reported that they were very verminous, and that no official arrangements existed for getting them up to our disinfecting station. I took immediate action to remedy these conditions as described in the following. I returned at once to Kragujevatz in the following day to represent to G.H.Q. the extreme importance of carrying out the recommendations I made—for the whole conditions I had observed seemed to me to point to the possibility that infection might once more break through from the Valyevo area (A) into the war area (B) and thence to the southern civilian area—precisely as it had originally done.

The conditions presented to me were an exact duplicate of those seen on my first day of travel north to Kragujevatz on March 8, four days after our arrival in Serbia, viz., soldiers and peasants waiting for hours at railway stations, spending hours in crowded railway carriages, with all the possibilities of conveying infection thereby entailed, and of a possible recrudescence of infection. I did not know at this time (May 1) that any recrudescence had occurred, for everything had been going on right on April 26 when I started on my tour.

On my return to G.H.Q., on May 2, I reported to the chief of the sanitary department what I had seen, and I sent him a report on the subject, on which he took immediate action by telegram, and subsequently by various orders. I then examined the returns for the period April 27 to May 3, during which I had been away, with most informing results. I found that during my week's absence, the fall in number of cases in hospital, which had been going on steadily since April 3 had stopped exactly on April 26, and there had occurred a definite rise April 27 to May 3. The total number of admissions—which had been 228 on April 26, had risen to 611 on April 27, followed by 553 cases on April 30. This increase was specially shown in Belgrade and Mladenovac.

In a further report (communication B of May 7) I submitted to Headquarters the data on this point, showing how infection had once more broken through from army area A into the adjacent army area B, causing increase of cases in that area, specially shown by the increased hospital admissions in Belgrade, Mladenovac and Pojarevatz.

TABLE.—TYPHUS.

Number of Admissions into Hospitals on April 26 and 27 in Different Areas in Serbia, showing Increase of Cases on April 27 to May 3, exactly Twelve Days after Resumption of Railway Traffic on April 16. (Charts, pp. 66, 96; Table, p. 62.)

	April					May		
	26	27	28	29	30	1	2	3
Army area A ...	89	89	38	32	34	36	15	48
,, ,, B ...	56	114	104	59	417	60	24	72
,, ,, C ...	11	31	15	19	18	20	24	30
,, ,, D ...	21	43	39	15	20	60	35	23
,, ,, E ...	10	7	9	12	13	5	18	5
	187	284	195	137	522	181	137	178
Civilian area F ...	41	327	39	107	31	79	55	81
Total ...	228	611	224	244	553	260	192	259

Daily average of admission, April 20 to 26, 235.
,, ,, ,, 27 to May 1, 384.

TABLE.—RELAPSING. (Chart, p. 67; Table, p. 64.)

	April					May		
	26	27	28	29	30	1	2	3
Army area A ...	0	150	30	34	31	25	42	28
,, ,, B ...	10	6	11	47	79	51	4	23
,, ,, C ...	3	20	5	6	2	18	7	26
,, ,, D ...	15	0	12	1	1	0	18	9
,, ,, E ...	14	0	0	4	1	2	1	4
	42	176	58	92	114	96	72	90
Civilian area F ...	47	128	68	41	117	49	72	63
Total ...	89	304	126	133	231	145	144	153

These figures showed (*see* Chart, p. 66) that army area A (Valyevo) was still the seat of the greatest infection of typhus on April 26, viz., 89 admissions, but no increase of typhus cases had there occurred either on April 27 or during the following seven days. The increase was therefore not due to some natural periodic rise. On the other hand the increase was definite in army area B, viz., from 56 admissions on April 26 to 114 on April 27 and 417 on April 30. There was, however, a very marked increase of relapsing in area A, viz., from none on April 26 to 150 on April 27, suggesting that it had been reintroduced into that area by peasants and refugees returning to the Valyevo area (A).

There was the possibility that the increased admissions of typhus into hospitals in area B might be due to evacuations from the field ambulances of the three armies in this area. The data as to the numbers of cases in these field ambulances I had at this time not been

able to obtain, but they were furnished me shortly before I left Serbia (Chart, p. 98). I found on analysing them (Table, p. 99; Charts, pp. 98-101) that no special evacuations of field ambulances had occurred at the period referred to (April 27 to May 1). On the contrary the numbers of cases in the field ambulances had increased at the same period as the numbers in the hospitals (*see* Chart, p. 98).

Any doubt as to the significance of the increase was dispelled by the figures which I found at that period for civilian areas (F)—viz., from Nish to Uskub. There, no field ambulances existed. At the period referred to, the number of admissions of typhus in these areas (F) had fallen on April 26 to as low as 41 cases. On April 27 it rose suddenly to 327, and during the five days April 27 to May 1 it averaged 120 cases (*see* Table, p. 62; Chart, p. 66). The number of cases of admissions of relapsing on April 26 had been 50. It rose on April 27 to 128, and during the following five days averaged 80 cases (Chart, p. 67).

The area which for purposes of my work I have here designated "Civilian areas F" extended from a little north of Nish to the southern Serbian frontier. It comprised some twenty-two towns with hospitals, and over two-thirds of all Serbia.

The Object and Effect of Mladenovac Disinfecting Station.

These were the conditions found as stated on my official visit to Mladenovac on May 1. As the result of resumption of railway traffic, infection had once more broken through from the army area A into other army areas, and also most of all into the civilian areas as already described. The break through was not an incident confined to the adjacent army area B, but definitely extended south into the civilian area F as already shown (Table, p. 62). Lastly, most interesting of all, the further the distance from the army area, the greater was the increase of cases admitted (*see* Map, p. 31).

The civilian area included as its chief towns, Nish in the middle, and Uskub, Monastir and seventeen other towns in southern Serbia. As already stated, the total number of admissions of typhus fever in the whole civilian area (F) on April 26 was 41 cases. This number rose suddenly on April 27 to 327 cases. On April 26, the admissions of relapsing fever in civilian areas had been 50. On April 27 they rose

to 128. This rise, it is to be noted, was much higher, actually and still more proportionately than any increase that had occurred in the war areas adjacent to war area A and to each other.

In other words, the further the distance from the war area, the greater the increase of typhus cases had been. The interpretation appeared to be that the longer the journey involved to soldiers on leave returning to their homes (and the journey from the war areas in the north to Uskub and other places in the south, involved at this period, with stoppages at junctions, at least two or three days or even more in the train) the greater the number of cases contracting the disease and admitted into hospital, twelve to fourteen days later.

The resumption of railway traffic and grant of leave to troops commenced on April 26. The rush of troops for home was great. For the following week, the traffic, as I was informed later by the chief military transport officer, was very great. The trains were crowded, affording all the conditions favourable to infection by contact with each other in crowded carriages. Assuming infection to have been contracted at this time (April 16 to 20) and allowing for an incubation period of twelve days as an average, the cases contracting infection would develop the disease about April 27 to May 1.

The above data show that on the 27th the admissions of typhus rose from 228 to 611 cases, and April 30 to 553 cases; those of relapsing from 89 cases to 304 cases. The daily average admissions of typhus for the five days April 22 to 26 was 230. It rose the following five days to 338 cases. The leave granted was for ten days. The men who left for home between April 16 and 20 were therefore due to journey back to their units approximately about April 26 to May 1. Assuming possibilities of infection being contracted by travelling back to the army areas, and allowing for an incubation period of twelve days, cases infected would develop the disease about May 8 to 14. The figures in Table, p. 62, show that on May 8 to 19 the admissions of typhus into the army areas were 340 and 285 cases. Moreover, most interesting of all on the 9th, no fewer than 162 cases were admitted in area A—the area in which in the preceding twelve days the admissions had been very low.

DIARY RELATING TO AND FOLLOWING VISIT TO MLADENOVAC, MAY 1 TO 10.

April 25 *and* 26.—In Nish, connected with the formation of a Board of Health for Serbia.

April 27.—Nish. Telegram to War Office: "Rapid improvement continues. During past two weeks there has been a fall of 6,186 cases in hospital of the three chief fevers, viz., a fall of 25 per cent. in typhus, 48 per cent. in relapsing and 35 per cent. in enteric."

April 28.—6.30 a.m.: Arrived in Kragujevatz. Found second consignment of cholera vaccines and Malta food stores, 139 cases and seven sacks. Arrangements for taking them that night to Kievo where there were fifteen officers (the train), and Mladenovac where there were three officers. Requisitions received from train for vaccines, food stores, iodine (20 lb.), alcohol (80 pints), spirit stoves (8), boiling vessels (16), needles most urgent to fit 5 c.c. glass syringes required by May 8. No alcohol was obtainable from any shop in Kragujevatz. I obtained some from Arsenal and had the rest commandeered by Serbian officer from a chemist who said he had none. 12 midnight, left for Kievo.

April 29.—Arrived at train, Kievo, at 12.30 p.m.

April 30.—9 a.m.: Visit to Belgrade. 5 p.m.: Returned to train at Kievo.

May 1.—7.30 a.m.: Left for Mladenovac. 11 a.m.: Arrived. 11.30 a.m.: Visited quarantine and disinfecting station with Lieutenants Clements, Cameron and Wall. 1 p.m.: Lunch. 2 p.m.: Called on railway director. 3.30 p.m.: Visited lower camp. 5 p.m.: Interviewed police director. Gave order for area in front of station to be cleaned up. 7 p.m.: Dinner with officers and Colonel Boro-Savlwitch and Colonel Nicholaievitch, with whom afterwards two and a half hours' close conversation.

May 2.—7 a.m.: Visited area in front of station. Found fifty men at work since 4 a.m., and ground levelled, cleaned up and limed. 10.30 a.m.: Saw police director and railway director and station master and thanked and congratulated them on work done. 11 a.m.: Left for Kragujevatz. 6 p.m.: Arrived at Kragujevatz.

May 3.—Report to Sanitary G.H.Q. regarding Mladenovac (communication A). Three interviews that day with chief of sanitary department. Statistics obtained regarding epidemic.

May 4.—Further interviews *re* Mladenovac. Arrangements with architect *re* receiving-room at First Reserve Fever Hospital. Visited Sixth Reserve Fever Hospital.

May 5.—8 a.m.: Inoculation of 670 men. 9 a.m.: Letter to Health Committee, enclosing my plan of receiving-room for First Reserve Hospital. 10-12: Visit to Mrs. Stobart *re* her plan for roadside dispensaries. 2 p.m.: Arrangements made for inoculation of 10,000 troops at Lapovo to commence on May 11. 5 p.m.: Twelve bottles of cholera vaccine given to Colonel Michailovitch. 9 p.m. to 1.30 a.m.: Worked at statistics *re* Mladenovac (communication B, of May 7, showing increase of fever cases, April 27 to May 1, after the resumption of railway traffic on April 16).

May 6.—8 a.m.: Inoculations. 9.30 a.m.: Visit to Stobart Mission *re* plans of roadside dispensary further considered and settled. Telegram sent off to Serbian Relief Fund *re* above. 11.30 a.m.: Telegram to War Office. Further work at statistics relating to Mladenovac.

May 7.—9 a.m.: Communication B sent in *re* spread of infection through Mladenovac. 9.30 a.m.: Visit from Dr. Elsie Inglis just arrived. 10 a.m.: Visit from Mrs. Stobart's doctors. 10.30 a.m.: Letter to Lieutenant-Colonel Stammers on train. 12 noon: Major Antitch (director) called *re* plan for receiving-room First Reserve Hospital. 4 p.m.: Letter to War Office. 5 p.m.: Visit with Major Antitch to Stobart Mission.

May 8.—Statistics relating to Mladenovac and in Serbia (April 27 to May 3). Letter from G.H.Q. ordering that all troops be detained at Mladenovac for twenty-four hours for disinfection, as I had requested in communication A of May 3.

May 9 (*Sunday*).—Statistics.

May 10.—Inoculations in Kragujevatz finished; total 7,229. Arrangements made for four officers to go to Lapovo to-morrow (Tuesday) to inoculate 3,000 troops, also on Wednesday and Friday. Arrangements also made for two officers to go to Pojarevatz to-morrow, south of the Danube, to inoculate about 16,000.

