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To

HIS EXCELLENCY

GENERAL SIR DONALD MARTIN STEWART BART,

G. C. B., C. I. E.,

COMMANDER-IN-CHIEF IN INDIA,

These Notes

ON

MILITARY TRANSPORT BY INDIAN RAILWAYS

ARE WITH

HIS EXCELLENCY'S MOST KIND PERMISSION

DEDICATED.

P R E F A C E.

The following pages are published in accordance with suggestions from various quarters to the effect, that information collected from reliable sources, respecting the transport of troops by railways in India, would be very useful, as demonstrating what can be done ; and as also affording instruction for some future occasion when perhaps, the transport of troops in India will be required on a larger scale than heretofore.

During the late war in Afghanistan, 1878-81, I superintended the arrangements for the despatch of troops of all arms, as well as that of military stores by the Sindh, Punjab and Delhi Railway, and the results of my experience during that period were set forth at length in a lecture, delivered at the United Service Institution of India, at Simla.

That lecture is now issued in a condensed form ; I have also revised and embodied various reports on the question of military transport by Indian Railways, which have been submitted from time to time. The whole comprising all the available information on a very interesting and important subject.

DAVID ROSS.

Lahore, April 1883

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„ XII & XIII	{ Graphic Time Tables showing Troop movements which could be conducted without interfering with public traffic.
„ XIV & XV.	{ Graphic Time Table showing Troop movements with only goods traffic stopped

MILITARY TRANSPORT BY INDIAN RAILWAYS.

GENERAL REMARKS

In arranging transport for large bodies of troops by railway, the military authorities should, if possible, give the railway executive officers timely notice, with full details as to the strength, quantity of baggage, number of horses and guns, and the stations between which they are to be conveyed; the dates of departure should be added, and the hour of starting, halting and arrival, also what each train unit will consist of, whether battery or half battery, wing, troop or squadron.

Another and most important point is, that in an emergency, when the carrying and running capacity of railways are taxed to the utmost, orders for the movements of troops should be issued by one central authority in the Quarter-Master-General's Department.

This will prevent demands being made at one and the same time from two or three different points for special troop trains, when probably there is only sufficient stock for carriage from one station, and it would be necessary to give precedence to the movement which appeared to be the most urgent.

One central authority regulating priority in the despatch of troops, would also prevent the unnecessary haulage of trains to certain points ; perhaps, only to find on arrival that orders had been changed, and that the troops were to remain or to march by road.

*

Military stores should never be loaded up or forwarded until their ultimate destination by rail is definitely known ; for, if wagons so laden are detained, the work in the station yard is seriously interfered with : they take up the already limited siding accommodation, impede free working, prevent rolling-stock being employed or fully utilized in the conveyance of other traffic, and altogether cause general confusion.

The orders from the Quarter-Master-General's Department should also be communicated direct to the Traffic Manager of each railway, or through an officer especially appointed for the purpose ; that is to say, when the movements of troops are so extensive as to interfere with the ordinary traffic of the line.

The arrangements for the assembling of troops at the railway stations, so as to allow sufficient time for entering the carriages, and the order of doing so, also the loading up of baggage, horses or guns are clearly laid down in the Military Transport Regulations, and do not require to be detailed here.

MOVEMENTS OF TROOPS DURING THE LAST
AFGHAN WAR.

When intimation was received from the military authorities about the end of September 1878, that a large movement of troops towards the north-west frontier would take place, the traffic on the Sindh, Punjab and Delhi Railway was being conducted under considerable difficulties with two breaks on the line—each about two miles in length—over the Beas and Beyne Valleys, owing to some bridges and portions of embankments at these points having been swept away by the heavy floods which occurred in the previous month of August.

However, by great exertion, temporary bridges were run up in a very short time, through communication was re-established, and, early in October, the first troop trains conveyed the 12th Regiment of Khelat-i-Ghilzais and an Elephant-Battery ;—followed soon afterwards by special troop trains daily, supplemented by ordinary trains, which also carried large bodies of men and nearly all military stores.

The following summary shows the transport by rail of troops, horses, guns, and war material for the army in Afghanistan during the 1st, 2nd and 3rd campaigns, and their return from Kandahar.

FIRST CAMPAIGN.

MONTH.	No. of Specials.	Troops and Followers.	Horses, Mules and Ponies.	Bullocks.	Camels.	Guns Artillery and Engrs.'s Carriages.	Military Baggage, Commissariat & Ordnance stores, &c.	Frontier Ry. Material for Kan- dahar.	Frontier Ry. Material for Pesha war.
Octr 1878	35	25,500	2,518	807	...	165	Mds. 1,03,582	Mds. 1,622	Mds. 43,001
Novr. "	94	39,097	6,688	1,505	7	153	1,93,022	1,642	14,881
Decr. "	21	30,408	922	585	...	...	2,55,179	1,342	56,960
Jany. 1879	10	10,095	286	1,499	...	...	1,14,441	11,096	2,173
Febv. "	17	17,776	2,408	46	9	...	1,69,956	12,732	21,075
March "	13	19,265	3,857	1,786	6	...	2,10,040	13,413	57,421
April "	25	14,951	2,425	292	191	...	1,35,249	7,139	8,089
May "	14	13,762	5,143	280	551	...	1,38,888	8,232	416
June "	13	8,591	872	753	209	18	48,720	98	6,826
July "	13	12,162	1,459	...	...	21	44,935	1,575	11,451
TOTAL . .	258	1,91,605	26,578	7,553	973	357	14,11,012	59,201	2,55,272

SECOND CAMPAIGN (after the massacre of Sir Louis
Cavagnari and the Embassy.)

Sept. 1879	25	11,193	3,053	42	302	...	42,149	4,111	4,684
Octr. "	65	21,806	11,044	1,093	2,328	12	1,60,142	71,728	8,547
Novr. "	22	20,084	18,583	30	692	...	2,90,717	2,72,472	23,526
Decr. "	14	13,478	4,673	...	588	36	2,28,435	2,78,992	39,366
Jany. 1880	28	26,318	7,874	...	645	9	1,17,310	31,388	22,666
Febv. "	16	19,436	2,782	85	342	...	97,078	3,136	1,42,780
March "	5	11,892	663	300	507	...	97,085	.	1,35,406
April "	7	9,538	2,556	2,425	1,932	...	2,26,377	10,164	1,06,710
May "	5	9,286	3,259	2,356	320	...	93,433	9,632	56,584
June "	5	5,976	3,591	277	8	...	52,851	...	1,66,291
TOTAL . .	192	1,49,217	58,078	6,608	7,664	57	14,11,880	6,81,653	7,06,659

THIRD CAMPAIGN (*after Maiwand.*)

MONTH.	No. of Specials.	Troops and Followers.	Horses, Mules and Ponies.	Bullocks.	Camels.	Guns Artillery and Engr.'s Carriages.	Military Baggage, Commissariat & Ordnance Stores, &c.	Frontier Ry. Material for Kandahar.	Frontier Ry. Material for Peshawar.
							Mds.	Mds.	Mds.
July 1880	6	9,856	3,146	38	8	...	19,229	375	2,01,248
Augt. "	33	18,050	4,239	400	...	65	6,92,141	600	18,390
Sept. "	31	14,109	4,715	411	..	...	94,608	7,993	74,995
Oct. "	58	40,816	3,818	..	...	..	1,27,585	666	36,102
Novr. "	50	29,742	2,823	...	...	...	48,193	457	13,126
Decr. "	21	19,045	2,249	398	...	..	18,667	162	77,098
Jany. 1881	19	10,393	1,236	...	...	...	25,041	..	52,785
Feby "	4	6,338	508	3	1	...	14,333	259	96,257
March "	23	9,139	1,450	66	...	...	22,352	1,650	43,766
TOTAL ...	248	1,57,018	24,194	1,316	9	65	10,62,149	12,162	6,14,047

Return from Kandahar.

April 1881	17	17,357	1,977	...	...	...	1,15,918	3,568	24,602
May "	58	16,499	3,197	...	..	..	29,873	639	41,018
June "	12	6,668	132	...	...	...	30,128	56,492	78,918
TOTAL ...	87	40,524	5,306	...	...	...	75,919	60,699	1,44,564
Grand Total }	785	5,38,364	1,14,156	15,477	8,645	479	39,63,960	8,13,715	17,20,442

The gross military traffic booked under Government warrants during the Afghan war was :—

538,364 Troops and Followers.

114,156 Horses, Ponies and Mules.

15,477 Bullocks.

8,645 Camels.

479 Guns, Artillery and Engineers' Carriages.

148,889 tons of Commissariat, Ordnance and Military Stores.

93,099 „ of material for the Frontier Railways.

Requiring an estimated number of 2,023 trains, 785 of which were special troop, live-stock and material trains.

The greatest number of special troop trains running in one day was eight, carrying 4,000 men and followers with guns, horses, baggage and stores.

The weight of stores despatched only represents the quantity booked under Government warrants, and as the greater portion of Commissariat supplies was sent by traders, these figures only show a small proportion of what was actually forwarded by rail.

On the other hand the number of troops and followers conveyed seems very high, but this arises from each separate despatch of troops being reckoned as a fresh departure.

Thus, a number of regiments were concentrated at Ambala, Mian Mir, Multan and elsewhere, in the first place; and remained there for a few weeks before proceeding to the front; these troops, of course, are reckoned twice, and often three times. Each despatch involved nearly the same amount of work with the exception of haulage, to the Railway authorities, as if the regiments had gone at first right through to their destination, that is so far as collecting stock, embarking and disembarking, and arranging Time-tables were concerned.

In order to cope with this heavy traffic, it was necessary to adopt for regular working the "train following system" in despatching trains under "caution messages;" a method previously resorted to only under exceptional cases. The "absolute line clear," which is virtually the same as the "block" system, had been hitherto in force, but owing to the greatly increased traffic, "time intervals" had to be adopted and trains followed each other at fixed periods of not less than 10 and 15 minutes. The speed of the troop specials was about 21 miles per hour exclusive of stoppages, which were fixed by the Military authorities. Loads averaged 33 vehicles per train.

For some time there were about sixty trains entering and leaving the Lahore station daily, which will give an idea of the heavy work that had to be conducted, and this on single lines of railway.

A series of Time-tables for troop trains had been previously prepared, so that the Quarter-Master-General's requirements for the despatch of troop specials were met at a moment's notice.

