

technical officers in charge of the branches of the directorates, etc., and also for their requirements of labour from the army.

These technical officers are enumerated as follows:—

D.A.D.R.T.—Deputy Assistant Director of Railway Transportation.

R.C.E.—Railway Construction Engineer.

O.C.R.O.D.—Officer Commanding Railway Operating Division.

A.D.L.—Assistant Director of Light Railways.

A.D.R.—Assistant Director of Roads.

D.A.D.I.W.T.—Deputy Assistant Director of Inland Water Transport.

The A.D.G.T. was virtually a Chairman of a Committee the members of which were the above mentioned representatives of the technical directorates. It was not his function to instruct any one of the technical representatives as to how his particular work was to be carried into effect, the latter communicated direct with G.H.Q. to their own respective heads of directorates, etc., on departmental questions and technical detail.

### **Work Performed by Directorates.**

A brief survey is given here of the method and volume of work performed by the various directorates so as to give you some idea of the dimensions of the organisation, commencing with the work at the base ports.

**Directorate of Docks.**—The six base ports for the British Armies zone of operations were, from north to south, Dunkirk, Calais, Boulogne, Dieppe, Rouen, and Havre, and they were placed under the control of the Director of Docks, who was responsible for the whole of the working of the traffic for the British Armies through these ports, except the embarkation and disembarkation of personnel. The magnitude of the work performed can be judged by

a glance at the following statement showing imported tonnage through all ports for one week in November, 1917.

Description of Traffic.	Tonnage Imported.
<b>Ammunition</b>	44,948 tons
<b>Supplies other than Coal</b>	
General . . . . .	23,323 "
Hay . . . . .	14,616 "
Oats . . . . .	20,520 "
Petrol (case) . . . . .	1,387 "
Petrol (bulk) . . . . .	10,741 "
<b>Timber</b>	
Royal Engineer Stores . . . . .	1,107 "
Railways & Roads	6,650 "
<b>Coke and Coal</b>	
Supplies . . . . .	3,371 "
Railways and Inland Water Transport. . . . .	9,642 "
Admiralty . . . . .	694 "
<b>Railway Material</b>	
New, other than timber . . . . .	10,161 "
Rolling Stock on own wheels.	2,571 "
<b>Road Material</b>	
Road Stone . . . . .	3,217 "
Slag . . . . .	5,181 "
<b>Royal Engineer Stores</b>	
Hutting, etc. . . . .	9,408 "
<b>Ordnance Stores</b>	10,144 "
<b>Miscellaneous</b>	6,741 "
	184,222 tons Total for week

At each port the Director was represented by an A.D.D. (Assistant Director of Docks) who was assisted by the following technical staff:—

(i) D.A.D.R.T.—Deputy Assistant Director of Railway Transportation, who controlled all railway traffic in and out of the port area.

(ii) D.A.D.D.—Deputy Assistant Director of Docks, for supervising all labour on the quays and in the transit sheds.

- (iii) **D.R.E.**—Docks Resident Engineer, to supervise the maintenance and repair of all equipment and cranes and other appliances, and any other engineering matters at the port.

### Directorate of Railway Transportation.

This directorate embodied the major portion of the old Directorate of Railways, but under the new organisation it only embraced the two establishments mentioned hereunder.

- (i) **R.T.E.**—**Railway Transport Establishment**, the personnel of which was placed at railhead areas, docks, etc., to accept the demands for railway transport for meeting the military requirements. They formed liaison between the military and the railway operating authorities either French or British.
- (ii) **R.O.D.**—**Railway Operating Division**, which embraced the technical personnel and locomotive power, etc., for operating on either British or French lines.

Hereunder is given a summary of the operations of this Directorate for one week during Nov., 1917. The number of troops carried during that week equalled 374,981. The average number of trains run per day, during the same week entirely for the British Armies was as follows:—

Trains from Bases to Railheads per day.

Description.	Number.
Supply .. . . .	46.4
Ammunition .. . . .	16.4
Royal Engineer Stores	8.6
Road Material .. . . .	18.0
Railway Material .. . . .	30.9
Personnel .. . . .	13.7
Ambulance Trains .. . . .	8.7
Special .. . . .	7.3
<b>Total .. . . .</b>	<b>150</b>

Trains on Lines of Communications per day. Ports to Bases and Bases to Bases.

Description.	Number.
Bulk Supplies .. . . .	25.3
Coal for R.O.D. .. . . .	2.1
Ammunition .. . . .	15.6
Ordnance .. . . .	3.3
Royal Engineer Stores	10.3
Railway Material .. . . .	7.4
Personnel .. . . .	5.4
Remounts .. . . .	1.7
Ambulance Trains .. . . .	5.9
Miscellaneous .. . . .	21.0
<b>Total .. . . .</b>	<b>98</b>

The grand daily total = 248 (for British Armies).