The above decision, taken by G.H.Q. on May 8, in response to my request on May 3, was the most important one that had been taken in connexion with the disinfecting station. Up to that time no definite official orders as to troops passing through Mladenovac being disinfected. The work of the disinfecting station had been limited owing to difficulties in getting people up to the station. This order altered the whole state of matters. The number dealt with each day rose from about 20 to as many as 1,700 in a day and averaged about 800 daily. The disinfecting station was in full action from May 9 onwards.

Section XI.—Arrangements made to Check the Spread.

These were connected with our cleansing station at Mladenovac, and are described in the following communication sent in by me, and received during the period May 3 to June 4, 1915.

Recommendations for Improved Working Arrangements at Mladenovac.

(II) *Quarantine and Disinfection Station at Mladenovac.*

I visited Mladenovac and closely inspected the arrangements and conditions there, and I am of opinion that the work to be done there is of the utmost importance for the health of the armies.

Conditions.—I found the conditions around the station extremely bad, large numbers of refugees and soldiers lying on the ground for many hours daily just outside the station and the whole area of ground close by made extremely dirty and offensive by 250 prisoners who occupy the station sheds a few yards from the station, and my officers reported that the whole of the refugees were in an extremely dirty and verminous condition.

I consider that the return of these people, convalescents and soldiers to the army is a real source of danger to the troops, and that unless the strictest measures be taken to disinfect them before they go through there will certainly be a recrudescence of infection among the troops.

Recommendations.—I therefore recommend as follows, and Colonel Bori-Savlyevitch and the other chiefs of departments there (police, station and railway directors) are in thorough agreement with the recommendations.

(1) That all troops and refugees returning to the front through Mladenovac shall be detained there for twenty-four hours to allow of their inspection and disinfection by my officers at the disinfecting station. (Ordered by G.H.Q., May 6.)

(2) That immediately on arrival of trains, the troops should be marched up under the charge of responsible officers to the disinfecting station, be bathed (in magazine No. 1) and have their clothes disinfected; and that all refugees be taken up to the same camp, and be similarly treated (in magazine 2). (Ordered by G.H.Q., May 6 and officer appointed May 13.)

(3) That no troops or refugees be allowed to return to the neighbourhood of the station till room can be found for them in the trains. (Ordered May 6.)

(4) That wood be provided at once (the disinfecting station was without any wood yesterday) in large quantity to allow disinfection to be carried out from 4 a.m. every morning and for the whole day, by our two large disinfectors and twenty-five barrel disinfectors. (Wood supplied.)

(5) *That all prisoners be forthwith removed* from the sheds close to the station and be lodged elsewhere—the sick in the hospital, the healthy in some place (or in the open fields) above the town away from other people, and that the sheds be thoroughly cleaned out and disinfected under the immediate supervision of my officers, and be reserved as shelters, or waiting rooms. (Ordered by telegram by G.H.Q., May 3.)

(6) That the whole land around the station (now extensively befouled, and with an open sewage ditch running through its middle) be levelled, covered in with fresh earth, and kept thoroughly clean with lime. (At my request the Police Director effected a most striking change between 6 p.m. on the day of my arrival and 10 a.m. the next day), the drain cleaned out, and all refuse of every kind removed or buried. (Commenced at once, May 1, and carried out in a week.)

(7) *Mladenovac from its situation and importance to the health of the field armies should be made the cleanest and best ordered station in Serbia,* and my officers will be only too glad to make it such if they can carry out what I desire. To facilitate their work I have asked for the loan of three tents from

Sir Ralph Paget (pending the arrival of the 150 store tents sent out from England and now in Salonica), and we can then carry out our disinfection work close to the water pumps, as well as in the magazines, and thus save much time (in carrying water up to the magazines).

(8) After their return to their commands I recommend that every company of troops (250 men) should have a barrel disinfector at their disposal, and that disinfection be carried out in a systematic way daily of all soldiers' clothing and bedding.

Lieutenant (Major) Clements, who is in charge, is a sanitary officer with the largest experience, and if he is given a free hand I know no one who is better fitted to carry out what I consider to be a very urgent and very important piece of work for the health of the armies.

On my return to Kragujevatz on May 3 I immediately called at Sanitary H.Q. and reported the result of my visit to the Chief of the Department, who took immediate action by the following telegram :—

To Serbian Authorities in Mladenovac.

May 3, 1915.

The Chief of the English Military Mission, Colonel Hunter, states that the prisoners who work at the station are very badly accommodated in the railway sheds; there are sick cases amongst them and cases of death; that the prisoners mix with the people and with our soldiers. Inform us at once why they are not sent into hospitals, and why the prisoners cannot be sent elsewhere in order that the sheds can be thoroughly disinfected.

At the time I visited Mladenovac on May 1 and made the observations and recommendations with a view to prevent spread of infection, I had been away from my headquarters in Kragujevatz since April 26, and did not know that any infection had recurred. The figures when I left on April 26 were extremely satisfactory: typhus admissions reduced to 228 daily, relapsing fever to 89 daily. On my return on May 3, I found the returns of the previous seven days awaiting me, and I immediately examined them and found that my fears of further spread of infection were well grounded—typhus admissions on April 27 increased to 611 cases; relapsing cases, 1,304. I therefore wrote at once to G.H.Q. as follows, under date May 6 :—

COMMUNICATION B.—THE IMPORTANCE OF MLADENOVAC.

Kragujevatz, May 6, 1915.

(1) In my letter to you yesterday regarding the conditions at Mladenovac, I expressed my fear that unless the strictest measures of disinfection were

taken, there was grave risk of infection being conveyed from the Valyevo area, and also from the south into the Belgrade Army areas.

(2) I now beg to report for your information the following figures drawn from the official daily statistics for the week ending April 27 to May 3. (Average daily figures of cases in hospitals: Total number of new cases admitted in the following centres.) (*See* p. 114.)

(3) The foregoing figures (relating to Valyevo, Belgrade, Mladenovac) show that there has been a striking increase of typhus in Mladenovac and Belgrade—the number of admissions in Mladenovac in one week being no fewer than 92 (raising the number in hospital from 38 to 89), and the number of new cases in Belgrade being 108, rising daily, from 9 on April 27, to 28 on May 3.

(4) This increase is without doubt connected with (*a*) the resumption of railway traffic on April 15; (*b*) the passage of refugees and troops on leave through Mladenovac into the Belgrade area—either from the deeply infected Valyevo area or from the South. Since the whole epidemic originally came from that area it is quite possible that it may again be spread from that area—as indeed it has already begun to spread.

(5) In view of these facts, the question arises whether it would not be the wisest and best precaution to stop all passenger traffic of peasants and refugees from the Valyevo area for another period of a month—or during the important period when troops are returning to the Belgrade area. This would cut off at its source the chief supply of infection. I therefore have the honour to recommend this to your consideration. It would greatly simplify the problem of disinfecting all the troops (passing through Mladenovac—either from Valyevo or from the South) during a temporary stay of twenty-four hours in Mladenovac.

(6) It would help most materially if a young Serbian officer could be appointed at Mladenovac to meet all trains of returning soldiers, and carry out the arrangements (described in my previous letter of May 3) connected with their stay, and departure after being disinfected.

Immediate steps were once more taken, as shown in the following reply of May 5, followed by that of May 8:—

Kragujevatz, May 7.

I am in receipt of your letters of May 3 and 7, and thank you for your information about work of your officers in inoculation of troops.

I shall soon also inform you about all orders, which were upon your proposal given to the quarantine station at Mladenovac.

The barrel disinfectors are being prepared in the arsenal—and one portion of them has already been received by Dr. Kopsha for his sanitary train.

May 8, 1915.

I have duly received your letter of May 6 *re* quarantine station in Mladenovac, and have referred the same to Chief of the Headquarters Staff (Colonel Pavlovitch), who has, in consequence, ordered: "That all men

returning from leave or as convalescents be retained at Mladenovac for twenty-four hours to have their clothes disinfected."

I also beg to request you, for information, what has hitherto been done in Mladenovac with regard to the creation of quarantine station, and thus enable me to order anything else wanted.

The order here given was a strong and most important one, exactly meeting the needs of the case. It was important that a young Serbian officer should be appointed as an M.T.O. to direct the movements of troops, and I therefore wrote again (May 9), with following result :—

May 13 (Thursday).

I beg to inform you that by order of Staff of Headquarters dated May 12, it has been decided that Second Lieutenant Milan Provoulovitch be placed at the disposal of the Chief of the British Military Division in order to direct soldiers, and taking care of them at the quarantine station at Mladenovac. Order has been given that this officer be deputed to the City Commander at Mladenovac.

The effect of these developments was immediately shown in the Report asked for and received on May 11 from the O.C. in charge of the station, Captain Clements.

Mladenovac, May 11, 1915.

Sir,—I have the honour to present the following report on the disinfecting and cleaning station established at Mladenovac.

You will remember that it was originally intended to use this place as a true quarantine station for troops returning from leave or after convalescence from illness, detaining them fourteen days after disinfecting and cleansing them. Owing to the large numbers, it was found impossible to deal with all troops in this way, and our plans had to be modified. We now attempt to disinfect and clean all soldiers passing through the railway station, and allow them to proceed forward to their commands on the same day.

The site selected for the disinfecting and cleansing station is within easy distance of the railway station; two large magazines capable of holding 700 or 800 men have been placed at our disposal. These were at first intended to be used as sleeping accommodation for those in quarantine, and will at any time be available for this purpose should a body of troops require to be placed in quarantine; but at present they are used as quarters for the staff, and as waiting, bathing and dressing rooms for those undergoing disinfection.

Some difficulty was experienced in getting a supply of water. This has been overcome, and there is now an abundant supply from the two artesian wells situate about 700 yards from the magazines. The carrying of water by buckets is laborious, and is a cause of delay, but as soon as the tents

arrive, which you have secured for us, we will be able to carry out the bathing and disinfection close to the wells, as originally intended.

A staff of eighteen men arrived on April 14, and were occupied for some days in cleaning and whitewashing the magazines, removing a large manure heap, and in surface draining the ground, preparing soakage pits, latrines, &c.

On April 20 the equipment supplied by the Serbian Government, such as baths, towels, &c., were received, and on the same day our own stores were removed from the railway station, and all were arranged in the magazines. On April 22 the station staff were disinfected and cleaned, and from that date the station was ready for the purpose for which it was designed.

Refugees.—For a period of ten or twelve days there were large numbers of refugees passing through Mladenovac towards Belgrade and the Danube; the condition of these people appeared to me to be a danger to the health of those places to which they were returning, and I therefore approached the Commissioner of Police with a view to having them disinfected. At the same time I heard from Colonel Borisavlevitch, who was anxious that something should be done for them, and suggested using some empty sheds adjacent to the railway. I prepared a scheme for dealing with these people, and while this was under consideration the men and children were removed to the magazines and disinfected. During the last week there have been no refugees detained at Mladenovac, and should they come here again it will be easy to deal with large numbers of them with the assistance of our railway disinfecting wagons. In presenting the above scheme for disinfecting refugees, I requested the Commissioner of Police to clean out the open sewer which runs near to the railway station, and also to remove certain latrines used by Austrian prisoners, which were offensive to public decency and most insanitary. The adjoining ground was much fouled with human excreta, and it was requested that this should be removed. Part of this work was commenced by the Commissioner of Police, who has at all times afforded us every assistance, but there was some dispute as to the authority responsible for cleaning these places, and it was not until you, Sir, arrived here on May 1 and made additional and urgent representations that these matters were put right. During your visit you instructed me to see that the Austrian prisoners were disinfected and their sleeping quarters cleaned, and that they should be removed to new quarters away from the railway station.

On May 6 all the Austrian prisoners occupying sheds near to the railway station were disinfected and cleaned, their quarters were thoroughly cleaned, disinfected and whitewashed, all old straw and material that could be burned was dealt with in this way and fresh straw, &c., provided. About thirty prisoners who were ill or so weak as to be unfit for work were transferred to Nish, and the military commandant of the station now informs me that he has made arrangements for the remaining prisoners to be removed to quarters in a more open and less frequented place.

Wood Supply.—Several days' delay has been caused through the want of wood. A good supply of wood is essential, and without it disinfection cannot

be done. Orders have now been issued from headquarters to the local command to supply us with wood, and I do not anticipate any trouble from this cause.