The hours of starting, constitution of the trains, the halts and arrivals were fixed in consultation with the respective Deputy Assistant Quarter-Masters-General, and there was no difficulty generally in despatching the trains at the times required by the Military authorities, and without interfering in any way with public traffic.

The ordinary traffic of the line, which was very heavy at the time, was not delayed or hindered, although troops and military stores had in all cases the first supply of vehicles, and also priority in despatch.

In each case printed Time-tables were issued to all the Stations concerned, showing distinctly the times of arrival and departure, and where other trains were to be passed or crossed, and the halts for refreshments.

Copies of these Time-tables were also furnished to the respective Assistant Quarter-Masters-General and Commissariat Officers, as well as to the Officers in Command of the troops proceeding with the special trains.

When the urgency of military requirements did not permit of sufficient previous notice being given to issue printed Time-bills in the usual way, the necessary instruc-

tions to the Traffic staff were telegraphed to all stations in regard to the running of troop specials and the trains worked to "line clear."

The conversion of the Goods rolling-stock for troop and passenger purposes, had also been the subject of previous careful experiment, so that when the movements commenced, covered goods wagons were adapted in a few hours for the carriage of troops or passengers, by the simple arrangement of removing a few of the side iron panels for ventilation, and fixing boards as temporary seats.

The only way in which the public suffered, although it is reported that the natives considered it no hardship, was the substitution of covered wagons for third class carriages, the latter being all required for the conveyance of troops.

Those vehicles similarly treated, with the addition of breast-bars fixed across the wagon, were admirably suited for the carriage of horses: eight were placed in each, four abreast, with their heads facing the centre, allowing space between them, for Syces, provender and harness.

About 250 wagons were thus altered for the conveyance of ordinary third class passengers and cavalry, enabling the Sindh, Punjab and Delhi Railway to meet all the requirements of the Military authorities, and also to conduct unimpeded, the regular traffic of the line.

The ordinary horse-boxes were in all cases used for officers' chargers.

The chief difficulty to contend with during the first campaign was the want of sufficient siding, platform and loading bank accommodation at such stations as Multan, Lahore, Mian Mir, Jalandhar, Ambala and Meerut; but even those obstacles were in a great measure surmounted by marshalling the ordinary trains at points not affected by the troop traffic, and using all cantonment stations as much as possible for military purposes alone.

Profiting however, by this experience, large additions to sidings and platforms have since been made, the advantages of which were experienced during the succeeding campaigns.

TIME-TABLES FOR TROOP TRAINS.

MAXIMUM FORCE.

Some time previous to the commencement of hostilities in Afghanistan, a troop time-table was prepared, showing the maximum carrying capabilities of the Sindh, Punjab and Delhi Railway. It was based on the assumption that the ordinary traffic was stopped; that there was sufficient engine-power and carriages; and that the necessary platform and siding accommodation would be provided at the rest and terminal stations.

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Below are sketches of troop train time-tables, and also a summary of the transport powers of the Sindh, Punjab and Delhi Railway under similar conditions.

These time-tables provide for 13 trains running each way on the Lahore and Multan Section, and 17 in each direction on the Lahore and Delhi Division; this is the maximum number that could be run under "line clear" with a load of 35 vehicles each at a speed of 22 miles per hour, with the existing number of crossing stations, and allowing stoppages for necessary purposes, such as breakfast, dinner, &c., varying from 30 minutes to 2 hours.

To illustrate the following tables as clearly as possible, diagrams or Graphic Time-tables are given in the Appendix, see plates Nos. X. and XI.

UP LOADED—

Maximum number of Troop Trains

Allowing the following halts—30 minutes about 6 A. M., one hour

Miles from Delhi.			2	4	6	8	10	12
.	Delhi	 dep.	0-13	1-5	2-24	3-26	5-12	6-33
13	Ghaziabad	 { arr	0-53	1-45	3-4	4-6	5-52	7-13
		 { dep.	1-3	1-55	3-14	4-16	6-2	7-23
43	Meerut Cant.	 { arr.	3-5	3-55	4-47	5-56	7-41	9-2
		 { dep.	3-15	4-6	4-52	6-24	7-46	9-56
75	Muzaffarnagar	 { arr.	4-53	5-40	6-56	8-0	10-17	11-31
		 { dep.	4-57	5-45	7-1	8-10	10-22	11-36
111	Saharanpur	 { arr.	6-43	7-41	9-5	10-8	12-13	13-30
		 { dep.	7-3	7-58	10-38	11-31	12-43	13-54
161	Ambala Cant.	 { arr.	10-37	11-31	13-39	14-32	15-33	18-39
		 { dep.	11-5	11-52	13-55	15-11	17-29	19-13
232	Ludhiana	 { arr.	15-3	18-27	19-38	20-52	21-46	23-2
		 { dep.	17-7	18-41	19-43	21-9	21-51	23-7
240	Phillour	 { arr.	17-40	19-14	20-15	21-42	22-24	23-40
		 { dep.	18-18	19-36	20-54	22-12	23-29	0-11
264	Jalandhar Cant	 { arr.	19-37	20-47	22-8	23-30	0-35	1-21
		 { dep.	20-0	21-2	22-20	23-45	0-52	1-41
316	Amritsar	 { arr.	23-27	0-8	1-19	2-36	3-56	5-12
		 { dep.	23-32	0-21	1-36	2-41	4-16	5-17
345	Mian Mir, East	 { arr.	1-1	1-49	3-19	4-8	5-40	7-17
		 { dep.	1-5	1-54	3-25	4-11	5-45	7-27
348	Lahore	 arr.	1-15	2-4	3-35	4-21	5-55	7-37

DELHI TO LAHORE.

with all other Traffic stopped.*between 9 & 10, 2 hours between 15 & 17, 30 mts between 18 & 19*

14	16	18	20	22	24	26	28	30	32	34*
8-40	9-55	10-53	12-58	15-48	18-45	18-48	19-43	21-10	22-0	23-23
9-20	10-35	11-33	13-38	16-28	17-25	19-28	20-23	21-50	22-40	0-3
9-30	10-45	11-43	13-48	16-38	17-35	19-38	20-33	22-5	22-50	0-31
11-9	12-27	13-20	17-31	18-15	19-40	21-18	22-8	23-50	0-39	2-10
11-14	12-32	13-31	17-39	18-39	19-45	21-21	22-19	23-55	0-53	2-13
12-54	14-7	16-57	19-14	20-13	21-29	22-55	0-11	1-45	2-29	3-41
13-4	14-31	17-3	19-19	20-17	21-34	22-58	0-26	1-48	2-36	3-18
14-49	18-6	19-10	21-7	22-6	23-25	0-54	2-12	3-32	4-32	5-35
17-13	18-36	19-32	21-25	22-29	0-23	1-23	2-32	3-52	4-52	5-55
20-21	21-18	22-17	0-9	1-19	3-9	4-9	5-11	6-40	7-37	8-39
20-31	21-46	22-25	0-18	1-27	3-19	4-27	5-16	6-45	8-0	9-58
0-29	1-29	2-21	4-9	5-16	7-37	8-43	10-40	11-50	12-51	13-54
0-39	1-33	2-40	4-11	5-21	7-42	9-20	10-45	11-55	12-58	14-6
1-12	2-5	3-12	4-17	5-54	8-14	9-53	11-18	12-28	13-31	14-39
1-27	2-41	4-1	5-58	7-14	8-41	10-27	11-56	13-14	14-30	17-0
2-38	3-52	5-31	7-11	8-21	10-34	11-40	13-7	14-21	17-36	18-15
2-43	4-0	5-36	7-20	8-25	10-42	12-0	13-16	14-26	17-41	18-31
5-51	7-17	8-43	10-52	12-10	13-28	15-10	16-5	19-23	20-50	22-7
5-56	7-22	9-13	11-20	12-15	13-33	17-10	18-10	19-43	20-57	22-12
8-10	8-52	11-11	12-48	13-41	15-1	18-38	20-5	21-11	22-25	23-40
8-15	8-55	11-15	12-53	13-46	15-5	18-43	20-10	21-15	22-30	23-45
8-25	9-5	11-25	13-3	13-56	15-15	18-53	20-20	21-25	22-40	23-55

DOWN EMPTY—

Maximum number of Troop Trains

Miles from Lahore.					1	3	5	7	9	11	
	Lahore	...	...	...	dep.	0-15	1-35	3-5	5-28	6-18	7-16
3	Mian Mir, East				arr.	0-55	1-45	3-15	5-38	6-28	7-26
					dep.	1-2	1-50	3-20	5-41	6-32	7-31
32	Amritsar	...	...	...	arr.	2-32	3-26	5-8	7-21	8-20	9-9
					dep.	2-37	3-57	5-52	7-30	8-44	9-34
84	Jalandhar Cant.	...	...	...	arr.	5-27	7-19	8-49	10-30	11-59	13-15
					dep.	5-52	7-24	8-54	10-35	12-4	13-20
108	Phillour	...	...	...	arr.	7-14	8-33	10-3	11-44	13-13	14-29
					dep.	8-46	9-54	11-19	13-32	15-1	15-35
116	Ludhiana	...	...	...	arr.	9-19	10-27	11-51	14-5	15-34	16-8
					dep.	9-48	10-41	11-55	14-10	15-40	16-18
187	Ambala Cant.	..	...	...	arr.	13-41	14-40	15-53	18-6	19-10	21-1
					dep.	13-50	14-48	16-31	18-40	20-25	21-31
237	Saharanpur	...	...	...	arr.	16-38	18-0	19-31	21-21	23-19	0-22
					dep.	17-7	19-11	20-1	22-28	23-55	1-13
273	Muzaffarnagar	...	...	...	arr.	19-18	21-2	22-13	0-25	1-26	3-24
					dep.	20-14	21-30	22-56	0-30	2-30	3-42
305	Meerut Cant.	..	...	...	arr.	22-4	23-9	0-37	2-55	4-5	5-50
					dep.	22-9	23-14	0-40	3-6	4-14	5-57
335	Ghaziabad	..	...	...	arr.	23-18	1-51	2-36	5-7	5-58	8-14
					dep.	0-4	2-15	3-17	5-53	6-24	8-31
48	Delhi	...	...	...	arr.	0-41	2-55	3-57	6-32	7-4	9-11

LAHORE TO DELHI.

with all other Traffic stopped.