In addition British locomotives handled an average of 307 trains daily for the same period for the French Authorities over the Nord and Etat Railway systems.

The daily average number of loaded waggons hauled in the previous case = 6918,  
in the latter case = 6888,

The daily average total = 13,806 hauled by British locos.

#### Directorate of Roads.

This Directorate's sphere of operations was mainly in the Army Areas, the roads outside these areas and in the British zone were maintained by the local French Authorities.

The Army Area was subdivided into areas coinciding with those held by the Army Corps, with a Deputy Assistant Director in charge of all road work in the Corps area up to the D.G.T. line previously mentioned. This line usually extended along the British front in the vicinity of the guns of the heavy artillery. All roads in front of this line were constructed, re-constructed and maintained by the Chief Engineers of the Army Corps, work well known to the Australian engineer and infantryman.

The total mileage of roads maintained by the Directorate during the month of October, 1917, equalled 1659 miles averaging 14 men to the mile. The materials used in maintenance and construction of new roads were:—

Imported.	Obtained Locally.
Stone	Stone
Slag	Pierre de Fosse
	Gravel
	Sand, for bedding stone sets

This material averaged 8,404 tons daily used by the Directorate alone.

In the old battlefield areas timber bottoms had to be laid for a foundation, and for this purpose sleepers, pit props and split slabs were used, averaging 6000 daily.

### Quarries.

The French Authorities handed over to the D.G.T. several quarries, pits and fosses, for his sole use, and these were worked with British, French civilian, and German prisoner of war labour. The total daily output of these quarries etc., equalled 7500 tons.

### Road Construction Plant.

Practically the whole of this plant was installed by the D.G.T., and consisted of the following equipment at the latter end of 1917.

Description.	No.
Steam Rollers . . . . .	169
Steam Waggons . . . . .	312
Petrol Rollers . . . . .	28. (For use in Front Area under enemy observa- tion.)
Petrol Lorries . . . . .	222
Sweeping Machines . . . . .	176
Tarring Machines . . . . .	62
Water Carts . . . . .	147
Dump Carts . . . . .	963
Mud Tumbler Carts . . . . .	131

Prior to the Directorate of Transportation being established, the greater portion of road stone and road metal was imported from Britain for use in the British zone, amounting to many thousands of tons.

### Directorate of Light Railways.

Similar to the roads, this Directorate was subdivided into Army Areas, in addition, it embodied a Lines of Communication Area for handling the carriage of timber from the forests to the broad gauge railways or canals. The principal function of the Directorate was to convey the tonnage from the broad gauge railheads to the dumps, approximately in the vicinity of the heavy artillery and support line. The gauge adopted was 60 centimetres (1ft. 11 5/8 in.).

As mentioned earlier in the paper, I had some experience in this direction. During the Somme battles I con-

structed a complete light railway system in France, built with Australian labour drawn from the fighting troops, and operated by Australian railway traffic men, also drawn from the front line.

It was the first complete system of its kind in operation on the British front, and many of the principles laid down were afterwards adopted by the Light Railway Directorate.

The system designated as The Anzac Light Railways, which I had the honor of establishing and commanding, was taken over by the Director of Light Railways in May, 1917, when the Australians were taken out of the line for a rest, and the system as it stood became the 5th Army Light Railways, the Australians returning to their fighting units, except the operating personnel, who were formed into a Light Railway Operating Company for working under the D.G.T.

**Growth of Directorate.**—In October, 1916, Light Railways were practically non-existent in the British zone, but by October, 1917, there were 674 miles in operation.

There were 545 steam locomotives and 366 petrol electric and petrol tractors in use.

The locomotives were mainly of the Baldwin type, 4-6-0 and 2-6-2, weighing 15 tons loaded. Three petrol tractors were equivalent to one locomotive, and the average was one loco to each mile of track operated. The average speed maintained was  $2\frac{1}{2}$  miles per hour, including shunting and delays from enemy shellfire. Rolling stock was standardized to 10 ton bogie waggons and 3 ton four wheeled trucks; approximately 4,250 trucks were in use. The estimated number of waggons to each mile of track operated was 7, and each waggon averaged one trip per day.

**Carrying Capacity.**—The directorate reached a carrying capacity of 30,000 tons per day, or approximately 200,000 tons per week, consisting of all classes of tonnage and the percentage of useful tonnage for the armies being on an average 75 per cent, and the average length of haul for the total tonnage was 4.5 miles.

### **Inland Water Transport Directorate.**

This Directorate was established by the Royal Navy in 1915, and its principal officers were drawn from the Royal Indian Marine Service, the balance of personnel was recruited from the merchant service and amongst the Thames and Yorkshire bargees.

Its function was to maintain and develop the waterway system in the zone of operations of the British Armies in Belgium and France in order to supplement the other means of transportation of the Army by conveying by water a large quantity of tonnage from the bases to canal heads, which were as near to the zone of actual operations as was practicable.