Arrangements for Stopping Troops and Removal to Quarantine Station.—Satisfactory arrangements have, after some delay, been made for the removal of troops passing through Mladenovac to the cleansing station. All troops now proceed from the railway station to the City Commandant's office, from which place they are sent in charge of policemen to the cleansing station. They are all inspected by a medical officer, and if any are found suffering from fever they are transferred to the military field hospital, while those found with physical defects likely to interfere with active service are instructed to report themselves to the medical officer on arrival at their commands; a note is also made on their passports as to the condition found. After disinfection they return to the railway station and proceed forward by the next train available. Occasionally when large numbers arrive late in the afternoon, it is necesssary to detain some of them over night, and sleeping arrangements have been provided for these.

Recruits.—The City Commandant informs me that 15,000 recruits will pass here during the next eight to ten days; such large numbers will probably be more than the disinfecting station under present conditions could deal with. If the tents which have gone by mistake to Belgrade could possibly be obtained before these recruits commence to pass through it would enable us to deal with them more expeditiously. I would recommend that a special messenger be sent to Belgrade to inquire about the tents, as no reply has been sent to my telegrams.

Additional Equipment Required.—(1) The tents already mentioned; (2) three additional boilers for hot water; (3) overalls for the men. (Those engaged in haircutting and handling dirty clothes have on several occasions been infected with lice and fleas, and had to get disinfected again); (4) a heater for supplying steam to the disinfecting wagon now at the railway station. The station authorities cannot spare one of their engines to generate steam. I have this morning telegraphed to the Chief of the Military Railway Inspection Department, Yagodina, and asked for a heater. I am waiting for a reply.

When our equipment is complete and the staff get familiar with the routine of the work, I estimate that we could disinfect from 800 to 1,000 troops a day.

Communication C.—Base Mission Hospital Proposed.

There still remained, however, the necessity of providing increased hospital accommodation at Mladenovac, especially for fever cases; and therefore in forwarding the preceding report I submitted the following proposals on May 17, 1915, and again on May 20 and 25.

I have the honour to submit for your information the report received

from my officer, Lieutenant Clements, who is in charge of the quarantine station at Mladenovac.

(1) The information he gives fully confirms the opinion I have expressed in my letters to you, regarding the importance of this station, in relation not only to the spread of infection northwards among the troops, but also to its conveyance and spread southwards (from Valyevo and adjacent areas) to the civil population.

(2) I heard from Lieutenant Clements by telephone last night that since he sent in his report on May 11 the number of cases (up to that date 1,053) which he had been able to deal with in the previous fortnight has risen to over 6,000 in the last six days—the highest number dealt with in one day being no fewer than 1,700.

(3) He informs me that the need for further and better hospital accommodation is very urgent, as some of the troops have medical and surgical complaints for which a temporary detention is necessary.

(4) I am of opinion that an *additional hospital* there—preferably a tent one—with a *mission attached* could render a great service not only to Mladenovac, but also to the cause of the general health of the army. To enable Lieutenant Clements to carry out disinfection as rapidly as possible I ordered the new wagon disinfector with heater to be sent to him from our sanitary train, and they were duly sent. But he informs me that they have not arrived, but have gone astray somewhere on the railway.

(5) I also learn that the three tents brought down to the station at Skople by my orderly, Sergeant King, whom I specially sent to Skople to see them packed the week before last, have not yet reached Mladenovac, and are reported to be still at Skople. I should be greatly obliged if they could be sent to Mladenovac, where they are urgently needed.

COMMUNICATION D.—*Re* ESTABLISHMENT OF A BASE MISSION HOSPITAL AT MLADENOVAC.

May 20, 1915.

(1) I have the honour to submit for your information a chart which I have prepared showing the number and distribution of cases of typhus at the present date (May 17) in the Northern, Middle, and Southern areas of Serbia; and, in comparison therewith, their number and distribution in the same areas on April 3, when the epidemic was at its height. The chart shows in a graphic way the great improvement that has taken place in the last six weeks: an improvement that commenced ten to twelve days after the railway traffic was suspended, on March 16, and leave from the army stopped.

(2) I understand that all field hospitals have recently been emptied, and the patients sent back to the rear in view of probable contingencies; and the chart shows in a striking way the increasing importance of Mladenovac as a hospital, as the result of this change. The number of typhus cases in

Mladenovac has increased from 71 to 330. In relation to the troops in the Belgrade area, Mladenovac has thus largely taken the place as an important hospital centre, formerly taken by Palanka (the number of cases of typhus in which has fallen from 402 to its present number of 110). (Chart A, p. 46.)

(3) From its position on the railway line at the junction of the Belgrade and Valyevo line, Mladenovac is a station of exceptional importance; and if a good hospital—preferably a tent one—could be established there in charge of an English mission, it would be possible in conjunction with the necessary work of disinfection carried out by the military mission under my charge, to control the whole spread of disease from Valyevo and Belgrade areas. (I think the choice of Pojarevatz, as the seat of work of the new unit of the Scottish Women's mission (under Dr. Alice Hutchison), an exceedingly good one.)

(4) I hear from Dr. Inglis, of the Scottish Women's Hospitals, that she has another tent hospital on the way. If this were established at Mladenovac in charge of her mission it would, in my judgement, render the greatest possible help, and prove of greatest value in checking the spread of infection from the army area southwards.

(5) I have the honour to strongly recommend this for your consideration and acceptance. Mladenovac would then be made the most important quarantine and disinfecting station in Serbia. It would be supplied with:—

(*a*) A well-equipped disinfection station (now in full action), with two large disinfectors, twenty-five barrel disinfectors, and one or two railway van disinfectors, under the immediate charge of English officers.

(*b*) Its existing hospital in one of the magazines for medical and surgical cases (non-infectious) requiring temporary detention.

(*c*) A tent fever hospital under the charge of an English nursing mission.

Kragujevatz, May 25.

Re Mladenovac Quarantine Station.

With reference to my report thereon, and the need for new hospital accommodation, preferably a tent hospital, under the charge of a mission, and my suggestion to you that Dr. Elsie Inglis of the Scottish hospital be asked, as I know she is anxious to undertake this important duty. I beg to inform you that I have instructed Captain Clements at Mladenovac to furnish me with a report on the hospital there.

The official figures as to the number of typhus patients arriving in Mladenovac during the past three weeks show the great importance of establishing a great base hospital for fever cases in that place. I find that the number of new cases arriving in hospital there, during the three weeks April 27 to May 17, has been no fewer than 486, while the number discharged in the same period was 165. No fewer than twenty-four cases arrived on one day, May 8, followed by daily groups of thirteen to forty-five cases in the following week; the number in hospital was no fewer than 332.

On May 18, 157 were discharged, or evacuated by train elsewhere—e.g., the

number admitted into Kragujevatz that day increased by about 100. The transference of typhus cases by train from one place to another must always tend to spread the disease. This could be altogether avoided, if, as already suggested, a great base hospital, for fever cases coming from the army areas, were established at Mladenovac. I have the honour to strongly recommend this to be done, as a matter of great necessity and urgency, not only in relation to the spread of typhus now, but also to the spread of cholera should any outbreak occur during the coming summer.

COMMUNICATION E.—MEMORANDUM ON FINAL ARRANGEMENTS IN MLADENOVAC DISINFECTION STATION.

From Captain Clements. Mladenovac, May 30, 1915.

Hospital Accommodation.

Sir,—Following your instructions, I have the honour to submit a report on the hospital accommodation in (*a*) Arangelovatz, (*b*) Mladenovac.

(*a*) Arangelovatz is a town of about 2,000 inhabitants, situated on the Mladenovac-Valievo railway, and distant about three hours by rail from the former. In the summer months it is a popular health resort; the splendid water, of which there is an unlimited supply, attracting many on account of its supposed medicinal properties. The hotels and houses are clean and attractive looking, the surrounding country is well wooded, and there are numerous paths through the woods provided with seats which render it a desirable place for convalescent patients.

At present there is only one hospital in the town, called the Arangelovatz Reserve Hospital. This comprises a medical and surgical hospital of 460 beds housed in a large hotel which lends itself admirably for hospital purposes, and a short distance away a fever department of 120 beds also housed in a small hotel. Both hospitals appear to be extremely well managed, the wards are well lighted, well ventilated, and every place connected with the hospitals is scrupulously clean. The arrangements for the admission and discharge of patients are also excellent, every precaution being taken to ensure the destruction of vermin and to thoroughly disinfect all garments and infected material.

At the time of my visit there were 300 empty beds in the general hospital, but the staff are ready at any moment to deal with large numbers of wounded or other cases. The staff comprises four doctors, three qualified dispensers, sixty nursing orderlies, and an adequate general staff for cleaning, cooking and laundry purposes, all of which are carried out on the premises.

The epidemic of typhus, which was particularly bad in the area supplying this hospital, is now said to be over. In the fever hospital there are at present only fifty "fever" cases, all in the convalescent stage. When the epidemic was at its height all the available beds, surgical and medical, were devoted to "fevers."

I made a careful inspection of every part of the general and fever hospital, and without going into details, I can say that it is the best administered hospital I have visited in Serbia. The major in charge does not think that further hospital provision is required at present, and this appears to be borne out by the fact that there are a large number of empty beds available. However, the character of the town and its surroundings make it eminently suitable for convalescent or other hospitals, and its proximity to the railway makes transport an easy matter.

(*b*) Mladenovac: There are two hospital units at Mladenovac: (1) The field hospitals at present occupying two of the magazines, but liable to move forward as soon as the divisions of the army to which they belong advance; (2) the Seltzers Reserve Hospital. This latter is a small hospital of 150 beds for medical and surgical cases. It is situated about fifteen minutes from the railway station and on the opposite side of the valley from the magazines. The hospital buildings are permanent structures and are well suited for their purpose. The scope of this hospital could be much extended by erecting hospital tents on the adjoining grounds and utilizing part of the permanent building for administrative purposes.

The field hospitals consist of: (*a*) First Field Hospital, Timok Division; (*b*) First Field Hospital, Morava Division; (*c*) Fourth Field Hospital, Morava Division. They are housed in two of the large magazines, each magazine being divided by wooden partitions into five parts; four parts serve as wards and one as a dispensary. The total capacity of the two magazines is 800 beds, of which 220 are now occupied. Cases of typhus exanthematicus are sent to the First Field Hospital, Morava Division; all other cases, including typhus recurrens, are allocated to the other two field hospitals. Patients are brought to hospital in bullock carts, or special ambulance bullock wagons if these are available, and those transferred by rail to base or convalescent hospitals are similarly removed to the railway station. Previous to discharge, patients are bathed and their clothing disinfected. The beds consist of a straw mattress placed on the floor and two or three blankets. The latrines are unsatisfactory and the arrangements for preparing food and dealing with soiled linen are not all that could be desired. It should, however, be remembered that these are field hospitals and intended only to provide temporary accommodation.

Should these hospitals be removed from Mladenovac, as it is anticipated that they will be in a few days, there will be required a large hospital to take their place and a suitable opportunity would then present itself for improving or removing the drawbacks attached to the present field hospitals.

Postscript.—In connexion with the foregoing account of the developments of Mladenovac at this period—not merely as a great disinfecting station, "the most important in Serbia," as I declared it to be my aim to make it, but also the seat of a base hospital for fever work, and my recommendation of Dr. Elsie Inglis's (No. 6 Reserve) Hospital at Kragujevatz for that purpose—the following references to this move on her part are of interest. They are to be found in "The Life of Dr. Elsie Inglis," by Lady Francis Balfour (Hodder and Stoughton, 1918):—

"So much for what we *have* been doing; but the day before yesterday (May 28) we got our orders for a new bit of work. They are forming a disinfecting centre at Mladenovac, and Colonel Ghentitch, who is the head of the medical service here, wants us to go up there at once with our whole fever staff under canvas. They are giving us tents till ours come out. Typhus is decreasing so much that No. 6 is to be turned into a surgical hospital, and there will be only one infectious disease hospital here. I am so pleased at being asked to do this, for it is part of a big and well thought out scheme.

"The surgical hospital is to remain here. (Dr.) Alice Hutchison goes to Pojarevatz or Valyevo, also for infectious diseases."