13	15	17	19	21	23	25	27	29	31	33
8-14	10-18	11-1	13-25	14-7	16-10	17-5	18-32	19-10	20-57	23-25
8-54	10-25	11-14	13-35	14-17	16-20	17-15	18-42	19-20	21-7	23-35
9-2	10-32	11-31	13-42	14-22	16-23	17-21	18-48	19-26	21-12	23-41
10-39	12-6	13-13	15-6	16-54	17-55	18-57	20-28	21-12	23-10	1-12
10-53	12-11	13-11	15-11	16-4	18-6	19-24	20-51	22-14	0-9	1-20
13-53	15-9	16-38	18-0	19-20	21-57	23-4	0-4	2-29	3-40	4-19
14-24	15-29	16-42	18-22	19-38	22-18	23-40	1-22	2-39	3-53	4-24
15-17	16-38	18-17	19-35	20-53	23-28	1-26	2-43	4-0	5-16	5-57
16-33	18-7	20-16	21-35	22-33	23-53	2-6	3-33	4-18	5-55	7-3
17-6	18-40	20-18	21-8	22-6	0-26	2-39	4-6	5-20	6-28	7-36
17-34	18-45	20-53	22-9	23-23	0-36	3-3	4-11	5-25	6-31	7-41
22-21	0-45	2-2	3-12	3-58	5-9	7-12	8-33	9-43	10-31	11-46
22-26	1-20	2-21	3-20	4-20	5-47	7-43	8-40	9-50	10-33	11-56
1-18	4-40	5-45	6-50	7-53	8-58	10-37	11-33	12-33	13-50	14-49
3-33	5-11	6-11	8-1	9-6	10-9	11-14	12-31	13-42	14-50	15-59
5-36	7-50	8-55	9-56	11-9	12-15	13-43	14-30	15-36	16-45	17-51
5-41	8-1	9-0	10-18	11-39	12-53	14-8	15-1	16-42	17-53	18-54
7-14	9-32	10-45	11-57	13-16	14-22	15-42	16-36	17-19	18-31	19-36
7-19	9-35	10-50	12-10	13-21	14-40	15-45	16-39	17-35	18-36	19-41
8-58	11-36	12-34	14-39	15-23	16-37	17-29	18-26	19-25	20-32	21-23
9-42	11-46	12-40	14-49	15-39	17-26	17-53	18-39	19-34	20-57	21-51
10-22	12-26	13-29	15-29	16-19	18-5	18-33	19-19	20-14	21-37	22-31

DOWN LOADED—

Maximum number of Troop Trains

Allowing the following halts,—30 mts. about 6 A. M., one hour between

Miles from Multan Cant.				1	3	5	7
...	Multan Cant.	...	dep.	1-25	2-45	4-30	6-15
...	...	...	arr.	4-20	5-37	7-54	9-10
58	Channu	...	dep.	4-27	6-7	8-6	9-15
...	...	...	arr.	5-27	7-7	9-5	11-10
70	Chichawatni	...	dep.	5-54	7-14	9-11	11-17
...	...	...	arr.	7-9	8-31	10-28	12-32
105	Montgomery	...	dep.	7-29	8-51	11-28	12-52
...	...	...	arr.	8-50	10-54	12-44	14-4
128	Okara	...	dep.	9-11	11-1	12-51	14-11
...	...	...	arr.	12-59	13-52	15-29	18-43
182	Raewind	...	dep.	13-4	13-57	17-29	18-18
...	...	...	arr.	14-10	15-3	18-35	20-19
204	Mian Min, West	...	dep.	14-15	17-3	18-10	20-24
...	...	...	arr.	14-27	17-15	18-52	20-36
208	Lahore	...	...				

UP EMPTY—

Maximum number of Troop Trains

Miles from Lahore.				2	4	6	8
...	Lahore	...	dep.	11-25	13-54	15-36	17-16
...	...	...	arr.	11-37	14-6	15-48	17-28
4	Mian Min, West	...	dep.	11-42	14-11	15-53	17-35
...	...	...	arr.	13-3	15-18	16-59	18-47
26	Raewind	...	dep.	13-53	15-30	17-4	19-35
...	...	...	arr.	16-30	18-30	20-20	22-10
80	Okara	...	dep.	17-22	18-38	21-14	23-3
...	...	...	arr.	18-39	20-9	22-22	0-11
103	Montgomery	...	dep.	18-54	21-7	22-56	0-53
...	...	...	arr.	20-8	22-24	0-48	2-38
129	Chichawatni	...	dep.	20-10	22-41	1-27	2-55
...	...	...	arr.	21-12	23-39	2-47	4-14
150	Channu	...	dep.	21-39	23-46	3-2	4-21
...	...	...	arr.	1-16	3-1	6-1	8-30
208	Multan Cant.	...	...				

MULTAN TO LAHORE.

with all other Traffic stopped.

9 and 10, 2 hours between 15 and 17, 30 minutes between 18 & 19.

9	11	13	15	17	19	21	23	25
7-5	8-10	11-0	12-47	14-35	18 12	20 24	22 0	23-13
10-44	12-20	14-0	17-43	19 56	21-35	23-33	1-13	2-41
11-3	12-27	14-7	17-50	20-3	21-40	23-40	1-20	2-48
12-5	13-27	15-7	18-50	21 5	22 40	0 42	2-12	3 50
12-10	13-32	15-10	18-55	21-11	22-50	0-49	2-39	3 57
13-25	14-17	18 22	20 12	22-28	0-9	2-6	3-51	5-13
13-35	17-16	18-46	20 59	22-18	0-39	2-26	4-16	5-43
14-39	18-34	20-14	22-6	23-56	1-16	3-34	5-24	6 51
16-41	18-31	21-21	22-11	0 1	1-51	3-41	5-31	7-21
19-34	21-24	23-3	0-49	2-40	4-30	6-20	8-24	11-22
20-4	21-29	23-8	0-57	2 45	4-35	6 50	8-29	11-27
21-11	22-35	0-14	2 3	3-51	5 41	7-56	10-30	12-33
21-15	22-40	0-19	2-8	3 56	5-46	8-1	10-35	12-38
21-27	22-52	0-31	2-20	4-8	5-58	8-13	10-47	12-50

LAHORE TO MULTAN.

with all other Traffic stopped.

10	12	14	16	18	20	22	24	26
20-3	21 28	23 6	0-55	2-43	4 33	6-43	8-19	9-22
20-15	21-40	23-18	1-7	2-55	4-45	7-0	8-31	9-34
20-20	21-44	23-23	1-12	3-0	4-50	7-5	8-36	9-39
21-23	23-5	0-56	2-44	4-31	6-24	8-18	9-41	10-50
21-26	23-10	1-1	2-51	4-41	6-33	8-25	9-44	11-23
21-0	1-50	3-40	5-30	7-20	9-10	11-0	12-50	14-38
0-53	2 38	4-28	5-58	7-44	9-20	11-13	13 19	14-43
2-2	3 49	5-39	7 6	8-50	10-58	12-51	14-58	15-51
2-33	4-0	5-56	7-18	9-16	11-19	13-26	15-18	17-9
3-56	5-17	7-13	8-40	10-37	13-21	14-43	16-35	18-41
4-29	5-50	7-23	9-6	11-11	13-31	15 8	16-41	18 51
6-6	7-8	9-6	10-16	12-10	15-7	16-8	17-43	19 51
6-27	7-55	9-16	10-57	12-21	15-12	16-15	17-50	19-57
10-13	11-11	12-31	14-13	16-2	18-3	19-45	21-52	23 33

ROLLING-STOCK NECESSARY FOR TROOP TRAINS.
MAXIMUM FORCE.

The number of trains provided for in the foregoing time-tables would be equal to the concentration at Lahore daily of an average Army Division consisting of,—

2 Batteries Royal Horse Artillery.

1 Battery of Field Artillery.

1 Regiment of British Cavalry.

1½ Regiments of Native „

“

3 „ of British Infantry.

5 „ of Native „

or a total force of,—

6442 Officers and men.

5039 Followers.

1441 Horses.

747 Ponies and Bullocks.

167 Wagon loads of tents and Military Baggage,
exclusive of what may be carried in Brake-
vans.

14 Wagons of Bazaar and Commissariat Stores.

12 „ „ Ammunition.

18 Guns with Ammunition and Stores Wagons.

To show the rolling-stock required for the conveyance of this maximum force, the following tables K. and L., have been prepared :—

**TABLE
DETAILS**

The following Table shows the details of this force, posing it, a deduction of 20 per cent. has been made for Regimental Depôts, or would be sick or unfit for active

DESCRIPTION OF UNITS	No. of Trains required	DETAILS		
		European Officers	Native Officers	Medical Subordinates and Staff Sergeants.
2 Batteries of Royal Horse Artillery	4	10		8
1 Battery of Field Artillery	2	5		4
1 Regiment British Cavalry	1	20		12
1½ Do Native do	6	10	18	
3 Do British Infantry	9	72		36
5 Do Native Infantry	5	35	65	
TOTAL,	30	152	83	60

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K. OF FORCE

From the total strength of the different military units com-
officers and men, &c, who, it is assumed, would be left at
service.

OF FORCE.

Non Commissioned Officers and men	Followers	Officers' Horses	Troop Horses	Poles and Cattle	Wagons for Baggage	Wagons for Bazaar & Commessant Stores	Powder Vans	Trucks for Guns	Grand Total Officers Men & Followers
218	106	21	296	176	10	2		21	11,481
124	197	7	88	60	7	1	1	12	
355	573	51	319	181	20	1	1	.	
532	235	48	532	282	10	2	2		
2,103	2,538	18		39	81	3	3		
2,785	1,090	35		..	30	5	5	.	
6,147	6,039	180	1,255	747	107	11	12	30	11,481

TABLE

The following Table shows the details of the Rolling-

Description of Units.	No. of Trains.	DETAIL OF ROLLING							
		First Class.	Composite.	Second Class.	TROOPS 3RD CLASS		FOLLOWERS.		
					Third Class	Box Wagons	3rd Class.		Box Wagons
							Double story	Single.	
2 Batteries of Royal Horse Artillery ..	4	..	4	.	.	12	.	..	12
1 Battery of Field Artillery ..	2	..	2	..	.	6	..	..	6
1 Regiment British Cavalry	4	..	4	4	8	..	..	12	4
1½ Do Native do.	6	..	6	..	..	30	..	..	6
8 Do British Infantry	9	9	..	9	..	108	..	..	72
5 Do Native do.	5	5	..	5	95	..	10	..	6
Required for Loaded Trains ..	30	14	10	18	103	150	10	12	105
Do for Empty Trains..	90	11	10	18	103	156	10	12	106
..	..	28	32	36	206	312	20	21	210
Add 10 per cent. for vehicles usually under repairs ..	..	3	3	4	21	31	2	2	21
GRAND TOTAL ..	..	91	35	40	227	343	22	26	231

L.

stock requisite to carry the force enumerated in Table K.