The Directorate embodied the following units:—

- (i) **Canal Salvage Units.**—There were three of these units, and their function was the putting into trafficable order, portions of canal systems in captured enemy territory.

The units were very complete in every detail including 10 ton Priestman grabs, electric and pneumatic plants, the whole fitted on canal barges.

- (ii) **Dredging Units.**—These units (which comprised bucket and pump dredges) could deal with 40 tons per hour in the case of each unit. They also included self-propelled barges fitted with 3 ton Priestman grabs.

- (iii) **Filtration Barges.**—Each of these barges was capable of dealing with 4,000 gallons of water per hour, there was also a chemical laboratory for testing water, and an incubator was installed for development and observation of bacteria encountered.

These barges were used in Belgium in the vicinity of the sand dunes on the Belgian Coast for supplying fresh water to our troops and transport.

- (iv) **Pump Barges.**—Each barge had a capacity of one million gallons per hour, by means of 22in. centrifugal pumps. They were responsible for the supply of fresh water to the troops on the Somme, from which river they pumped the water, it being lifted in stages as far as Pozieres, almost to within four miles of Bapaume. They were also used for maintaining inundations in Belgium, thus providing a barrier to the enemy troops.

- (v) **Ambulance Barges.**—These barges were specially fitted out for the evacuation of wounded, and were very effectively used on the Somme during those operations. Others were fitted out to carry wounded and sick animals, and many animals' lives were saved by this means, as the transit was so smooth compared with the jolting of trains.

**General.**—The Directorate possessed a large fleet of steam tugs, oil launches and self-propelled barges, as well as the ordinary tow barge.

The latter type was capable of carrying 280 tons dead-weight.

The self-propelled barges, which (with the tow-barges) had been purchased from several sources, had many various types of engines, driven by one of the three oils,



petrol, paraffin and heavy oil. Altogether there were eleven different types of engines, causing much trouble in the matter of the supply of spare parts.

A standard barge, self-propelled, was designed, and 42 of this type were put into commission. Its leading dimensions were:—

Length . . . . .	120ft.
Draught . . . . .	5ft. 10 7-8in.
Capacity . . . . .	200 tons D.W.

and was driven by a 50 H.P. Kelvin engine.

**Towing Methods.**—The French method was chiefly by horse traction, the Belgian by tug haulage, and the British entirely by tug haulage. A greater speed than 4 kilometres per hour was not possible owing to the possibility of damaging the canal banks, and the time taken on an inland voyage depended on the following conditions: (a) length of daylight, it was impossible to voyage after dark; (b) weather conditions; (c) volume of traffic on the waterways (negotiating locks). From Dunkirk to Bethune (the later place was close to our old front line), a distance of 52 miles, one tug and 4 barges would take 2½ days to make the journey, one way. A self-propelled barge would traverse the distance in 2 days, as its despatch from the locks would be much quicker.

**Cross-Channel Barges.**—During 1917, it was decided to build barges for towing across the English Channel, and conveying tonnage from the Thames direct to the Bases in France and Belgium. These barges were more stoutly built, needing sufficient freeboard for the cross-Channel voyage. They had to be built to the dimensions of the French Standard Barge, so as to pass through the locks, and consequently their tonnage capacity had to be curtailed somewhat. viz, to 180 tons. D. W.

By this means some 10,000 tons of general cargo was transported economically from the factories in Britain to

the bases in the British zone. The Directorate's weekly operations averaged some 52,000 tons of cargo and the transporting of 12,000 troops, etc.,

Of the remaining Departments, much could be said of their organisation if time permitted, and of the Chief Mechanical Engineer's Department, the work of assembling and putting into traffic 1396 locomotives, and 41,000 trucks to augment the French rolling stock.

The organisations for these purposes allowed for 10 locos., and 300 waggons a week to be assembled and put into traffic. A large number of locos. were brought over on their own wheels from the British railways, the balance being supplied by contract, including ten New South Wales "T" class goods engines, the balance of an uncompleted order from the North British Railway Coy., for the N.S.W. Government. A very fine base locomotive workshop was established at St. Etienne du Rouvray, near Rouen for the purpose of erecting the new locos., and to cope with 30 heavy loco repairs a week, as well as to manufacture spare parts for the Belgian locos, which had been saved from capture in Belgium.

Of the Ports Construction Dept., the work of constructing the termini for the Cross-Channel Train Ferries was their principal concern. This Dept. was organised to be ready to commence work on the captured ports in order to put them into operation immediately after capture.

In conclusion the following chart shows the number of troops employed in the various departments etc., in order to maintain the transportation services.

Making a total of approximately 94,000 troops all told, and, together with troops from other sources, the grand total was 150,000 troops employed on transportation works and services, approximately  $8\frac{1}{2}$  per cent. of the total fighting troops.