COMMUNICATION F.

Disinfecting and Quarantine Station, Mladenovac.

Objects.—To cleanse and disinfect all soldiers passing through Mladenovac, to examine and detain if necessary those who are ill, referring those requiring hospital treatment to the field or reserve hospital, and to supply temporary dressings and treatment to those requiring it.

Accommodation and Equipment.—Two large magazines, each capable of holding 400 men: Ten store tents with accommodation for 200 to 300 men; three hospital tents, capacity about fifty beds.

Stores.—Axes, 4; buckets, 25; water boilers, 2; lanterns, 24; pickaxes, 12; shovels, 12; saws, 4; soap bars, 300; soft soap, 1 box; soap dishes, 10; scrubbing brushes, 6; two large portable (Thresh) steam disinfectors; twenty barrel disinfectors; baths (long), 10; basins (enamelled), 20; razors, 20; razor strops, 5; jugs, 6; hair cutting scissors, 6; blankets, 200; mosquito netting, 50 yards; bath towels, 400; hammers, 2; kidney dishes, 10.

In addition to the above, there is a large quantity of general stores, consisting of sprayers, liquid formalin, mercurial ointment, string, surgical dressings and appliances, drugs, &c. There is also a heater and a large disinfecting wagon held in reserve at the railway station.

Water Supply.—Water is obtained from two artesian wells which have been sunk on the south side of the station.

Wood is obtained through the divisional headquarters.

Staff.—Three medical officers and twenty-five men. The men sleep and occupy a part of one of the large magazines, they are supplied with food from the adjoining field hospital.

Latrines.—Short shallow trench latrines are provided on the ground at the back of the magazines, also large soakage pits to absorb all waste and bath waters.

Method of Working.—Soldiers are detrained at the railway station and report themselves at the office of the City Commandant, who sends them in charge of policemen to the disinfecting station where they are inspected by one of the medical officers. If any of the men are suffering from an infectious

fever or are too ill to undergo bathing they are transferred to the appropriate hospital, the remaining men pass into the portion of the magazine reserved as a waiting room, and thence in batches of ten to twelve they proceed to the undressing room where they are shaved and have their hair cut and all their clothing is removed for sterilization. After bathing they are given a blanket and proceed to the room set apart for those who are cleansed, and wait there until their clothing is brought to them from the disinfectors. After disinfection and cleansing their passports are stamped and they are allowed to proceed to their commands.

Numbers that can be dealt with.—The station with its present staff is capable of disinfecting and cleansing from 500 to 800 men per day, and during the period in which it has been working some 10,000 men have been disinfected in the way indicated above.

Section XII.—Summary of Programme of Prevention.

Thursday, March 4 to 7.—Arrival of Mission in Nish. Inspection of hospitals. Conferences with Army Sanitary Authorities and with Parliamentary Sanitary Commision. The following seven communications were sent to the Serbian authorities on March 8 :—

(*A*) Disinfecting Measures against Typhus and Relapsing Fever.

March 6 to 7.—(1) An appeal to the people of Serbia, "War against Disease. To every Man and Woman in Serbia."

(2) Means to prevent the spread of relapsing and typhus fevers.

(3) A simple, inexpensive, improvised steam disinfector (Stammers' "barrel disinfector").

(*B*) Sanitary Measures against Typhoid, Cholera, and Water Contamination.

(4) Water supply and water for drinking.

(5) Simple methods of purifying water by means of chlorine.

(6) Chlorine method of sterilization of water for troops on active service.

(7) The probable occurrence of cholera in Serbia in future operations.

(8) Telegram home for 300,000 sets of doses of anti-cholera vaccines.

March 8.—Arrival in Kragujevatz, G.H.Q.

These communications were followed by others in quick succession.

(*C*) General Measures relating to Serbia as a whole against Typhus and Relapsing Fever.

Proposed Scheme of Work of the Officers of the Royal Army Medical Corps with the Serbian Army (Communication 8).

March 10.—(1) Suspension of railway traffic.

(2) Stoppage of leave from army.

(3) Quarantine and disinfection station at Mladenovac, to control spread of infection between army and civilian areas.

Decisions regarding the first two schemes were taken at once and put into effect on March 16.

Sanction of Quarantine and Disinfection Station, which was hoped for in a day or two, was delayed and not received till March 22—a delay the results of which on the course of the epidemic from April 17 onwards were very definite, and were controlled by the action of the disinfection station.

Conference with G.H.Q. sanitary authorities at Kragujevatz regarding medical arrangements and needs in Serbian armies.

(From this time onwards I had interviews daily and generally several times daily with Chief of Sanitary Department.)

March 11.—(*a*) Further information obtained regarding numbers and characters of infectious diseases prevalent in Serbia, and also in Kragujevatz hospitals. (Reports of number of cases in hospitals for forty-two towns of Serbia, and for Kragujevatz, were afterwards supplied me every night.)

(*b*) Information obtained regarding wants of hospitals in Serbia. (Telegram to War Office.)

(*c*) Sixteen officers joined up from Nish, followed by remainder about a week later. (Detained by illness of two officers in Nish.)

March 14.—Instructions issued to officers to visit and report on Kragujevatz hospitals.

March 16.—Railway traffic suspended for fifteen days up to March 30. Leave from army stopped.

(*a*) Suspension very thoroughly carried out; only one passenger train in every twenty-four hours for all Serbia (e.g., from Kragujevatz starting at midnight, run during the night).

(*b*) Effect on railway, as seen by me on March 24 and then subsequently in going to and fro, was very marked in regard to quietness; cleansing of all stations and their precincts; cleanliness of railway carriages, only wooden third-class carriages being allowed.

March 22.—"Scheme of Work" (No. 8) sanctioned by Serbian authorities.

March 24.—Communication 10: "Further proposals relating to scheme of work of Royal Army Medical Corps."

(*a*) "An English Inoculation and Disinfecting Train" for use in the army areas.

(*b*) Necessity of continuing suspension of railway traffic strongly urged.

March 27 to *April* 16.—Formation of Disinfecting and Quarantine Station at Mladenovac commenced and completed.

March 30.—Suspension of railway traffic continued for another fortnight, to April 16.

April 2.—Official order given for the formation of an English Disinfecting and Inoculating Train. The work put in hand on April 5 and completed on April 16.

April 6.—Official orders given to supply the various articles asked for in

connexion with the formation of the disinfecting station at Mladenovac. Also expressing thanks for information given that the British Government had sent large supplies of clothes, &c., to Serbia (including 150 store tents).

April 16.—Resumption of railway traffic, and leave from army.

April 17 *to* 19.—Train completed and arrived at Kragujevatz. On the 10th it left for the second and third army areas (Area B) under charge of Lieutenant-Colonel Stammers with fifteen officers. Other disinfecting wagons used by Captain Kopsa on his Serbian train.

(*c*) Effect of suspension of railway traffic on epidemic—especially on typhus—very marked from the first, but not clear for fourteen days (incubation period of cases contracting infection prior to March 16) during which period the numbers in hospitals rose from 5,361 cases to 7,980. During period March 1 to 14, the numbers of typhus cases in hospital had risen from 3,743 to 5,361. During period March 15 to 28 they rose from 5,361 to 7,980, and a week later to 8,213—their maximum. On estimate the number of admissions daily between March 14 and 28 was 1,000 to 1,500 cases daily, the infection contracted before March 16.

The effect first showed itself about April 3, by the number of cases in hospital becoming stationary for five or seven days, indicating a lesser number of new cases, then by a rapid fall in numbers of cases in hospitals indicating a great fall in the epidemic.

Between April 3 and 26 the numbers in hospitals fell from 8,213 cases to 5,979 cases, a fall of 27 per cent. The average number of admissions, April 15 to 19, was 370; this fell to 235, April 20 to 26.

April 27.—Recrudescence of typhus and relapsing fever ten days after resumption of railway traffic. The number of admissions, which had been 317 on April 26 and had averaged 230 between April 22 and 26, rose to 611 on April 27 and averaged 340 cases—April 27 to May 3.

May 1.—Visit by me to Mladenovac; observation of conditions and difficulties there.

May 3.—"*Mladenovac Communication A*," relating to the above conditions and developments immediately required, viz., all troops passing through to be stopped and disinfected. These were carried out at once, making the station able to deal with men up to 1,700 daily.

May 7.—"*Mladenovac Communication B*." Report on state of epidemic, with data showing the increase in the typhus infection in army area B (second and third armies), and also in the south (civilian area F), following the resumption of traffic (April 27 to May 1). The break through of infection was first checked on May 6, and then arrested after May 15. The average daily number of admissions of typhus for the four weeks May 4 to June 1, were 215, 260, 187, 110.

May 7.—*Mladenovac disinfecting station* in fullest working order. All men in transit stopped there for twelve to twenty-four hours to be disinfected. The numbers dealt with averaged about 1,000 men daily. The number dealt with in four weeks was over 10,000; carrying out the purpose for which it was

established of holding up infection passing from the armies to Southern Serbia. The station was left in charge of a Serbian base hospital with personnel on June 4.

March 20.—"*Mladenovac Communication C.*" Further developments recommended for the establishment of two new base hospitals at quarantine station, one for fever work (the Scottish Mission). This was carried out in a week's time.

May 28.—All inoculations completed.

June 1.—Order of recall of Mission to Malta, where services were urgently required.

June 10.—Mission left Kragujevatz.

June 14.—Mission left Salonica for Malta on conclusion of its work.

(*D*) Disinfecting Measures.

Devising of "Barrel Disinfectors" and "Railway Van Disinfectors," "Railway Van Baths," and Special Sanitary Train for Preventive Work.

March 6.—"Barrel disinfector" devised by Lieutenant-Colonel Stammers.

March 9.—The formation of the barrel disinfector put in hand in the arsenal of Kragujevatz: completed on March 11.

March 13.—It was tested and found most satisfactory in No. 3 Reserve Hospital (Scottish Women), at Kragujevatz.

March 18.—Orders were given to have these made in hundreds in the arsenal, at the rate of at least 50 to 100 per week. Subsequently also on March 28 in the railway works at Nish. Orders were subsequently given for the barrel disinfectors to be sent to the Mission hospitals in Kragujevatz, Uskub, Vrynatchka Banja, and Belgrade.

March 14.—*Communication* 4A.—Method of using the improved disinfector (Stammers' barrel disinfector), afterwards known in Serbia as the "English barrel disinfector"; and, later on, in all Eastern war areas where subsequently introduced into use as "the Serbian barrel disinfector."

(*a*) Serbian pamphlets and brochures drawn up describing its use, and the use of other methods of disinfection.

(*b*) Classes of instruction in Kragujevatz were formed, each lasting four days, and made up of fifteen men from regiments and divisions who were practically trained how to use them.

(*c*) The barrel disinfector was taken by me to Nish, and its use demonstrated in the Parliament House and before the Medical Society in Nish; others were made in the railway works, and orders given by the Prime Minister that 100 should be immediately made and sent as samples to the Prefects of the chief towns, with orders to them to form similar ones in each place.

(*d*) There was a widespread use of them in the Serbian armies and generally (and subsequently in British armies in Eastern war areas as described by me in an address on "Prevention and Arrest of Lice-borne Diseases by New Methods of Disinfection." Royal Society of Medicine, July, 1918, *Lancet*, ii, pp. 377, 378).

March 25.—A new type of disinfector devised by Lieutenant-Colonel Stammers (*railway van disinfector*) and permission granted to form one experimentally from a wooden van. While under formation another one was formed by me at Nish (April 6) from a meat van, also a "*railway van douche bath*," devised and formed and at the same time to be used in conjunction with the railway van disinfector, the steam for heating it being supplied by a heating engine coupled between them. Three more similar disinfecting and bath vans formed by order of the Prime Minister.

Sequel.—Subsequent introduction of "barrel disinfectors" and "railway van disinfectors" in Eastern war areas, viz., barrel disinfectors by Lieutenant-Colonel Stammers in Mudros and Salonica, van disinfectors by Colonel Hunter in Egypt and Palestine (February, 1916) (and subsequent widest use in Egypt, Gallipoli, Salonica, Mesopotamia, East Africa, Palestine) from August 15, 1915, during the next two or three years (with results described by me in address, "Prevention and Arrest of Lice-borne Diseases in Eastern War Areas by New Measures of Disinfection," July, 1918. Royal Society of Medicine. *Lancet*, September, 1918).