STOCK REQUIRED.

Horse Boxes, single.	Horse Boxes, double.	Wagons for Horses.	Wagons for Cattle and Ponies.	Wagons for Baggage	Wagons for Bazaar and Commissariat Stores	Trucks for Guns.	Wagons for Ammunition.	Break-vans.	Total No. of Vehicles.	No. of Vehicles on each Train
.	4	36	20	16	2	24	.	8	138	35
..	2	12	8	8	1	12	1	4	62	81
3	8	44	20	20	1	..	..	8	130	84
6	6	66	30	12	2	..	2	12	178	{ 3 of 29 1 of 30
9	..	..	1	81	3	..	3	18	913	{ 2 of 94 7 of 36
5	5	..	..	90	..	..	5	10	175	36
23	25	158	70	167	9	36	11	60	1,002	
23	25	158	70	167	9	36	11	60	1,002	
46	50	316	158	334	18	72	22	120	2,004	
5	5	32	16	33	2	7	2	12	201	
51	55	348	174	367	20	70	24	132	2,205	

Table L. has been drawn up to show what can actually be done with the existing rolling-stock, utilised as far as possible; and it is assumed that in an emergency, which would necessitate the stoppage of public traffic, troops would be forwarded in any vehicle not absolutely unsuitable.

The covered goods wagon is the class of rolling-stock of which there is the largest number on all the railways in Northern India; each of these fitted with temporary seats will convey 20 soldiers or 35 followers, and it is supposed that they, would be utilised in the absence of carriages.

Some military units are not so composed as to be carried economically by railway; as for instance, a Regiment of British Infantry; it is somewhat too large to be carried in two trains in the Sindh, Punjab and Delhi Railway stock, while, on the other hand, there is a waste of power, when three trains are used, and troops and followers are supplied with carriages.

Again, a Native Infantry Regiment could not be conveyed in one train, unless coaching vehicles were provided for both men and followers.

The same remarks also apply to the transport of a British Cavalry Regiment in 4 trains.

This will explain the seeming incongruity of providing covered wagons as per Table L. to followers in some cases, whilst in others, European Troops are required to travel in goods vehicles. The object of this arrangement is to utilize

the existing rolling-stock as far as possible, and to convey the different military units without mixing them up on the same train.

TABLE SHOWING ACTUAL STOCK ON THE SINDH, PUNJAB AND DELHI RAILWAY COMPARED WITH MAXIMUM REQUIREMENTS.

The following table shows the rolling-stock actually on the line, as compared with what would be required for the transport of the force detailed in Table K, and carried in the vehicles detailed in Table L:—

Description of Rolling-stock.	On Line	Required as per Table L.	Surplus.	Deficient	REMARKS.
Reserved Carriages	(a) 12	31	7	(aa) 11	(a.) Can be used as first class carriages.
First Class "	26				(aa.) Can be used as composites and deficiency of latter reduced to 1.
Composite "	21	35	.		
Second Class	(b) 41	40	(bb.) 1	..	(b.) 11 of these will carry 32 men each, the rest 20.
Upper "					
Single Third Class ...	232	253	(bb.) 19	..	(bb.) Can be used as single 3rd class and deficiency in latter will be reduced to 18.
Double "	21	22			
Horse Boxes, single	26	51	...	(cc) 25	(cc.) Wagons fitted for Horses could be substituted.
" double "	7	55	...	(c.) 18	(d.) About 700 suitable for horses.
Covered Goods Wagons	(d.) 2100	(e.) 1309	791	..	(e.) Includes number of wagons for troops, followers, baggage, Bazaar and Commissariat stores & those needed in substitution of deficiencies.
High-sided open "	90	174	...	(f.) 84	(c.) (f.) (g.) & (h.).
Low-sided & 6-wheeled Trucks	419	79	370	...	
Powder-vans	11	24	...	(g.) 13	
Break-vans	86	132	...	(h.) 46	

This table shows that the Punjab and Delhi Railway would have a deficiency of only 4 composite and 18 third class carriages to carry the force enumerated, and at the same time have an equal number of vehicles running empty in the reverse direction every 24 hours. It must, however, be borne in mind that whilst troops are embarking or disembarking from trains, the rolling-stock would be idle for a certain period, and this would affect the carrying power of the line, unless some spare trains suitable for the different military units were provided to meet such a contingency.

It would, therefore, be necessary to provide 2 additional trains for Artillery, 2 for British and 2 for Native Cavalry; similarly, 2 for British and 2 for Native Infantry: these with 10 per cent. of the rolling-stock added for repairs, and the deficiency of composite and third class carriages alluded to in the preceding para., will make the total number of extra vehicles that would have to be provided as follows:—

5 First Class Carriages.

11 Composite „

5 Second Class „

73 Single Third Class Carriages.

4 Double „ „

The 10 additional trains would, of course, require a number of other vehicles, such as Horse-boxes, Brake-vans, &c, for all of these, covered goods wagons of which there is more than enough, would form efficient substitutes.

TABLE SHEWING ENGINE POWER REQUIRED.

It is estimated that the following engine power to run the maximum number of trains would be required over the different parts of the line:—

Between Delhi and Saharanpur	...	15
„ Saharanpur and Phillour	...	20
„ Phillour and Lahore	...	17
„ Lahore and Montgomery	...	14
„ Montgomery and Multan	...	14

Shunting Engines—

At Ghaziabad	...	...	...	2
„ Meerut	...	...	...	2
„ Saharanpur	...	...	...	2
„ Ambala	...	...	...	2

Carried forward ... 88

	Brought forward	...	88
At Phillour	.	...	2
„ Mian Mir	...	...	2
„ Lahore	.	...	6
„ Multan	.	...	4
		— —	
			102
Add 25 % under repairs	..	...	26
		— —	
	Total required	..	128
Actually on line	...	...	124
		— —	
	Short	...	4

This estimate is calculated on the basis of allowing engines to work trains for 18 hours daily, or an average of about 126 hours per week, and shunting engines 12 hours daily, or 84 hours per week.

It would be necessary for the former to run 18 hours out of the 24, allowing 6 for cleaning, &c.; two Drivers would, however, be required to work the engine. This strain would only be necessary for ten days or a fortnight, to enable the concentration of all the available troops on the Frontier.

MAXIMUM CARRYING POWERS OF THE SINDH,
PUNJAB AND DELHI, AND APPROXIMATE
FOR THE INDUS VALLEY, KANDAHAR,
AND PUNJAB NORTHERN RAILWAYS,
IN ONE DIRECTION

In connection with the maximum carrying capacities of the Sindh, Punjab and Delhi Railway as regards troops, an estimate is submitted in the following table of the carrying powers, both military and commercial, of the two neighbouring State lines. This information may be useful, as the latter are so intimately connected with the Sindh, Punjab and Delhi Railway; the Indus Valley forming in fact the internal portion and the Punjab Northern the continuation of that line :—

*Comparative statement shewing carrying capabilities for military
Valley and Kandahar and Punjab Northern Railways, with*

	SINDH, PUNJAB AND DELHI RAILWAY.		
	Delhi Line 835 miles	Multan Line 208 miles	Sindh Section 105 miles
Longest distance between stations, miles	14	20	12½
Time occupied by Goods Trains be- tween stations over heaviest portion of line, minutes	47	67	69
Speed per hour, miles	18	18	15
Commercial capacity with line clear system, per day	3 Passenger, 11 Goods Trains	1 Passenger, 9 Goods Trains.	2 Passenger, 9 Goods Trains
Military do do if all other traffic is stopped, per day	17 Troop Trains or 3080 men of all arms, with followers, horses and guns	13 Troop Trains or 2820 men of all arms, fol- lowers, horses and guns.	12 Troop Trains or 2100 men of all arms, fol- lowers, horses and guns
Commercial goods carrying capacity under absolute line clear system, per day.	852 Wagons or 2,010 tons.	270 Wagons or 2,100 Tons.	244 Wagons or 1,972 Tons
Military carrying capacity without disturbing usual Passenger and Goods Trains	1810 men of all arms with horses & guns & followers.	1410 men of all arms with horses & guns & followers.	1080 men of all arms with horses & guns & followers.
Commercial capacity with Train following system and with existing Train crossing accommodation at stations, per day.	3 Passenger, 14 Goods Trains	1 Passenger, 12 Goods Trains.	2 Passenger, 12 Goods Trains.
Goods carrying capacity with Train following system, per day.	491 Wagons or 3,360 Tons.	372 Wagons or 2,860 Tons.	312 Wagons or 2,496 Tons.

and commercial purposes of the Sindh, Punjab and Delhi, Indus
"line clear," and also with the "train following system."

L. V & K (STATE) RAILWAYS.		PUNJAB NORTHERN (STATE) RAILWAY		
Kotri to Multan 508 miles	Ruk to Rindh 149 miles	Lahore to Jhelum 103 miles	Jhelum to Attock 132 miles	Khairabad to Perhwar 44 miles.
16	16½	12½	11	12½
62	85	50	61	50
16	16	19	16	16
3 Passenger, 7 Goods Trains	2 Passenger, 5 Goods Trains	3 Passenger, 10 Goods Trains	2 Passenger 3 Goods Trains	2 Passenger, 3 11 Goods Trains
12 Troop Trains or 2600 men of all arms, followers, horses and guns.	9 Troop Trains or 1950 men of all arms, followers, horses and guns.	16 Troop Trains or 3400 men of all arms, followers, horses and guns	12 Troop Trains or 2600 men of all arms, followers, horses and guns.	16 Troop Trains or 3400 men of all arms, followers, horses and guns.
210 Wagons or 1,080 Tons.	150 Wagons or 1,200 Tons.	320 Wagons or 2,500 Tons	152 Wagons or 1,216 Tons.	201 Wagons or 2,112 Tons
1800 men of all arms with horses and guns and followers.	975 men of all arms with horses and guns and followers.	1780 men of all arms with horses and guns & fol- lowers.	1800 men of all arms with horses and guns & fol- lowers.	1780 men of all arms with horses and guns & fol- lowers
3 Passenger, 9 Goods Trains.	2 Passenger, 6 Goods Trains	3 Passenger 13 Goods Trains	2 Passenger, 10 Goods Trains.	2 Passenger, 14 Goods Trains.
270 Wagons or 2,160 Tons.	180 Wagons or 1,440 Tons.	416 Wagons or 3,328 Tons.	190 Wagons or 1,520 Tons.	336 Wagons or 2,688 Tons.

