

was practically a moving city, with a population varying from 105,000 to 160,000 men and from 25,000 to 60,000 horses, the whole or part of which often moved on short notice. The provision of the necessary facilities for the existence of this moving city constituted an important problem. It involved the provision and erection of the necessary hutting for quarters for officers and men, and in winter for shelter for horses; the necessary sanitary arrangements, such as latrines, baths, laundries, etc.; the provision of water for man and beast; and the one hundred and one things which are required for the maintenance of such a population in the field.

Arrangements had also to be made for the reception of the necessary supplies, rations and forage, ammunition, etc. This involved arrangements for railway sidings; development and maintenance of well-defined traffic routes to enable the heavy traffic to move without interruption; transport of supplies and ammunition to dumps and refilling points, from which they were distributed; and at these dumps and refilling points, facilities had to be provided for means of access, suitable covering for winter, and protection from damage by bombs and shell-fire.

Arrangements required by the medical department for the handling of sick and wounded involved the provision of roads or tramways for their evacuation; also the construction of regimental aid posts, advance dressing stations, main dressing stations and casualty clearing stations.

Water Supply

Reference has been made to water supply. This involved the provision of water supply necessary for drinking, cooking and washing for the men, and water for the horses; while, in addition, arrangements had also to be made in case of having to move suddenly into a new area a large number of men and horses; an area in which, probably, little was known of the facilities for water supply. In passing, I may mention that an important feature of the question of water supply for horses was that they must all be watered three times a day; and the strain on the available supply came at approximately the same hour. Furthermore, as it was very uncertain what engines and pumps were available, methods had frequently to be improvised.

I remember that at Ecoivres we developed a very large water supply, installing our own pumps and laying hundreds of miles of pipe to distribute the water. These pipes were laid on top of the ground at the start, but as labor became available, they were buried. In some of our areas we had water laid to the front line trenches. At Fosse 6, near Vimy, our engineers developed a water supply capable of providing 3,000 gallons an hour; and at Fosse 3, near Hill 65, we were developing a water supply of 4,000 gallons an hour. One interesting thing which occurs to my mind in connection with the water supply was our system of baths. We aimed to give every man a bath once in eight days.

Roads

The construction and maintenance of roads was also another very important feature. There were many good roads in the country where we served; but during the war the traffic on them was much greater than what had been contemplated when the roads were built, with the result that in bad weather many of the roads broke up. They required the most constant care and supervision. Many of them were altogether re-built. In the forward areas, the difficulties were enormously increased; many of the roads were under enemy observation, and so no work could be done in the day time. As there was no traffic on them in the day time, it followed that we had to repair them when the traffic was most busy.

It was often found that additional roads had to be made. To do this quickly we advocated the construction of corduroy roads, or plank roads,—a suggestion which was not at all enthusiastically received. In fact it was pooh-poohed until we had demonstrated the worth of a plank road, after which many such roads appeared. I remember our application for planks to build such a road was refused. We then asked whether, if we could not get planks, we could be furnished

with a saw mill. This was given to us, and in Bois de Alleux we cut down the trees and made our own planks,—an example of resource and initiative for which our Canadians became famous. Many infantry tracks and mule tracks had to be constructed and well marked. The proper way to mark a road was something we learned from the Boche; many will well remember such signs as "O.U. Denain," etc.

Bridges

Closely associated with roads are bridges. Apparently, the only bridge which it was contemplated the engineers would be called upon to put in position, was one made of pontoons; and most faithfully the sappers hauled their pontoons for many months, during which time it looked as though no need for them would ever arise. The only use to which I saw the pontoons put in the early days of the war was to furnish a grandstand at a sports meeting, or a platform for a boxing-bout. During the last hundred days, however, the pontoons well repaid the care they had been given and the practice of putting them into position. In the last hundred days the bridging problems confronting the engineers were very numerous and varied; while the difficulties were much increased by the thorough demolition of the original structures.

When the Germans were driven back they succeeded, in most instances, in destroying their bridges; not only were the girder sections cut by explosives and dropped into the river or canal, but the abutments were completely destroyed, and large craters blown in the approach roads. These craters had all to be filled or bridged before the heavy bridging material could be rushed forward. The reconstruction of these bridges was necessary to the development of our communications, and they were a tempting target for the enemy. As a general rule, they had to be erected on the original site, as otherwise a traffic diversion and road had to be made, and this involved loss of time. The bridging operations may be divided into three phases, viz: (1) Crossings for infantry; (2) crossings for first line transport, i.e., field guns, horse transport, etc.; (3) heavy bridges to take tanks, 6-in. guns, lorries, etc.

Infantry Crossings

These consisted of improvised crossings, or cork pier foot bridges, over the damaged structure. Sufficient slabs of cork to give the requisite buoyancy were baled together with wire netting and nailed across the stringers, and the bridge so formed took infantry across in single file. The German foot bridge was similar in many respects, with the exception that instead of cork they used hollow wrought-iron cylinders. These were more easily handled, but they were very easily punctured and the bridge put out of commission.

The pontoons and trestle equipment of the army proved itself invaluable for crossing the canal system; and a bridge of 90-ft. span could be erected in 1 to 1½ hrs. under adverse conditions. As an example of what can be done in speedy pontoon bridge construction by trained sappers, the following may prove interesting: The 12th Field Company, Canadian Engineers, erected 10 bays and one shore bay, total length 155 ft., of medium pontoon bridge, in 9 mins. and 48 secs. This was in England, and all the pontoons and equipment were unloaded and sorted out on the beach, but none were in the water prior to construction. Over the rivers various expedients were used; but, in general, trestle bridges were constructed with any material available.

Heavy Bridges

The construction of heavy bridges over the canals presented many problems; the latest type of tank had a live load of 37 tons, and the new 6-in. gun an axle load of 17 tons. The canals were approximately 90 ft. wide, and the clear span necessary about 108 ft. Clear span bridges were often required when it was impossible to remove the damaged structure and its presence in the bottom of the canal prevented the use of trestles and cribbing, at least for speedy construction.