(*E*) Hospital and Sanitary Measures.

Kragujevatz Hospitals.

March 16 to 27.—Conferences with State Commission for Prevention of Diseases and Kragujevatz Sanitary Authorities. (*a*) Information about municipal arrangements, number of hospitals, notification and isolation. (*b*) Decisions taken to establish compulsory notification, and, so far as possible, isolation of fever cases. To provide additional accommodation; to isolate typhus and relapsing fever cases in separate hospitals. To improve sanitary conditions in hospitals; to provide disinfecting arrangements: all of which were carried out in due course.

March 16.—*Communication* 9. "Proposals for a public bath and disinfecting station in Kragujevatz."

March 20.—Reply from Town Sanitary Authorities *re* establishment of public disinfecting station. Subsequent establishment of a good one dealing with 500 to 1,000 men daily.

March 17.—Visits to, and reports on, hospitals in Kragujevatz.

March 18.—Interview with Chief of Sanitary Department *re* results of above. Subsequent great improvements in sanitary conditions. Provision of two new fever hospitals, Sixth and Seventh Reserve (Scottish Mission). All typhus cases isolated in two hospitals (First and Sixth Reserve). All relapsing cases isolated in one hospital (Seventh Reserve).

March 24.—First visit to Nish to meet Sir Ralph Paget *re* a Foreign Office Commissioner for British Hospital Missions in Serbia, which I strongly urged him to accept, and which he did accept four days later.

March 22.—Reports from Dr. Barrie at Uskub, Mr. Berry and Captain Bennett in charge of Hospital Missions at Uskub and Vrynatchka Banja.

March 28.—Second visit to Nish to Conference of Representatives of British Hospital Missions, four in number, then at work in Serbia, viz., Lady Paget's and Dr. Barrie's Mission at Uskub; Scottish Women's Mission (three hospitals) in Kragujevatz; Dr. and Mrs. James Berry's Private Mission, and Captain Bennett's Red Cross Mission in Vrynatchka Banja.

April 28.—Formation of Board of Health for Serbia under H.R.H. Prince Regent, as President; Sir Ralph Paget, Vice-President; Colonel William Hunter (Army Area), Colonel Joubert (French) (Middle Area), Dr. Strong (American) (Southern Area), Directors.

(*F*) Anti-Cholera Inoculations.

March 7.—300,000 sets of doses of vaccines ordered from War Office.

March 18.—First consignment of 50,000 sets of doses sent off from London. (Arrived in Salonica April 4; sent off on April 9; lost for a week, and reached me at Kragujevatz on April 17, the *day before* our inoculation and disinfecting train arrived.)

March 25.—Proposals for "inoculation and disinfecting train" submitted and sanctioned. (Train ordered April 2, put in hand April 6, and completed April 17. Inoculations commenced April 18.) Second consignment of 50,000 sets of doses of vaccine sent off from London. (Arrived in Salonica April 15; Nish, April 21; and eventually after being lost, found in Kragujevatz on April 28—the day before our first supply had almost been exhausted.)

March 28.—Third consignment of 100,000 sets of doses asked for. (Sent off April 9; arrived May 6.)

April 2 *to* 5.—Inoculation train ordered and put in hand at Nish.

April 17.—Completed and dispatched to Kragujevatz.

April 18.—Left for Second and Third Army Areas with fifteen officers, under charge of Lieutenant-Colonel Stammers.

April 20.—Inoculations commenced on train and from Kragujevatz and carried out on about 250,000 men and completed May 28. On the train the inoculations were carried out with greatest dispatch and rapidity—up to as many as 10,235 men in the course of five hours.

April 23.—Fourth consignment of 100,000 sets of doses asked for. (Sent off on May 10 and reached Salonica May 30.) Total sent, 300,000 sets of doses as originally requested.

May 16.—Fifth consignment of 200,000 sets of doses asked for in sets of 50,000 at a time. (First set sent off on May 26; others to follow at weekly intervals on June 3, 10 and 17. These reached Serbia after departure of Mission on June 10.)

May 28.—Anti-cholera inoculations completed:—

On second and third armies (200,000 men)	200,000
Kragujevatz	7,000
Lapovo, Jagodina, &c., Badynevatz	20,000
Pojarevatz	15,000
Negotin	14,000
	256,000

Total consignments of anti-cholera vaccines requisitioned and immediately dispatched by the War Office were 500,000 sets of doses.

(*G*) Laboratory Work.

March 12.—Laboratory formed in Kragujevatz under Captain W. W. C. Topley, with one officer to assist.

March 13.—Research work on the bacteriology of typhus and routine work carried out till departure of Mission.

June 10.—When laboratory and all its equipment was handed over to the Serbian Authorities (reported on in *Journal of the Royal Army Medical Corps* by Captain Topley, August, 1915).

Epidemic Conditions on Arrival of Mission (March 4) and on Departure of Mission (June 4).

Number of cases in hospital	Typhus	Relapsing
March 1	3,743	7,069
,, 16 (*c*)	6,000	7,883
April 3	8,213	7,810
,, 16 (*f*)	7,324	4,960
June 4	2,860 (*m*)	1,609 (*m*)
Percentage fall, April 3 to June 4	63	80

(*c*) Supension of railway traffic and leave from army.
(*f*) Resumption.
(*m*) Most of these were convalescent.

PART III.

Section XIII.—Position at end of March. An Anxious Period. (*See* pp. 84, 88.)

The second measure we had advised on March 10, viz., the establishment of a *quarantine and cleansing station*, had not come into operation; it had only been sanctioned on the 22nd, by which time we had hoped to have made a start with it. In submitting it on March 10, two days after our arrival at Kragujevatz, we had hoped to have got official sanction and acceptance of it in two or three days, so that, on arrival of officers two days later, I might have been able to get forward a number of them to the war areas and make a start with our quarantine and disinfecting station at Mladenovac, simultaneously with the suspension of railway traffic which was to commence on March 16.

I was informed, indeed, two or three days later that the principle of our proposed scheme of work had been approved of, and I therefore waited expecting every day to hear officially.

Our time during this period of waiting was utilized in ascertaining the facts about the hospitals in Kragujevatz, and dealing in various ways, as I shall afterwards describe, with the problems of notification, isolation, sanitation and disinfection presented by them. But in relation to our chief purpose of getting forward to the army area, especially to Mladenovac to commence our disinfection station there, and to commence also our disinfection and inoculation work amongst the troops there by means of the new barrel disinfectors and, later on, van disinfection specially devised since our arrival, the needs of Kragujevatz were subordinate to our main object. The period of waiting day by day for ten days was, therefore, a most trying one; especially as I saw from the official data supplied to me, that the epidemics were steadily on the increase, and the prospects of starting our disinfection station in time to check them appeared to be steadily lessening.

Our third measure—viz., the formation of a *disinfecting* and *inoculation train*, had only been submitted; while approved, it had not been officially sanctioned. (It was sanctioned on April 3, put in hand on April 5 and completed with great dispatch in about ten days.)

The whole position at this time, as I have said, caused me much anxiety. The instructions I had received for the Mission was to form a programme of work that would control or check the epidemics as a

whole. It had been our aim to effect this result by measures we advised and pressed on the attention, with every degree of urgency, in the series of *communications*, eight in number, submitted to the authorities within seven days of our arrival.

The interval of fourteen days that had elapsed since our arrival in Kragujevatz and the submission (March 10) of our proposals regarding suspension of railway traffic, stoppage of all leave from the armies, and the establishment of our cleansing station at Mladenovac, measured in days—was not long. In relation to the urgency of checking the widespread and increasing epidemics, it seemed to magnify itself into as many weeks. (*See* pp. 84, 89.)

The outlook at this period appeared therefore sufficiently black. The epidemic had steadily increased for twelve days despite the suspension of railway traffic. In the past two or three days, the net increase of typhus cases in hospitals had shown signs of lessening—being only about 50 to 100 a day (March 25 to 28) (an increase which, allowing for discharges and deaths in a total of over 8,000 cases in hospital—represented probably 800 to 1,000 new cases daily) instead of about 400 on March 23-24, and 600 on March 20 and 25. But the possible significance of this was not at that time clear; although lessening, the daily increase was still continuing in spite of twelve days' suspension of railway traffic, and this measure was timed to cease in two days' time, viz., on March 30, having been introduced only fifteen days.

It was at this important period that our communication (No. 8) relating to the formation of the cleansing station at Mladenovac was sanctioned, and our further proposals (No. 10) for forming a sanitary train were sent in. It was there emphasized in the first sentence, that "it was *understood that all leave from the army had been stopped and would remain stopped until the epidemic ceased, or other causes arose making it necessary or advisable to again grant leave*"; that this was a most important and valuable measure since it cut off at one blow the greater part of the infection that had up to this time spread from the rest of Serbia to the army, or from the field army to the rest of Serbia; unless this measure were continued it would be practically impossible to establish a properly conducted disinfecting station owing to the number of troops that would be passing to the field army; and the proposal to establish such a station at Mladenovac was definitely stated to be subject to this condition, viz., continuance of suspension of traffic and leave.

The sequel to this communication was the decision, the very important one, taken by the army authorities, viz., to continue the

suspension of railway traffic for another fortnight. The importance of this decision will be afterwards seen. The sequel showed that the continuance of suspension determined materially the striking arrest of the epidemic which afterwards followed.

In the light of the subsequent result, it appeared to be a natural and wise decision to take. But in view of the circumstances of the country at the time, the many urgent needs felt by the army authorities to resume railway traffic, the many inconveniences to the public caused by the suspension—keenly felt by them as I had occasion to learn subsequently in conversation with Serbian civilians—the decision of the authorities to continue suspension was a very strong one, indicating their sound appreciation of the gravity of the situation, and their resolve to deal with it with a firm hand.

As a mere piece of counsel, our strong recommendation to continue the suspension might or might not have carried weight. Its effect on the epidemic had so far been little if at all apparent, the inconvenience occasioned had been great; and, under the circumstances, had traffic been resumed at this period, it might possibly have been held that a fair trial had been given to it—with little, if any, appreciable result (*see* p. 84).

But, as I have made clear, our recommendation was not merely an academic counsel; it was based primarily on the necessity of giving fair conditions for carrying out the measures of our programme of prevention, namely—the establishment of a disinfecting station at Mladenovac which the army authorities had duly sanctioned (March 22) and the further proposal to supplement this measure by forming a disinfecting and inoculation train—a measure also generally approved of but not at this time (March 27) officially sanctioned. This official sanction only came to me on April 3 in Nish.

The part played by these two proposals in determining the decision of the authorities to continue the suspension of railway traffic was not known to me at the time and only became known to me afterwards. These proposals, it then appeared, had a double effect. On the one side the resumption of railway traffic at this period would have rendered valueless, in a large degree, the establishment of the disinfecting station at Mladenovac which had been officially sanctioned; and, to give this measure a fair chance of success, the suspension of traffic and of leave from the army was therefore continued for another fortnight. On the other side, the urgent need for resuming traffic as soon as possible, was an additional inducement to get both the disinfecting station and the sanitary train into action as soon as possible.

The two measures were intended by us to be not merely of a temporary character, to meet present exigencies. They were of a permanent character, purposely designed, firstly, to meet the future needs of the armies in the event of future contingencies continually before them—viz., first of facing another attack of the Austrians upon their Northern borders, and secondly to face any possible recrudescence of typhus and relapsing fever the following winter. The authorities quickly recognized their importance and potentialities in these two relations, and were induced thereby to throw themselves with characteristic energy into carrying out measures which they realized to be of a practical and practicable nature.