ADDITIONAL TRAIN CROSSING STATIONS.

It will be observed that the capacities of the sections between Karachi and Kotli and again between Multan and Lahore, and also of the Indus Valley, Kandahar and Punjab Northern (State) Railways, *contrast unfavorably* with the Lahore and Delhi Section.

In order to equalize that of the Sindh, Punjab and Delhi Railway system throughout, it would be necessary to have train crossing stations between the following points.—

Karachi Cantonment and Landhi,

Jhampir and Meyting,

Meyting and Bholari,

or as near thereto as the Engineers may find suitable; while on the Multan Section, it would be necessary to provide the same between,—

Tatipur and Khanewal,

At Satghara.

Wan-Radharam and Changa Manga,

Changa Manga and Raewind.

The upper portion of the Delhi Section also shows to considerable disadvantage, when compared with the distance between Phillour and Delhi; this is occasioned by the want of train crossing stations between Phillour and Phagwara as also at Hamira and Butari.

The through carrying power, with additional crossing stations at the points indicated, would be increased over the distances between Phillour and Lahore, under the absolute "line clear" system, from 17 to 18, and the "train following" method, from 17 to 19 trains daily.

In the same manner, the capacity on the Sindh and Multan Sections, would be augmented by the former from 7 and 9 to 9 and 11 trains, and by the latter from 9 and 11 to 11 and 14 trains per day in each direction.

SYSTEM OF WORKING TROOP TRAINS.

In a real emergency of the kind for which such a special military train service, as is provided for by these timetables, would be necessary, the main object of the Commander-in-Chief will probably be, not so much the convenience of the Commissariat Department, to provide food for troops *en route* at the fixed places where they have the requisite establishments in time of peace, as to push troops to the front as quickly as possible; and in that case the practice would probably be resorted to, to serve out cooked rations for 2, 3 or even 4 days; and merely halt to supply beer and rum, or for other necessary purposes.

When halts have to be made of longer duration than those entered in the time-table, as, for instance, to enable the troops to have a night's rest, they should take place at

points about 200 miles apart; in which case they would not necessarily interfere with the time-table, although the stoppages may not be specially arranged for.

All that is required is, say if No. 10 Up Troop Train from Delhi-Ghaziabad is required to halt 12 hours at Meerut Cantonment, that No. 10 should for that day become terminal at that station, and subsequently continue its onward journey as No. 22 or 24 Train, which may possibly bring troops that are also to halt 12 hours there, or another body of troops which had previously halted at Meerut may continue their onward journey to the time of No. 10, and so on. As there will be a constant flow of vehicles downwards, there should be no necessity for even detaining trains for such halts, the carriages might at once be returned to the junction at Ghaziabad or Delhi, and others collected from Down Trains to make up their equivalent by the time troops were ready to move on again.

Another plan is, perhaps, preferable. The military authorities might set certain trains apart to carry infantry, others artillery and others cavalry.

Suppose No. 2 Up Train from Delhi-Ghaziabad to Meerut brought daily a European Infantry Regiment, and No. 4 carried daily a European Regiment thence to Mian Mir; in the same manner, No. 18 Up could convey a European Infantry Regiment from Ghaziabad to Meerut, and No. 20 could carry a European Infantry Regiment

from the latter station to Mian Mir. In this way two European Infantry Regiments would each get 12 hours' rest at Meerut; and immediately one Regiment disembarked, another would get into the same train and proceed onwards.

To elaborate this system, it would be necessary to lay the different troop time-tables of the whole of the Indian Railways before the officer regulating the movements, so that when issuing the needful instructions there should not be the slightest difficulty in giving a clear idea of what was required.

The Quarter-Master-General's Department would merely issue orders that certain trains on given lines and dates, and between certain rest-camps should carry a particular arm of the service, artillery, cavalry or infantry, as may be decided on; and that the troops travelling in such trains should halt at certain rest-camps.

This ought to ensure the utmost regularity in the movements of trains, and give all the troops proper intervals of rest, with the minimum sacrifice of time and efficiency in utilizing the rolling-stock.

To carry this system out thoroughly, it would also be necessary to issue stringent orders that troops, horses and baggage be unloaded at rest-camps or destination, at whatever hour the train may arrive.

The first halt of troops beginning a long journey would probably be longer or shorter than others, but subsequently

with proper arrangements they would fall in with the regularity of the time-table.

In order to give full effect to this plan, it would only be necessary to have a shunting engine at each rest-camp to shunt off, or on, the regimental baggage as required, and the same with the horses and guns for cavalry and artillery, which, of course, would require to halt as long as the men.

The heavy guns might, however, cause some detention of the trucks, but of these each railway has an ample supply, and no time would be lost by such detentions.

TROOP TIME-TABLES FOR ALL INDIAN RAILWAYS.

A Troop Time-table should, therefore, be prepared for all railways, and one distinctive letter or number should indicate each Up or Down Troop Train throughout between Calcutta, Bombay, Lahore, Peshawar or Karachi, as the case may be; so that the Quarter-Master-General might be able to order—say, Train A. or Train No. 6, to run on any particular day and between any given points. Train A. might be running on the same day from Calcutta, say to Muddapur, Dinapur or between Karachi and Sukkur, or Meerut and Lahore, or Rawalpindi and Peshawar, so as to suit requirements and the convenience of troops.

When the latter are to be concentrated on one point or in one direction, as for instance, on the Trans-Indus Frontier, the loaded Trains should have a clear road, and for necessary delays in crossing, the empty ones would require to give way.

TIME-TABLES, SHEWING TROOP MOVEMENTS
WHICH COULD BE CONDUCTED WITHOUT
INTERFERING WITH PUBLIC TRAFFIC.

Three thousand four hundred and ninety one troops could be landed at Lahore daily without disturbing the ordinary traffic of the line, or half the number of troops as compared with what has been shewn could be conveyed, if the public traffic was entirely stopped.

This allows for 9 Up and 9 Down Troop specials between Multan & Lahore, and 9 each way between Delhi and Lahore.

The regular traffic is estimated for the Delhi Section as four passenger and three goods trains, and on the Multan Section one passenger and two goods trains in each direction.

The force is supposed to consist of the following military units :—

2 Batteries Artillery
2 Regiments of Cavalry.
1 Regiment British Infantry.
3 Regiments Native Infantry

or

132 Officers
3 359 Non-Commissioned Officers and Soldiers,
2,548 Followers.
132 Officers' Horses.
954 Troop Horses.
547 Ponies and Cattle.

With Tents, Baggage and Ammunition complete.

In further illustration of the following tables, see Diagram or Graphic Time-table in Appendix—Plates Nos. XII. and XIII.

Troop Time Table without interfering with
Allowing the following halts—30 minutes about 6 A. M.,
minutes between

[illegible]

Troop Time Table without interfering with

Miles from Lahore.	STATIONS.								1
...	Lahore	...	...	...	...	...	...	dep.	0-20
3	Mian Mir, East	..	...	...	...	...	...	arr.	0-30
								dep.	0-33
32	Amritsar	...	...	...	...	...	...	arr.	2-3
								dep.	2-50
84	Jalandhar Cant.	...	...	...	..	...	...	arr.	6-6
								dep.	6-47
108	Phillour	...	...	...	...	...	...	arr.	7-58
								dep.	8-38
116	Ludhiana	...	...	...	...	...	...	arr.	9-11
								dep.	9-29
137	Ambala Cant.	...	...	...	...	...	...	arr.	15-4
								dep.	15-14
237	Saharanpur	...	...	...	...	...	...	arr.	18-16
								dep.	20-18
273	Muzaffarnagar	...	...	...	...	...	...	arr.	22-14
								dep.	22-19
305	Meerut Cant.	...	...	...	...	...	...	arr.	0-34
								dep.	0-39
335	Ghaziabad	...	...	...	...	...	...	arr.	2-50
								dep.	3-10
348	Delhi ..	...	...	...	..	...	...	arr.	3-50

DELHI TO LAHORE.

the ordinary Passenger and Goods Traffic.

one hour between 9 and 10, 2 hours between 15 and 17, 30
18 and 19.

4	6	8	10	12	14	16	18
4-20	5-23	9-2	10-55	14-12	16-16	18-55	20-10
5-9	6-3	9-42	11-35	14-52	16-56	19-35	20-50
5-30	6-26	10-38	11-45	15-31	17-6	19-45	21-0
7-8	8-2	12-30	13-40	17-20	18-48	21-48	22-39
7-11	8-19	12-36	13-49	17-30	19-13	21-53	22-49
8-47	10-0	14-12	15-27	19-31	20-51	23-34	1-31
8-52	10-45	14-17	17-30	20-0	21-20	23-40	1-55
11-25	12-32	17-56	19-31	22-30	23-38	2-1	4-19
11-52	13-8	19-17	20-5	23-28	24-0	4-1	5-6
14-45	15-51	22-1	23-0	2-20	2-45	7-11	8-32
17-0	18-59	22-22	23-32	2-25	3-10	7-15	10-0
21-12	23-24	2-24	3-37	6-16	7-51	11-10	13-54
21-17	23-29	2-32	3-42	6-26	8-4	11-45	15-33
21-50	0-2	3-5	4-15	6-59	8-37	12-12	16-6
22-15	0-37	3-34	5-7	8-0	9-14	13-24	16-21
23-26	1-46	4-14	6-18	9-9	10-24	11-34	17-32
23-51	1-50	4-48	7-1	10-0	11-21	11-39	17-40
2-49	4-47	8-12	10-16	13-27	16-5	19-2	21-47
2-57	4-52	9-12	11-0	14-3	16-53	19-34	22-0
4-23	6-20	10-12	10-14	15-34	18-23	21-5	23-43
4-30	6-25	10-50	12-50	15-40	18-29	21-10	23-18
4-40	6-35	11-0	13-0	15-50	18-39	21-20	23-58

LAHORE TO DELHI.

the ordinary Passenger and Goods Traffic.

3	5	7	9	11	13	15	17
1-3	5-25	11-4	11-45	13-50	16-2	19-25	22-10
1-13	5-35	11-14	11-55	14-0	16-12	19-35	22-20
1-18	5-41	11-19	12-2	14-8	16-17	19-41	22-24
2-56	7-29	12-57	14-2	15-52	17-44	21-12	23-54
3-34	8-16	13-28	14-41	16-11	17-49	21-48	23-59
7-40	11-50	16-24	18-0	19-17	21-40	1-42	3-0
8-1	12-5	16-29	18-5	19-22	22-16	2-12	3-27
9-14	13-23	17-38	19-14	20-33	23-32	3-31	4-53
10-9	14-41	19-18	20-26	21-51	1-58	4-16	5-28
10-42	15-14	19-51	20-59	22-24	2-31	4-49	6-1
10-47	15-31	20-8	21-13	22-31	2-44	5-23	7-5
15-43	21-39	1-27	2-24	6-16	7-42	9-42	12-53
16-14	22-3	1-32	2-53	6-26	7-17	9-50	12-58
20-1	1-52	4-53	5-53	9-27	10-52	12-48	15-5
21-31	3-20	6-16	7-16	10-22	11-26	13-58	16-57
23-24	5-58	8-31	9-31	12-24	13-53	17-29	19-29
23-35	6-8	8-48	11-33	12-58	14-13	18-16	19-36
1-50	7-54	10-26	13-19	14-32	15-53	19-58	21-36
2-0	8-3	10-44	13-22	14-42	16-10	20-3	22-0
4-10	10-37	12-55	14-58	17-5	18-39	21-51	0-14
4-20	11-46	13-5	15-8	17-37	18-46	22-15	0-54
5-0	11-26	13-45	15-48	18-17	19-26	22-55	1-34

DOWN LOADED—

Troop Time Table without interfering with
Allowing the following halts—30 minutes about 6 A. M., one hour

Miles from Multan Cant.		No. 1
	Multan Cant. dep.	2-50
58	Channu { arr. dep.	5-50 5-55
79	Chichawatni { arr. dep.	7-20 7-25
105	Montgomery { arr. dep.	8-40 9-4
128	Okara { arr. dep.	11-7 11-14
182	Raewind { arr. dep.	14-8 14-18
204	Mian Mir, West { arr. dep.	16-19 16-24
208	Lahore arr.	16-36

UP EMPTY—

Troop Time Table without interfering with

Miles from Lahore.	S T A T I O N S.	No. 2
..	Lahore dep.	12-33
4	Mian Mir West { arr. dep.	12-45 12-50
26	Raewind { arr. dep.	13-56 14-9
80	Okara { arr. dep.	17-41 18-27
108	Montgomery { arr. dep.	19-40 20-9
129	Chichawatni { arr. dep.	21-33 21-39
150	Channu { arr. dep.	22-50 22-56
208	Multan Cant. arr.	2-17

MULTAN TO LAHORE.

the ordinary Passenger and Goods Traffic.

between 9 & 10, 2 hours between 15 & 17, 30 minutes between 18 & 19.

No. 3	No. 5	No. 7	No. 9	No. 11	No. 13	No. 15	No. 17
5-20	7-45	10-20	12-10	18-5	19-45	21-25	22-35
8-30	11-54	13-24	15-4	21-27	22-55	0-25	1-36
8-38	12-3	13-31	17-8	21-34	23-5	0-31	1-46
9-44	13-15	14-31	18-16	22-34	0-13	1-37	3-0
9-47	13-17	14-38	18-26	22-39	0-18	1-48	3-15
12-41	14-28	15-55	20-8	23-54	1-34	3-11	4-36
13-0	14-42	18-7	20-38	0-14	1-54	3-54	5-18
14-0	17-43	19-40	21-40	1-20	3-10	5-0	6-50
15-56	17-48	19-47	21-46	1-27	3-17	5-7	6-57
18-36	20-54	22-34	0-26	4-7	5-56	8-4	9-42
18-40	20-59	22-43	0-33	4-11	6-26	8-11	10-34
19-44	22-7	23-49	1-39	5-15	7-32	10-24	11-38
19-49	22-10	23-52	1-18	5-20	7-35	10-27	11-41
20-1	22-23	0-1	1-55	5-32	7-47	10-40	11-53

LAHORE TO MULTAN.

the ordinary Passenger and Goods Traffic.

No. 4	No. 6	No. 8	No. 10	No. 12	No. 14	No. 16	No. 18
14-33	19-28	21-0	22-43	0-30	2-24	6-26	10-14
14-25	19-40	21-12	22-55	0-43	2-36	6-38	10-26
14-28	19-45	21-16	22-58	0-48	2-39	6-41	10-31
15-30	20-50	22-42	0-32	2-22	4-10	7-47	11-47
15-9	20-55	22-47	0-37	2-32	4-17	8-5	12-20
19-37	23-30	1-23	3-16	5-6	6-56	11-11	15-17
20-48	23-46	2-2	4-8	5-28	7-55	11-16	15-24
21-56	1-35	3-17	5-17	6-40	9-3	12-22	16-30
22-41	1-53	4-38	5-59	7-22	9-41	13-8	16-56
0-17	3-14	5-55	7-16	8-28	10-56	14-27	18-12
0-30	3-19	6-0	7-21	8-43	11-2	14-32	18-17
1-32	4-19	7-2	8-21	9-49	12-2	15-29	19-37
1-37	4-33	7-9	8-31	9-50	12-9	15-34	19-44
4-22	9-10	10-45	11-53	13-40	15-22	18-25	22-46

TIME-TABLES, SHEWING TROOP MOVEMENTS
WHICH COULD BE CONDUCTED WITH ONLY
GOODS TRAFFIC STOPPED.

The following time-tables permit of 4934 troops being conveyed to Lahore or $\frac{2}{3}$ ths of the number, if all public traffic were stopped.

The passenger trains are estimated as four on the Lahore and Delhi Division, and one on the Multan and Lahore Section.

This arrangement admits of 24 troop trains being run to Lahore daily, that is, 13 from the Delhi direction and 11 from Multan, and these would be equal for the transport of the following military units:—

3 Batteries of Artillery.

1 Regiment British Cavalry.

1 Do. Native do.

2 Do. British Infantry.

4 Do Native do.

•

or a total of,—

177 Officers.

4757 Non-Commissioned Officers and Soldiers.

3868 Camp Followers.

1235 Horses.

640 Ponies and Cattle.

18 Guns with Ammunition and Stores Wagons.

Baggage and Tents complete.

In further illustration of the following tables see Diagram or Graphic Time-tables in Appendix—Plates Nos. XIV. and XV.

UP LOADED—

Troop Time Table without interfering
Allowing the following halts—30 mts. about 6 A. M., one hour between

Miles from Delhi.	S T A T I O N S.				2	4	6	8	
	Delhi	...	...	...	dep.	1-15	2-19	3-10	4-39
13	Ghaziabad	..	...	...	{ arr.	1-55	2-59	3-50	5-19
					{ dep.	2-5	3-9	4-0	5-40
40	Meerut Cant.	...	...	...	{ arr.	3-43	4-54	5-49	7-23
					{ dep.	3-48	5-2	5-54	7-32
75	Muzaffarnagar	...	...	...	{ arr.	5-23	7-17	8-5	10-0
					{ dep.	5-28	7-20	8-9	10-3
101	Saharanpur	...	...	...	{ arr.	7-54	9-20	10-45	11-50
					{ dep.	8-14	10-3	11-0	12-8
161	Ambala Cant.	...	...	...	{ arr.	11-54	12-49	13-45	14-35
					{ dep.	12-1	12-55	13-51	14-38
232	Ludhiana	...	...	...	{ arr.	15-30	18-21	19-35	20-41
					{ dep.	17-30	18-33	20-7	20-40
240	Phillour	...	...	...	{ arr.	18-2	19-11	20-40	21-19
					{ dep.	18-13	20-36	21-30	22-17
261	Jalandhar Cant.	...	...	...	{ arr.	19-26	21-46	22-40	23-26
					{ dep.	20-10	21-51	22-47	23-45
316	Amritsar	...	...	...	{ arr.	23-4	0-21	1-40	2-58
					{ dep.	23-11	0-34	1-47	3-5
345	Mian Mir, East	...	...	...	{ arr.	0-46	2-7	3-17	4-35
					{ dep.	0-50	2-12	3-22	4-40
348	Lahore	...	...	...	arr.	1-0	2-22	3-32	4-50

DELHI TO LAHORE.

with the Mail and Passenger Trains

9 and 10, 2 hours between 15 and 17, 30 mts. between 18 and 19.

10	12	14	16	18	20	22	24	26
8-55	10-55	11-30	15-59	16-51	18-55	22-20	22-50	23-45
9-35	11-35	12-10	16-39	17-31	19-35	21-0	23-30	0-25
9-45	11-45	12-37	16-49	17-41	19-45	21-13	23-40	0-35
11-30	13-45	14-20	18-33	20-9	21-46	22-55	1-15	2-15
11-39	13-50	16-39	18-39	20-14	21-55	23-0	1-22	2-13
13-13	15-33	18-13	20-41	21-57	23-50	0-35	2-53	4-9
13-39	17-35	18-23	20-52	22-28	23-55	2-0	3-0	4-13
15-34	19-24	20-37	22-43	0-40	1-56	4-2	5-5	6-4
17-1	19-58	20-53	23-32	1-27	3-30	4-40	5-33	7-7
19-41	22-42	23-40	2-22	4-12	6-11	7-57	8-46	9-46
20-11	22-47	23-47	2-17	4-17	6-47	8-1	8-51	10-55
23-58	2-25	3-40	6-28	7-30	11-16	12-40	13-6	14-22
0-5	2-28	3-48	6-58	7-33	11-18	12-42	13-9	14-27
0-38	3-1	4-21	7-31	8-3	11-48	13-14	13-41	15-0
0-58	3-35	5-11	7-42	8-22	11-58	13-21	13-51	17-0
2-12	4-46	6-22	8-52	10-26	13-7	14-27	17-7	18-16
2-19	4-51	6-29	8-54	10-31	13-12	14-32	17-17	18-26
5-34	8-11	9-39	12-17	13-24	16-25	19-2	20-35	21-47
5-41	8-13	11-12	12-29	13-29	16-25	19-34	20-41	21-55
7-8	10-38	12-44	14-4	16-59	20-19	21-8	22-9	23-35
7-33	10-46	12-48	14-12	17-4	20-24	21-10	22-12	23-40
7-48	10-56	12-58	14-22	17-14	20-34	21-20	22-22	23-50