Of the two measures, the formation of the sanitary train for inoculation and disinfection appealed to them strongly. It was an entirely new measure, such as had never been previously introduced into any army. While difficulties of many kinds were in the first instance encountered by my officers in connexion with the formation of the cleansing station at Mladenovac (already referred to, p. 125), the effect of which was to retard its getting into full working order, the railway authorities at Nish, after the train was officially sanctioned on April 3, threw themselves with greatest energy into its formation. The result was that in the short period of ten days (owing to Eastertide, April 2 to 5, the work did not commence until April 6) they turned out a train of fifteen coaches and vans, unique in its character and complete in all respects for the purposes of prevention, for which it was designed. They could have completed it for all purposes in an even shorter period of seven days, so far as my instructions for its details were concerned. But with characteristic pride in workmanship, they determined that not only for its practical purposes, but also in its appearance, the train should be as complete as could be made; and in addition to the interior re-arrangements and fittings I had ordered, they gave the whole train an entirely new and unexpectedly attractive appearance by a new coat of varnish to all its coaches. They worked day and night to get it ready by April 17, the date fixed for the resumption of railway traffic; they attached so much importance to its usefulness, that they were anxious to have it in readiness before traffic was resumed.

The train was thus completed on April 17, and went forward with fifteen of my officers on April 19, three days after railway traffic was resumed. This relation of events appeared at the time to be a happy coincidence. It was not till afterwards that I learnt from one of the

chief railway staff officers concerned that the two events were not mere coincidences, but were directly related to each other—the formation of the sanitary train, having been purposely speeded up to fit in with the resumption of railway traffic, and to meet possible needs for disinfection after its resumption.

Following the acceptance of our scheme of work in communications 8 and 10, I had, along with Lieutenant-Colonel Stammers and three of my other chief officers, an interview with the Chief of the General Staff, Colonel Pavlovitch, who from first to last gave the Mission his strongest support, in which I explained to him the general purpose of our work. The following is a précis of the information submitted:—

STATEMENT TO CHIEF OF STAFF (MARCH 25).

I thank you for your letter, and we are glad that the proposals which we have had the honour to submit to you have received your approval. We have carefully considered how we may most efficiently and quickly carry out plans for—

(1) Protecting the Serbian troops from infection conveyed to them from civil population, and conversely from the armies to the civil areas.

(2) Our proposals for this end are: (*a*) To establish a quarantine station at Mladenovac, the important railway junction immediately behind the Second and Third Armies and the First Army, and make this point the basis of our operations with the army. (*b*) And we have worked out a plan of operations which will enable us, if approved by you, to go forward without delay and (i) inoculate the troops against cholera; (ii) at the same time, we hope, thoroughly disinfect the troops.

(3) Our plan is the following: To form an inoculation and disinfecting train (*a*) carrying sixteen to twenty officers, and fully equipped with our disinfectors and formaldehyde, sprays, syringes, vaccines, &c., with cars for baggage and stores, &c., and with sleeping and dining staff cars for officers, interpreters, and staff. (*b*) A Serbian military officer attached, knowing the disposition of the troops, and the nearest places on the railway line to which these troops, with least disturbance of military dispositions, can most easily be brought. (*c*) To stop at any point on the line where groups of soldiers can be most conveniently brought, and carry out with utmost dispatch their inoculation against cholera, and complete disinfection of their clothes and person if possible. Since at no time can the troops be removed far from the positions they now occupy, it will be necessary for the English doctors to move from their central base (Mladenovac), established on the railway line, to other places on the railway that are within easy reach of the troops. To effect this, certain special wagons, sleeping and living and disinfecting accommodation require to be placed at the disposal of the staff.

(4) The military situation will determine the number of troops who at any period can be spared from one section of the front. The nearer the stations can be to the point on the railway the more men can be spared.

(5) *Leave from the Field Army.*—This is absolutely necessary to be stopped from now until the epidemic ceases.

(6) My senior officers will proceed forward in a day or two to Mladenovac to ascertain the conditions. You state your intention of building new barracks there for 500 men. This may not be necessary, and on this point they would report to you. Please do not build any more new barracks at Mladenovac until our officers have been able to see and report.

(7) The hospital at Mladenovac should be prepared to take all cases of infectious disease discovered in the quarantine camp.

We ask your approval and authority to carry out this, and to authorize the preparation of the railway wagons as improvised disinfectors by the arsenal and railway authorities, and the other accommodation necessary for this train.

April 2 (Good Friday): *Formation of English Sanitary Train.*

From Chief of Sanitary Department, G.H.Q., Kragujevatz, to Colonel Hunter, Nish.

"Inform the English Colonel Hunter that the chief of staff of G.H.Q. has ordered the formation of an English disinfecting and inoculation train asked for by the English doctors. The commander of this train will be the first class cavalry captain Nikola Christitch. He has been ordered with the commander of our sanitary train (No. 5), named Dr. Kopsa, to put himself at the disposal of the railway directorate and the English to form this train. Dr. Kopsa is coming to Nish to-night, and Colonel Hunter should await him."

From Colonel Wm. Hunter to Chief of Sanitary Department, G.H.Q., Kragujevatz.

April 13.

"I beg to acknowledge the receipt of your letter of April 2, No. 12979, conveying to me the orders of the chief of headquarters, dated April 2, with regard to arrangements connected with the formation of the English disinfecting and inoculation train. The delay in replying to your letter is due to the fact that I have been absent in Nish for the last ten days in connexion with the above mentioned train. I have already met there Captain Christitch and Captain Kopsa, who have been officially attached to the train, and I am already much indebted to them for the help they have rendered. All the arrangements are now near completion, and I hope to have the train sent on to me on Wednesday night or Thursday at latest (April 14 or 15). From the time the official orders were issued by the chief of the headquarters, and telegraphed forward to Nish on April 2, the formation of the train has proceeded satisfactorily, interrupted only by the Easter holidays."

Formation and Character of Train.

Having put their heart, and also their energies, into the formation of the disinfection and inoculating train, they also determined that its start from Nish should coincide exactly with the resumption of railway traffic. Before its start it was visited by the Prime Minister and the English Minister (Sir Charles des Graz) and all the other chief Government officials. It duly started off on the evening of April 17 (the day traffic was resumed), and arrived in Kragujevatz on the morning of the 18th (Saturday).

Instead of the number of coaches I had selected for the purposes of the train—viz., three for inoculation, two van disinfection baths (van disinfector and a new bath van), and six for sleeping and living accommodation for English and Serbian officers-in-charge, with three others for stores—about fourteen in all, the train had come up the line along with the ordinary Serbian Red Cross train. The central feature of the whole train was its new van disinfector and the new van bath with heating engine between them, both of which the Serbians had painted white to denote their purpose; and the coaches adapted for inoculation work and for sleeping accommodation of eighteen officers of the staff.

The alterations I had arranged were :—

(1) The removal of the seats and partitions in the third-class coaches adapted for inoculation work and the fixing up of three small tables along one side in each coach as inoculating tables.

(2) The removal of the seats in four third-class coaches and the provision of three stretcher beds for officers in each of the two halves of the coach, with small wall basin for washing for each group of three officers, and with a lavatory and a small douche for each group of six officers.

(3) In one of the coaches the two halves were reserved as the combined office and sleeping-room for each of the two chief staff officers—one half for Lieutenant-Colonel Stammers, the other half similarly for Captain Christitch, the Serbian Commandant and liaison officer of the train. The two chief officers were thus in close relation to each other to conduct the work of the train.

The interiors of the coaches had been painted white, as all the coaches were old, and had been in a very dirty state. The extra touch given by the Serbians was to wash down and give a coat of varnish to the whole of the exterior of the coaches. The whole appearance of the train on arrival was thus one of extreme neatness and cleanness, very different from that of their original condition when selected by me.

Section XIV.—Character and Summary of Mission's Work, March 4 to June 4.

May 17, 1915.

I have just returned from a week's travelling to Nish to attend the opening meeting and constitution of a Board of Health for Serbia; then back to Kragujevatz; then on the following night northwards to Belgrade to visit the inoculating train at successful work near there; then back to Mladenovac to visit and inspect the quarantine and disinfecting stations we have established there, and then back to Kragujevatz on May 2.

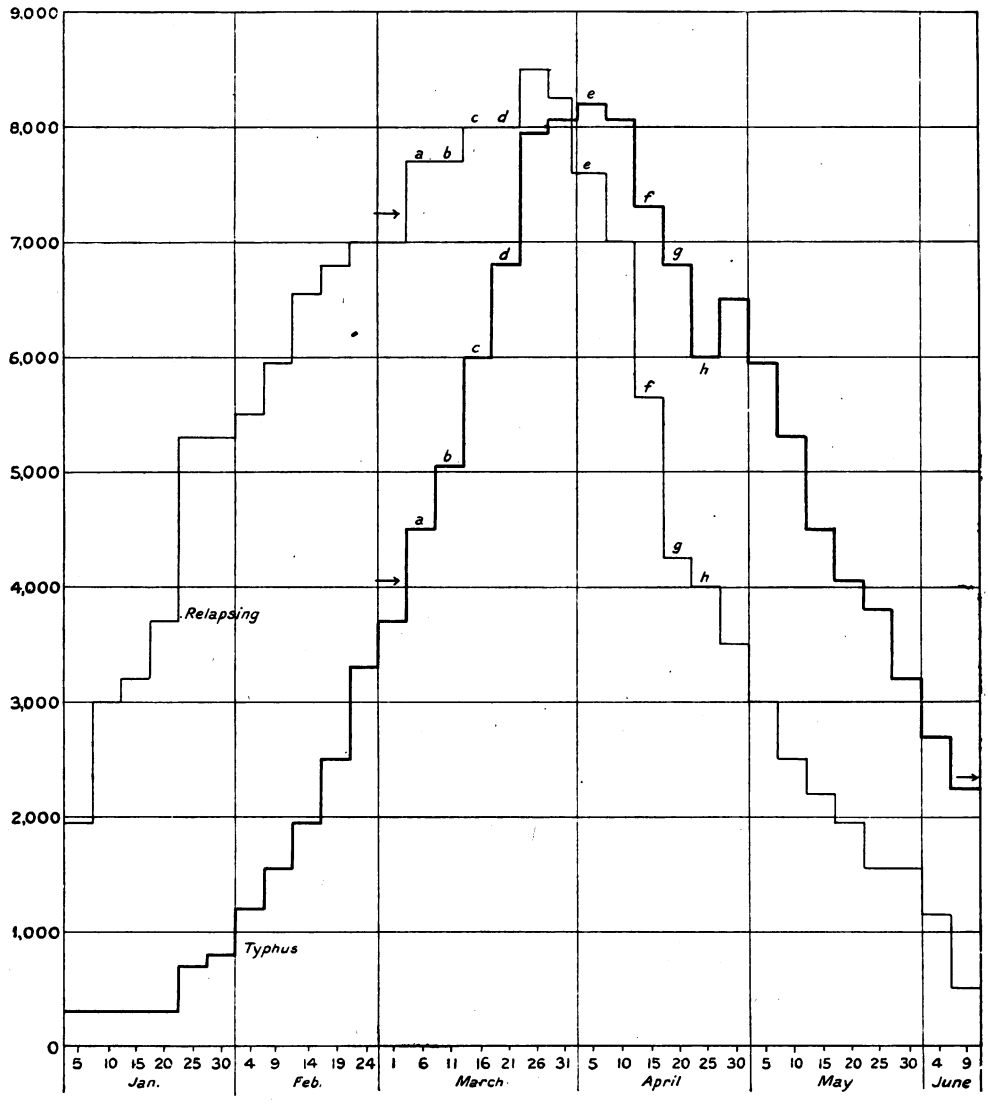
I have kept you informed by my weekly telegrams of the general conditions in the country and the progress of the epidemic; and I have now pleasure in sending herewith three charts which at a glance will show you precisely how matters stand. It is now only a little over two months since we first came here. It seems more like two years for the number of experiences crowded into it. Indeed, I never knew how many experiences of one kind or another could be crowded into one day till I came here.

We arrived here on March 4 at the very darkest period of the epidemic—fever cases increasing by leaps and bounds (*see* Chart, p. 44) and no means of controlling them, and no settled policy except that of getting as many doctors as possible into the hospitals to try and help patients under absolutely impossible conditions. In inviting help of doctors from our Government and others it is certain, I think, that the Serbian authorities had as their chief thought to get further and much needed clinical assistance. The task you assigned us was, however, a different and a more difficult one of endeavouring to check the spread of the epidemic as a whole by administrative measures and by sanitary measures.

The course of the epidemic (shown in Chart appended) shows how effective these measures were. The chief of them were the temporary cessation of railway traffic, suspension of leave from the army, and the improvisation of a method of disinfection which could be at the disposal of everyone. Chart (p. 147) shows the result in a striking way, viz., within a period of ten to twelve days from the suspension of railway traffic on March 15, and the thorough cleansing and disinfection of all stations and rolling stock, the numbers of new cases of typhus began to fall, and continued to rapidly fall so long as the suspension lasted and for ten days afterwards till April 26. Then within a period of ten to twelve days (in both instances this period corresponding with

CHART 4 (*a*).

Course of Epidemics of Typhus and Relapsing Fever in Serbia, 1915, *and their Relation to the Preventive Measures adopted.*



Number of cases of typhus and relapsing fever in hospital in Serbia on dates specified (five days intervals), January 1 to June 9, 1915.

March 4: Arrival of Mission in Serbia; June 10: Departure of Mission from Serbia. *a*, March 8: Barrel disinfector devised. *b*, March 13: Barrel disinfector made and tested. *c*, March 15: Suspension of railway traffic. *d*, March 22: "Van disinfector" devised ("Van 1"). *e*, April 5, Van disinfector ("Van 2") formed in Nish; "van bath" devised. *f*, April 15: Resumption of railway traffic. *g*, April 19: English sanitary train (inoculation, disinfection, and bath vans). *h*, April 25-30: Sudden check in fall of epidemic ten to fourteen days after resumption of railway traffic.

the incubation period of typhus) the resumption of railway traffic was followed at first by arrest of the fall, and then for a period of two weeks or so by an increase of new cases, with a slight increase in the total of cases.

I wish I could describe to you the change which has now come over the face of the country: the measures of cleanliness now in force in the stations and carriages of the railways and, indeed everywhere—in restaurants and houses; the feelings of hopefulness and happiness that now prevail instead of the gloomy fear that pervaded all classes when we first came. The extraordinary changes in the conditions of the hospitals; their cleanliness and relative comfort and order, instead of the overcrowding and shocking hygienic conditions which at that time prevailed. The changes in this respect I must reserve for a later report. But in the meantime I send you in Report E some information regarding the state of the hospitals in this town when we arrived, and in Chart (p. 87) the notable improvement that has here occurred, affecting not only the number of cases but the conditions of the hospitals and increasing use of disinfecting measures.

Statistics.—When we came here the only figures available were the total number of cases in hospitals each day and their increase or decrease (Table p. 58). When in Nish, forming the special inoculation and disinfecting train (described on p. 145) I pointed out to the Chief of the Sanitary Department that what I wanted was not only the totals but each day: The number in hospital, the number of new cases admitted, the number discharged, the number dying, and the number remaining. He took note of this, and since the middle of April (Table p. 76) these returns are daily officially given for each town in Serbia and are supplied to me daily. They yield most interesting information when closely analysed, as I am in the habit of doing; and some of the results of that interest and analysis will be found recorded in Report B (p. 93), relating to the conditions in Mladenovac, where we have our quarantine and disinfecting stations, and also in Chart (p. 46) which I have made, and in which I show the distribution of typhus cases throughout the whole country and their relation to the railway lines.

Number of Cases of Fever.—To show the full extent of the changed conditions I give here the official figures for typhus, relapsing and enteric fever, when they were at their maximum and as they now (May 16) are:—

	Maximum		Now (May 16)
Typhus	8,192	(April 4) ...	4,529
Relapsing	8,584	(March 25) ...	2,149
Enteric	2,304	(February 25) ...	391

The low incidence of enteric is remarkable having regard to the unhygienic conditions prevailing. But I think an outbreak of this disease is not unlikely later on in the summer, and therefore a good supply of anti-typhoid vaccines now on order will be well timed.

Plague.—You inquire about plague in Salonica. This matter received my immediate attention as soon as I heard of it on April 17. I wrote at once, and the correspondence is given in Report D, herewith enclosed.

Cerebro-spinal Meningitis.—Two or three cases, more or less doubtful, have occurred in Kragujevatz and have been carefully investigated in our bacteriological laboratory by Captain Topley. One of the cases is in one of the Sisters of the Scottish Women's Hospital. In relation to this disease, and also to typhus, they seem to have had extremly bad fortune, no fewer than one doctor and three sisters being recently down with typhus; all of them happily recovered.

Bacteriological Laboratory.—In this connexion I draw your attention to the work of this laboratory, described in Report C herewith sent. Captain Topley and his junior, Lieutenant McCall Smith, have made an excellent laboratory and are continuously engaged in work. The results foreshadowed promise to be of a most interesting kind, but it is too early to speak of them.

Inoculations against Cholera.—After many delays and disappointments our disinfecting and inoculating train, which I formed in Nish after Easter time, was duly completed, dispatched from Nish (after being visited by Mr. Paschitch, the Prime Minister, the English Minister, and many others), and reached here on Sunday, April 18; and, by a piece of great good luck, our cholera vaccines, which had taken from two to three weeks to come up from Salonica, arrived here on the day before. So our train was complete, and, after a farewell dinner on board before departure, it left on Monday, April 19, for Kievo (*see* map, p. 31), a station some ten miles south of Belgrade, to begin its work among the Second and Third Armies, under Lieutenant-Colonel Stammers, in charge, and Captain Christitch, as military commander of the train, and Captain Kopsha, representing the Serbian Sanitary Corps. I visited the train at Kievo about a fortnight later (*see* p. 119) and found everything exceedingly practicable and comfortable. It has enabled the work of inoculation to be carried on with the greatest dispatch. It has recently moved down the line to Ralya and Vlashka. The total number of inoculations carried out up to date is 109,261, carried out by fifteen officers, who have not only been in the train but have been stationed in adjacent areas, on 74,841 men, subsequently increased to about

150,000 men. In addition, with the four officers I have retained here at headquarters, we have made here a total up to date of some 25,000 inoculations in 20,270 men, viz. :—

	Inoculations	
Kragujevatz garrison	9,473	
Laporo, Badynvatz, Brzan, Radja ...	11,000	
Pojarevatz	4,200	(subsequently 10,000)
	24,673,	on 20,270 men

All officers are now away engaged in inoculating.

I have endeavoured, in the foregoing and in the Reports A-E and Chart, p. 147, which I now send to give you some, however incomplete, picture of some of the matters which, from first to last, have unceasingly engaged our attention.

British Military Hospital with the Serbian Armies.

Reports submitted by Colonel William Hunter, A.M.S. :—

May 17, 1915.

Contents.

Report A.—Correspondence between Headquarters Staff of the Serbian Army and Chief of British Mission relating to programme of work submitted by the Mission.

Report B.—Communications regarding the work of the Quarantine and Disinfecting Stations established by the Mission at Mladenovac (*see* p. 120).

Report C.—Work of Bacteriological Laboratory.

Report D.—Correspondence relating to the occurrence and prevention of plague in Salonica.

Report E.—The conditions in the hospitals at Kragujevatz at the time of arrival of British Misssion : with Chart, p. 87.

Chart 1.—Map of Serbia showing railways and chief towns, and numbers of cases of typhus in hospital in each town on May 15, 1915 (Charts, pp. 46, 47).

Chart 2.—Showing number of cases of typhus, relapsing and enteric fever in hospitals in Serbia, January 2 to May 14, 1915 (Charts, pp. 44, 45, 95, 102, with Tables, pp. 58, 76).

Chart 3.—Showing the number of cases of infectious diseases, typhus and relapsing fever, in Kragujevatz, March 10 to May 14, 1915, and increasing interest in the use of measures of disinfection (Chart, p. 87).

British Military Hospital, Serbia. Report A.

Letters from the Headquarters Staff of Serbian Army in reply to the programme of work submitted to them by the British Military Hospital attached to Serbian Armies.

Programme.—Submitted March 10, 1915; accepted March 22, 1915. ("Communication No. 8" already sent in to the War Office.)

Details of Train Programme.—Submitted March 27, 1915; orders for inoculating and disinfecting train issued April 2, 1915.

Train arrived at Kragujevatz, April 18, 1915, and left following night for Kievo, near Belgrade.

May 17, 1915.

(Signed) WILLIAM HUNTER, Colonel, A.M.S.

Course of Combined Epidemics of Typhus and Relapsing (*Chart, p.* 44), *as shown by Numbers of Cases in Hospitals* (*January* 1 *to June* 4).

Period 1.—January and February.
Period 2.—March.
Period 3.—April.
Period 4.—May.

The course as shown by numbers of cases in hospitals and other data was the following: (Charts, pp. 44, 45).

Period 1.—It commenced about the middle of December—following the defeat of the Austrians as already described between December 2 and 13, 1914. Prior to this period, according to the information supplied me, the Serbian forces had been very free from epidemic diseases. [This is supported by data of mortality from typhus, Kragujevatz area, which I afterwards obtained (*see* Chart, p. 86) extending back to August 14, 1914. During August and September and up to October 21, no deaths from typhus were recorded; in November nineteen, and in December thirty cases (fourteen cases in the first half, and sixteen cases in the second half). In January the number of deaths rose to 126; in February to 554, and in March to 581]. By the middle of January the number of cases in hospital had risen to 4,000 cases, and thereafter its course in periods of fifteen days was the following: In the last fifteen days of January, the number rose to 6,000; in the first fifteen days of February to 8,500, in the last fifteen days to 11,000.

Period 2.—It was at this date (March 3) that the English Mission arrived, and for the next fifteen days of March the number of cases rose to 14,000 (March 18), and eventually reached a maximum of 16,500 cases, ten days later, viz., on March 28. The combined epidemics reached their maximum of cases in hospitals on March 28, the rise in numbers of cases being greatest in the last ten days, March 18 to 28, viz., from 14,300 cases up to 16,500. Allowing for an average incubation period of about ten days, the rise in cases in hospital denoted a maximum contraction of infection in the ten days March 8 to 18.

Period 3.—After attaining their maximum on March 28, the numbers in hospitals remained fairly level at about 16,000 cases for a period of about ten days till April 7, indicating that the number of admissions only equalled the discharges and deaths instead of largely exceeding them. Thereafter the number fell in the most rapid manner—from nearly 16,000 on April 3 to below 10,000 on April 26, a total fall of 39 per cent. in twenty-three days. This degree of fall represented a very marked fall in numbers of admissions of cases. Between April 19 and 26 the daily combined numbers of admissions fell from 750 cases down to 317 cases in seven days.

Period 4.—Thereafter the numbers in hospitals fell from this number of 10,000 on April 26 to 3,460 on June 4, the daily number of admissions falling from the figure of 317 on April 26 to one of 185 on June 4. The fall in this latter period of forty days was then less marked and more gradual than in the preceding period of twenty-three days; or in the immediately preceding period of ten days.

The total fall between April 3 and June 4 was 78 per cent.

Recurrence of Infection.

The cause of this was a sharp recurrence of infection which manifested itself by a sudden rise in the number of cases in hospitals on April 27, and by a very sharp rise in the number of admissions (best shown in typhus curve, Chart p. 45). On April 26 (Chart p. 106) the number of admissions had fallen to 317 cases. On April 27 the numbers rose to 915 cases, and during the next five days (April 27 to May 1) they averaged 570 cases. In the following two days they fell again to an average of 326, but in the next five days (May 7 to 11), i.e., ten days after the original rise, they rose again to an average of 400 cases (May 7 to 12). They then fell once more to an average of 240; but rose (May 17 to 22) again to an average of 270 daily, and eventually (May 27 to 31) they averaged 250 cases daily. Apart from rises on particular days, the lower curve of fall, as shown over periods of five days, was from 300 cases daily to 100 daily.

On my urgent representation on May 2 (the exact period of the recurrence of infection, but before I knew of its actual recurrence) the recrudescence was again limited and controlled by our disinfecting station at Mladenovac—the work of which from this period up to the end of May became greatly developed (p. 121).

Section XV.—Final Communication to Chief of Sanitary Department, General Head Quarters, Serbia.

From Colonel William Hunter to Colonel Ghentchitch.

Kragujevatz, June 3, 1915.

Dear Colonel Ghentchitch,—I have the honour now of conveying to you by letter the information which, immediately on its receipt, I at once communicated to you personally on June 1. On that date I received an urgent message from the War Office in England ordering me with the Royal Army Medical Corps Mission under my charge to proceed at once to Malta where our services are urgently required.