DOWN EMPTY—

Troop Time Table without interfering

Miles from Lahore.	STATIONS.			No. 1	No. 3	* No. 5	No. 7
...	Lahore	...	dep.	0 36	1-43	3-3	6-15
3	Mian Mir, East	...	{ arr.	0-46	1-53	3-13	6-25
			{ dep.	0-49	1-58	3-18	6-29
32	Amritsar	..	{ arr.	2-32	3-50	5-8	8-7
			{ dep.	2-59	4-17	6-18	8-19
84	Jalandhar Cant.	..	{ arr.	6-8	7-51	9-13	11-0
			{ dep.	6-23	7-57	9-20	11-50
108	Phillour	...	{ arr.	7-34	9-39	10-31	13-15
			{ dep.	9-4	10-44	11-47	15-0
116	Ludhiana	...	{ arr.	9-37	11-17	12-22	15-29
			{ dep.	9-47	11-24	13-7	15-31
* 187	Ambala Cant.	.	{ arr.	15-36	16-28	18-15	19-58
			{ dep.	16-13	17-12	18-21	20-1
237	Saharanpur	...	{ arr.	18-54	19-44	21-49	0-27
			{ dep.	19-25	20-38	0-57	1-57
273	Muzaffarnagar	...	{ arr.	21-37	22-27	2-49	3-55
			{ dep.	21-58	22-37	2 54	4-10
305	Meerut Cant.	..	{ arr.	23-41	1-21	4-31	5-45
			{ dep.	23-43	1-31	4-36	5-50
335	Ghaziabad	..	{ arr.	1-26	4-0	6-45	7-32
			{ dep.	2-6	4-26	7-15	8-0
348	Delhi	...	arr.	2-40	5 6	7-55	8-40

LAHORE TO DELHI.

with the Mail and Passenger Trains

No. 9	No. 11	No. 13	No. 15	No. 17	No. 19	No. 21	No. 23	No. 25
7-54	8-30	11-2	12-30	14-2	19-26	20-59	21-55	23 29
8-4	8-40	11-12	12-40	14-12	19-36	21-9	22-5	23 39
8-14	8-46	11-17	12-45	14-17	19-41	21-24	22-10	23-56
9-44	10-19	13-13	14-22	15-43	21-38	22-56	23-56	1-36
9-48	10-48	13-24	14-41	15-48	21-43	23 5	0-24	1-41
13-11	14-27	17-0	17-58	19-16	1-4	2-15	3-35	5-10
13-18	14-34	17-3	18 17	19-26	1-9	2-21	3-42	5-17
15-0	16-50	18-17	19-35	20-34	2-16	3-32	4-52	6-28
15-40	18-4	19-33	21-20	23-31	3-2	4-22	6-24	8-4
16-13	18-37	20-6	21-52	0-4	3-35	4-55	6-57	8-35
16-18	18-42	20-42	22-26	0-20	3-43	5-0	7-31	8 38
22-5	23-37	1-31	3-25	6-16	8-34	11-28	12-42	13-43
22-43	23-42	1-37	3-30	6-20	8-56	11-54	12-50	13-47
1-26	2-22	5-27	6-32	9-1	11-50	15-0	16-3	17-0
3-0	4-3	6-12	6-55	9-46	12-31	15-42	16-30	18-25
4-52	6-5	8-1	8-44	11-39	14-20	17-34	18-22	20-29
5-24	6-7	8-6	8-49	11-44	14 25	18-14	19-20	20-42
6-55	8-21	9-41	10-34	13-31	15-59	19 57	21-2	22 41
7-0	8-31	9-46	10-44	13 46	16-4	20-10	21-15	22-56
8-35	10-36	11-25	12-36	16-15	17-40	22-4	22-58	0-34
8-46	10-46	12-48	13-15	16-40	18-34	22-36	23-31	1-0
9-26	11-26	13-28	13-55	17-22	19-22	23 17	0-12	1-42

DOWN LOADED—

Troop Time Table without interfering

Allowing the following halts—30 mts. about 6 A. M., one hour between

Miles from Multan Cant.	STATIONS.	No. 1	No. 3	No. 5	No. 7
..	Multan Cant ... dep.	1-10	2-50	5-20	7-45
58	Channu ... { arr.	4-25	5-46	8-30	11-54
	... { dep.	4-32	5-52	8-38	12-3
79	Chichawatni ... { arr.	5-34	7-20	9-44	13-1
	... { dep.	6-3	7-25	9-17	13-6
105	Montgomery ... { arr.	7-20	8-40	12-41	14-22
	... { dep.	7-40	9-4	13-0	14-12
128	Okara ... { arr.	8-51	11-7	14-0	17-45
	... { dep.	8-56	11-14	16-2	17-52
182	Raewind ... { arr.	12-28	14-8	18-36	20-54
	... { dep.	12-31	14-13	18-40	20-59
204	Mian Mir, West { arr.	13-35	15-19	19-44	22-7
	... { dep.	13-38	15-24	19-49	22-10
208	Lahore ... { arr.	13-50	15-36	20-1	22-23

UP EMPTY—

Troop Time Table without interfering

Miles from Lahore.	STATIONS.	No. 2	No. 4	No. 6	No. 8
...	Lahore ... dep.	12-28	14-13	16-56	19-28
4	Mian Mir, West { arr.	12-40	14-26	17-9	19-40
	... { dep.	12-44	14-28	17-19	19-45
20	Raewind... { arr.	13-50	15-39	18-39	20-50
	... { dep.	14-9	16-58	19-2	20-55
80	Okara ... { arr.	17-51	19-50	21-46	23-36
	... { dep.	18-27	20-48	22-32	23-46
103	Montgomery ... { arr.	19-40	21-56	23-45	1-37
	... { dep.	20-9	22-41	0-21	1-53
129	Chichawatni ... { arr.	21-36	0-17	1-47	3-14
	... { dep.	21-39	0-30	1-57	3-19
150	Channu ... { arr.	22-50	1-32	3-6	4-19
	... { dep.	22-56	1-37	3-8	4-26
208	Multan Cant. ... arr.	2-35	4-22	6-45	9-10

MULTAN TO LAHORE.

with the Mail and Passenger Trains.

9 and 10, 2 hours between 15 and 17, 30 minutes between 18 & 19.

No. 9	No. 11	No. 13	No. 15	No. 17	No. 19	No. 21
10-29	12-10	13-50	18-5	19-45	21-27	22-35
13-24	15-4	15-17	21-27	22-55	0-25	1-30
13-31	17-8	19-17	21-31	23-5	0-31	1-46
14-31	18-10	20-18	22-31	0-13	1-37	3-0
14-38	18-26	20-23	22-39	0-18	1-48	3-15
15-55	2-8	21-40	23-54	1-34	3-11	4-36
18-17	20-33	22-22	0-14	1-54	3-54	5-18
19-50	21-40	23-30	1-20	3-10	5-0	6-50
19-57	21-47	23-37	1-27	3-17	5-7	6-57
22-34	0-26	2-16	4-6	5-56	8-4	9-12
22-43	0-33	2-24	4-11	6-26	8-14	10-34
23-49	1-39	3-30	5-15	7-32	10-21	11-38
23-52	1-43	3-33	5-20	7-35	10-27	11-41
0-4	1-55	3-45	5-32	7-47	10-40	11-53

LAHORE TO MULTAN.

with the Mail and Passenger Trains.

No. 10	No. 12	No. 14	No. 16	No. 18	No. 20	No. 22
21-0	22-43	0-30	2-24	4-8	6-26	10-14
21-12	22-45	0-43	2-36	4-20	6-38	10-26
21-16	22-53	0-48	2-39	4-24	6-41	10-31
22-42	0-32	2-22	4-10	5-30	7-17	11-47
22-47	0-37	2-27	4-17	5-57	8-5	12-29
1-26	3-16	5-6	6-56	8-55	11-1	15-17
2-2	4-8	5-28	7-55	9-5	11-8	15-24
3-16	5-17	6-40	9-3	10-27	12-16	16-30
4-38	6-59	7-21	9-41	10-48	13-8	16-56
5-55	7-16	8-38	10-56	12-5	14-25	18-12
6-0	7-21	8-43	11-2	12-7	14-32	18-17
7-2	8-23	9-43	12-2	13-8	15-29	19-16
7-9	8-31	9-50	12-9	13-25	15-34	19-31
10-45	12-0	13-40	15-22	17-0	18-22	22-49

RESULTS OF EXPERIENCE GAINED AFTER THE AFGHAN CAMPAIGNS.

What was actually done in regard to the transport by train of the army for Afghanistan during the various campaigns has been stated ; and also what the Sindh, Punjab and Delhi Railway was prepared to perform under certain emergencies and conditions ; and now will be briefly detailed the lessons learned from the experience thus gained.

SIDINGS, PLATFORMS AND LOADING BANKS.

No such strain as has been contemplated would probably be put on the Indian Railways ; either in regard to providing transport for such an army, or furnishing the necessary rolling-stock, but assuming that carriage was wanted for even half the maximum estimated number, *viz.*, 3,500 troops of all arms per day, still, before this number could be conveyed in a thoroughly efficient manner, the siding and loading platforms at certain military stations, where there are rest-camps, would require to be enlarged.

Loading platforms, equal to at least 3 troop specials, that is, one for infantry, another for cavalry, and a third for artillery or for commissariat, ordnance stores and live-stock for transport, would be necessary. With the loading banks and sidings so arranged that the shunting of any one train would not interfere with the next, nor with the ordinary traffic of the main-line.

The platforms need not be expensive, but might simply consist of earth-work with a breast wall. The loading bank sloped or ramped behind, and at each end; so that access could be had at all points by men, horses or guns to the vehicles composing the train. The slope would also prevent all danger to refractory horses in case they backed and refused to enter the wagons. Old rails rejected from the main line would be well adapted for the purposes of these sidings.

This extra accommodation would also be useful during a heavy grain traffic, now of frequent occurrence in connection with famines, scarcities, or export trade, or in storing spare stock during a slack season.

Troop platforms should in all cases be nearly level with the floor of the wagons, so that horses and guns may be easily laden; this arrangement is also more convenient for troops, baggage and stores. Each loading bank should be long enough to hold a complete train of 35 vehicles with engine and tender, clear of all other lines.