(I) (1) In communicating this order to you, I confess I do so with mixed feelings. The first feeling is one of regret, that it terminates for the time being the great and honourable duty which I have had the satisfaction of discharging since our arrival in this country, viz., of co-operating with you in every way in my power in measures to check the great epidemic now happily ending. This feeling is only relieved by one of extreme satisfaction, that the present condition of health of the army and country, of which I have kept my Government fully informed since my arrival on March 4, renders our help in the opinion of our Government less urgent than it was at the time (middle of February) when we were at a few hours' notice dispatched here officially. If we have succeeded by any measures we have taken or any counsels we have given in contributing to this happy result, it will always remain a permanent source of satisfaction to us, particularly to myself, since I have had a most intense and absorbing desire to help in every way in my power.

(II) In view of the urgency of that call and the necessity it entails for our early departure, it is a matter of great satisfaction to me that it is possible for us to leave without any material alteration of the lines on which we have carried out our work.

(1) The problem of providing a simple and efficient method of disinfection available for every one and for railway purposes, has been solved, *not only now, but for all time.*

(2) The preventive anti-cholera inoculations (which, thanks to your provision of our special disinfecting and inoculating train, we have been able to carry out on some 300,000 men, at the rate of 10-15,000 men a day—and have carried out in the army with the vaccines we had prepared especially for Serbia from strains of cholera bacilli prevalent in Galicia) can be successfully continued by your own officers with the 300,000 to 350,000 doses of vaccine on the way from England, which I have had the pleasure in a former communication of placing at your disposal (No. 92, date May 29).

(3) The preventive inoculation against typhus abdominalis can similarly be commenced and continued as opportunity presents, with the 70,000 doses of anti-typhoid vaccine which I have now here, and are at your disposal.

(4) Lastly, the choice of Mladenovac by us as a town particularly well

adapted by its situation for the purposes of a great disinfection and cleansing station (to cut off infection coming from the armies to the general population or vice versa) has proved a wise one. It has during the past week received an important extension, which will add greatly to its value and efficiency, by decisions taken at your hands, with my strongest approval and support (*see* p. 127). These decisions are: (1) The establishment at Mladenovac of two large base hospitals, viz.: (*a*) the one transferred from Parachin; (*b*) the choice of that town as the seat of the Scottish Fever Mission work of Dr. Inglis, with complete tent equipment for 400 beds. (2) The choice of Valyevo and the dispatch thither to-day of another great Unit of the Scottish Fever Mission, also completely equipped with tents. The fullest provision has thus happily, and I think most judiciously, been made for: (*a*) the continuance of disinfecting and cleansing station at Mladenovac by handing over the work of that station to the Serbian personnel of the Serbia Fever Unit which you have transferred from Parachin. (*b*) Ample hospital fever accommodation (in Valyevo, Belgrade and Mladenovac) for fever cases occurring in these important areas. (*c*) The effective prevention of any spread of infection south of Mladenovac.

For purposes of disinfection we leave our two large disinfectors with twenty-five additional barrel disinfectors. For purposes of isolation and hospital equipment, thirty large English store tents are available, accommodating 600 patients.

(III) For purposes of bacteriology I have pleasure of placing at your disposal the equipment of our bacteriological laboratory, and I may take this opportunity of adding for your information that Captain Topley, who has had charge of the laboratory, has been successful in isolating a special organism present in all cases of typhus exanthematicus, and not found in any other disease. This discovery, if followed up and confirmed by further investigations on his return, will itself be a most important outcome of our work here.

(IV) Lastly, I have pleasure in handing over to you a large store of formaldehyde and other material which I hope may prove of value to the hospitals, specially those in Kragujevatz, in which I have taken a very close interest.

(V) I shall have the honour of communicating with you at an early date regarding the arrangements for our departure, which, I regret, must be very soon.

(VI) I desire, in concluding this communication, to express on behalf of myself and all my officers, our deep sense and appreciation of the numerous tokens of welcome and consideration which we have received at the hands of so many during our sojourn here. I desire particularly to thank you, Sir, and all the staff of your department, for the great courtesy and consideration which you have always extended to me personally in the many interviews and conversations which we have had during my stay here. I desire further to express my deep sense of indebtedness to Colonel Bojidarevitch and to Lieut.-Colonel Deroc of the Arsenal, for the great interest they took from the

outset in the construction of the Barrel Disinfector devised by us a few days after our arrival in Kragujevatz; and for the invaluable help which, in my judgment, they have rendered by the continual energy they have shown in providing such a large output of these most important apparatus. To Captain Christitch, who has commanded the English sanitary train, we owe a special debt of gratitude. Without his able and ready assistance at all times and under all circumstances, it would not have been possible to carry out a work we have done in inoculating against cholera. His services have simply been invaluable to our Mission, and, we consider, also to the army whose interest he has so closely at heart. I would also finally express my deep personal sense of the important services rendered to us and to the sanitary services on the railway by Captain Kopsha, who has helped so energetically and enthusiastically in all the matters relating to the work of disinfection and inoculation.

I have the honour to remain, Sir,
Your obedient servant,

Kragujevatz, June 3, 1915. WILLIAM HUNTER, Colonel, A.M.S.

The State Commission for the Prevention of
Infective Diseases, No. 2120, Nish.
May 26, 1915 (June 8, 1915).

To Colonel Dr. Hunter, Chief of British Military Sanitary Mission.

At the moment that you and your colleagues—doctors of the British Mission, are starting on your way back to your beautiful country, the State Commission for the Prevention of Infective Diseases, has the honour to express its most hearty thanks for your conscientious, devoted and useful work in the service of Serbia—and Serbian nation—in the hard times when infection was destroying this nation, already hardly tried and worn out by this war. Receive, Gentlemen, in the name of the whole Serbian nation, the greatest thanks. Glory and honour to your noble country, that you have represented amongst us so agreeably, usefully, and with so much dignity.

(Signed) The President VELISLAV VOULOTITCH,
Ex-Minister and National Representative (M.P.).

Members: Inspector of Military Sanitation, Colonel Dr. Sondermeyer.
Dr. Drag. Pavlovitch, M.P., Professor of Belgrade University.
Miloye Johannovitch, M.P., Director of the State Bank of Credit.

General Headquarters, Sanitary Department,
No. 1896.

To the Chief of the British Military Sanitary Mission.

I have received your letter of June 3, and I thank you for the kind thoughts in it. Your departure and that of your officers has been so unexpected that it is not possible for me at the present moment to say all I would have wanted

to say. I ask you, therefore, to allow me to thank you and your officers in a few words only for all you have done for the Serbian army and nation. I regret that your useful work cannot be continued, and the friendship that arose between your and our officers could not be developed further. Your Government has recalled you to give you new duties more important than the work that has still to be done in this country. Though you and your Mission have worked for a short time only, extraordinary results have been obtained. The help your Mission has given us in every way, under your experienced leadership, will be put at the head of all foreign aid we have had in this war. Wishing you and your officers a happy voyage, I thank you heartily for all the materials you brought down with you and that you have left us, and I thank you also for all the materials that have been sent to us from England at your request.

The Chief of the Sanitary Department of the
General Headquarters,
Colonel Dr. LAZAR GHENTCHITCH.

Kragujevatz, May 25, 1915 (June 7).

To the Chief of the British Military Sanitary Mission in Serbia,
Colonel W. Hunter.

Before all, please accept my deepest thanks for the numberless kindly attentions which you, as also all gentlemen of your Mission, have extended to me. From every side, and from the side of the Chief of our Sanitary Department, the remarkable activity of your Mission for the good of our Fatherland has been recognized and acknowledged. I should like now further to assure you that great as was our joy when we heard of your coming, and we could greet you with us, double as great are the feelings of our gratitude, now that we take farewell of your Mission. I should like to mention two special grounds for our joy and gratitude :—

An old proverb says: True friends are recognized in need. Now, you came to help us when our need was endless great, and have thereby shown us true friendship.

A second more important ground for our joy and gratitude is the following: The unfavourable geographical and political position of our Fatherland has brought it about that the great British nation, up to the time of the present world war, has only seen us through spectacles which were made in Austria, Hungary, and Germany, and allowed us always to appear in the most hateful light. Now, through your visit, the moment has come when these spectacles are for ever broken. You have seen our people as in reality they are, and for that we are both joyful and thankful to you.

We have always known and esteemed the great British nation, now we have learnt to love her. Please be the interpreter of this feeling to your

nation. I hope that it will find a response with her, and wish that the reciprocity of this feeling may form the basis of a sincere and lasting friendship between our nations.

Yours sincerely and attached and grateful,

Dr. MILUTIN KOPSHA,

Sanitats Captain and Commander of No. 5. Serbian Sanitary Train for Disinfection.

Nish, May 27, 1915 (June 9).

ACKNOWLEDGEMENTS.

With these final kindly tributes paid to its efforts and results of its work in Serbia, the Mission left Kragujevatz on June 10 and Salonica on June 14 for Malta, where the services of its officers were urgently required for the hospital needs created by the Dardanelles operations. If, as stated, its efforts had been successful, this was in a special measure due to the kindly welcome and warm support given to it by the Serbian authorities from first to last; it was also largely due to the military experience, sanitary knowledge, ingenuity in devising new and simple and practical and pre-eminently successful methods of disinfection of Lieutenant-Colonel G. E. F. Stammers, R.A.M.C., its chief staff officer. From the first, in my official reports, it was a pleasure to me to draw attention to the special character of his services. And looking back on the work of the Mission and its results, I feel more than ever how valuable they were in attaining the object of the task allotted to us—on such short notice—of restoring the Serbian armies to military efficiency by freeing them and the sorely stricken Serbian people from the overwhelming epidemics that hampered their action and added so terribly to their previous sufferings and losses. From all the other officers, the list of whom I here enclose, I likewise received strongest and warmest support; and I bear with me as one of my chief memories of our experiences—amid the rough and trying conditions of our life we had to meet on our arrival and for some weeks subsequently—the warm personal feelings of friendship I formed for all the officers constituting the Mission. Two of them fell ill within forty-eight hours of our arrival (Lieutenants Shorten and McFadden), and had to be invalided home four weeks later. Three of them (Captains R. H. Spittall, C. G. Smith, and S. E. McClutchey) were afterwards killed on the battlefields in France, and the others continued their work in various war areas of the East, where I afterwards had occasion to meet them.

Corps of Officers.

The Corps of Officers of the Mission was the following: Colonel Wm. Hunter, A.M.S., O.C.; Major (later Lieutenant-Colonel) G. E. F. Stammers, R.A.M.C. (Sanat.); Captain W. W. C. Topley, R.A.M.C. (Bacteriologist); Lieutenant F. F. Brown, R.A.M.C.; Lieutenant J. M. Clements, R.A.M.C.; Lieutenant B. C. Ewens, R.A.M.C.: Lieutenant C. M. Foster, R.A.M.C.; Lieutenant L. W. Forbes, R.A.M.C.; Lieutenant J. M. Hill, R.A.M.C.; Lieutenant S. W. Lund, R.A.M.C. (Special Reserve); Lieutenant S. E. McClutchey, R.A.M.C.; Lieutenant J. McFadden, R.A.M.C.; Lieutenant B. McCall-Smith, R.A.M.C.; Lieutenant C. R. Nicholson, R.A.M.C.; Lieutenant F. H. Ravenhill, R.A.M.C.; Lieutenant H. Y. Riddell, R.A.M.C.; Lieutenant P. J. Seccombe, R.A.M.C.; Lieutenant J. H. V. Scott, R.A.M.C.; Lieutenant W. W. Shorten, R.A.M.C.; Lieutenant R. H. Spittall, R.A.M.C.; Lieutenant C. G. Smith, R.A.M.C.; Lieutenant E. S. Walls, R.A.M.C. (Special Reserve); Lieutenant G. Whittington, R.A.M.C.; Lieutenant W. M. Will, R.A.M.C.; Lieutenant J. S. Williamson, R.A.M.C.; Lieutenant A. L. Walker, R.A.M.C., and Major Cox, R.A.M.C., who joined us from Shanghai two days before our recall.