When such is not the case, trains have to be loaded up in sections; first the troop horses, then the officers' chargers, and finally the baggage. If the whole train could stand alongside the platform, one hour would be sufficient to load a special train of 35 vehicles containing a troop and a half of cavalry.

Attention should be given to the making of proper sidings and loading platforms, for without these, great difficulties have to be contended with in the despatch of troops.

The marshalling of troop trains, embarking and disembarking men, horses or guns, ought to be effected without, in the slightest degree, interfering with the ordinary traffic, or blocking the main line.

Further, the platforms should be constructed on the echelon or step system, so that the moving of one train may not interfere with that of any other. Sometimes a line on each side of a troop platform would be an advantage in loading two trains from it simultaneously, and so save a second platform it should be wide and ramped at the ends.

DETENTION OF WAGONS LADEN WITH COMMISSARIAT STORES IN TRANSIT.

During the first campaign, experience showed that commissariat and ordnance stores should not be despatched until their ultimate destination is definitely known, as detaining wagons *en route* causes great confusion.

There was no cause for complaint under this head during the second campaign, but the difficulty cropped up in another form, in the detention of wagons at certain stations by commissariat officers for examining and testing the quality of the grain.

Commissariat flour mills should be either established at the despatching or terminal railway station; for when grain is not introduced on the road either for examination or for the purpose of being converted into flour, it involves a delay of at least two days to the rolling-stock of the railway.

TRANSPORT CARTS.

Of the large number of carts forwarded, two only were loaded in each wagon, as they were, as a rule, sent on their wheels with sides complete, and often filled with grain, straw or *bhoosa*.

If they had been taken to pieces, from four to six might have been loaded in each Railway truck, thus saving expense to Government, besides enabling the Railway to utilize the stock, so unnecessarily employed, for other purposes, resulting in a general reduction of expenditure to Government in cost of carriage, and to Railways in saving extra Engine haulage, and also requiring less plant and siding accommodation.

With fodder loaded in these carts, the danger of transport was also increased, a number of fires having occurred by sparks from the engine alighting on the straw.

TRANSPORT ANIMALS.

Arrangements were duly made for the supply of water to the live-stock at certain stations at intervals of 6 hours; and in all cases camels were released, and allowed to stand up during long stoppages at stations, the height of these animals requiring them to be kept in a sitting position during the journey.

Extra sweepers were also employed to remove refuse from the trucks, and this was more particularly necessary when the cattle were delayed in consequence of the want of engine power or other causes.

The Commissariat Department also established extra depôts for feeding cattle ; and where great detention occurred, the arrangements were under the immediate charge of a commissioned and warrant officer.

In fact, everything possible was done, so as to prevent suffering to the animals, and considering that some of the cattle had performed railway journeys varying from 300 to over 2,000 miles, it is surprising that in a gross total of about 50,000, the mortality only amounted to 18.

These remarks, however, only apply to the Sindh, Punjab and Delhi Railway, and as a great number of the cattle were received at the junction stations of that line in a wretchedly thin state, the watering and feeding of them may have been previously performed in rather a perfunctory manner unless the animals were originally despatched in bad condition.

On this account the following suggestions deserve the attention of the Railway and Military authorities not only on humanitarian grounds, but for another paramount reason, *viz.*, that of preserving the efficiency of draught animals by attending to their necessary wants, while travelling in railway wagons over long distances.

It is evident that some system is necessary to ensure regular supplies of food and water at certain intervals of time.

At stations where the latter is required for the animals, the stoppages should be long enough to give all of them a sufficient supply; and if this is not done, many have to continue the journey for more than one stage without water.

This remark applies particularly to bullocks and horses, which being generally loaded in covered wagons having only panel ventilations or the doors left open, are with difficulty got at by the *bhistee*; those nearest the doors make it almost impossible for the others to get within reach; and it is probable that, when proper supervision is not exercised, the men in charge make no extra efforts to see that all alike get what they want.

Camels, ponies and mules being loaded in open wagons, are more accessible; and if the men in charge of them did their duty, they would all be amply supplied.

Of course, it will be understood that if the animals are not properly cared for in transit, they lose in condition, and are not so fit for their work as they might be.

Over the end of open wagons, an iron tank should be fixed to be filled with water at certain stages, say every 50 or 60 miles, by the railway servants. The man in the truck with the animals (and one man should always be there) could then with a suitable vessel supply all the cattle. In this way the desired end could be obtained, and the delay which now occurs, by the attendants having to go for some distance to get water and bring it by frequent journeys in a *mussuck* or bucket, would be obviated.

Water could always be provided beforehand at the station, on the platform, in large tubs, or obtained from engine water-cranes and distributed by means of a hose to

each tank fixed on the vehicles. For bullocks and horses, loaded in covered wagons, a similar trough might be laid laterally on the floor of the wagon, and they could then help themselves, after the breast bars had been removed while the train was at a stand.

During the recent campaigns, a large number of animals were booked through from the Madras and Bombay Presidencies to Jhelum, a distance of over 2,000 miles, the railway transit sometimes occupying 14 days. It is, therefore, evident that unless they are cared for especially on the journey they must suffer and become unfit for work, in which event loss is occasioned to Government, and the difficulties of the Transport Department of the army are increased.

Such measures as have been briefly outlined, should take the form of stringent instructions; and in addition, it should be provided that when the animals halt for any time not less than 12 hours, they should be unloaded and re-loaded.

There may be some objection to this on account of its interference with the work of the station at which the halt is made, but with suitable arrangements, the construction of extra sidings and loading banks, as already proposed, for troop traffic, the wagons might be emptied with ease, and their occupants enabled to have a few hours' natural rest.

Particular care should be taken after wagons are unloaded to clean and disinfect them thoroughly, not only to prevent infection, but also to prevent fires, as the refuse of straw, &c., from the animals, is very liable to ignite by sparks from the engine.

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LOADING AND UNLOADING HORSES AND GUNS.

See Plates Nos. I and II.

During the last five or six years, experiments have been conducted by the military and railway authorities at the principal cantonment stations of Mian Mir, Ambala, Meerut and Delhi, in loading and unloading troops, horses and guns; also in despatching trains for short distances to test the relative merits of the different systems. Many of the railway staff were in this way trained to this particular work, and were placed at the principal stations to assist in the trucking arrangements whenever troops were despatched or rested *en route*.

The different systems of loading and unloading horses and guns, the "end" and "side" loading of vehicles, the use of stations and loading platforms, or embarking and disembarking on the open line, have their respective advocates.

At all the experiments made, it was found that the "end" loading of guns and horses can be effected more rapidly than by the system of "side" loading, and this method also admits of better packing.

The ramps and girders introduced by General Sir Charles Reid, K. C. B., are admirably adapted for the purpose; but as this method necessitates the alteration of the covered stock for horses, it would seriously interfere with the utility of this description of wagon for the ordinary traffic of a railway, and this forms a very serious drawback to its introduction. It has been

estimated that making openings in the ends of covered wagons to admit horses, would weaken and reduce the life of the vehicle 25 per cent. In fact, it is almost impracticable, as it would be most difficult to prevent the ingress of sparks or rain, and it has also been found to increase the tare of the wagons, stronger underframes and axles being required.

Low-sided wagons with the ends and sides to fall down, are well adapted for the purpose of "end" loading.

The flaps at the ends of the low-sided trucks, when down, form a flooring over the buffers and between the vehicles; but care must be taken that the former do not project beyond the buffer heads, 2 strong iron knees are required underneath the flaps, so as to better bear the weight of a heavy gun.

The principal objection, however, which can be urged against the otherwise admirable system of "end" loading, is that it virtually blocks the line between any two stations, while troops or guns are being loaded or unloaded, and, of course, stops all traffic, whether military or public, for the time being, on either side,—a very grave fault. The operation of "end" loading on main lines should only be resorted to in very exceptional cases; as, for instance, in the event of an engagement actually taking place on or in the immediate vicinity of a line of railway.

Colonel Gray, R. A., a member of the Committee assembled at Agra in January 1877, to carry out experiments in military transport with the metre gauge vehicles, states in his memorandum on the subject

"Siege trains primarily would, I conceive, be embarked from existing platform sidings of railway stations. Their debarkation should, I am disposed to think, be arranged for at the nearest station up to 15 or 20 miles, perhaps, of the territory in which they may be required; for it would, perhaps, take less time to march that distance than to disembark at a point either on an embankment or cutting on the line traversed not provided with a platform, improvised platforms and expedients for unloading heavy masses are not desirable, except under very exceptional circumstances * * *

End-loading would not, I am inclined to think, materially shorten the time in embarking a siege train, nor would I advocate the employment of cranes for the purpose of transferring guns, &c. &c., from one line of rail to another, *viz.*, from the metre to the broad gauge; I think that no advantage in time would result therefrom. Men are put to work with appliances to which they are not accustomed.

These remarks also apply generally to a Heavy Field Battery (40 pounder Armstrong, &c.), such battery being composed of units of a siege train.

* * * * I am opposed to disembarking, except on very exceptional occasions, even a Field Battery at points of the line of railway other than at station platforms. The delay or time occupied, and the disadvantages attending such an operation, would necessarily be greater than at a station platform.

The matter is one to be dealt with separately from a general operation of war point of view. The unloading at

any point is undoubtedly feasible, but I cannot think it advisable if it can be avoided."

Stations should always be utilized for loading and unloading troops, horses or guns, as far as possible, otherwise the whole traffic of the railway would be disorganized. This would be more especially likely to take place on our Indian single lines of railway, with the heavy traffic which would of necessity occur in moving large bodies of troops and war material, and probably every crossing station occupied by trains, as was frequently the case on the Sindh, Punjab and Delhi Railway during the late campaigns in Afghanistan.

At Ambala, when the 10th Bengal Cavalry left for Malta in 1878, a troop of 80 horses was loaded in 10 minutes from the ordinary platform. As a rule, there was greater trouble and delay in trucking the grass-cutters' ponies than the troop horses; many of the former had to be pulled into the vehicles by main force. A rope placed round the hind-quarters, is sometimes very effective in making the animals enter the wagon.

The average time occupied in loading up a squadron of cavalry was about 1 hour and 30 minutes, but with platforms of sufficient length and height this could be easily reduced to one hour; and about the same time should be allowed for unloading.

As showing the time occupied in embarking cavalry, the following figures may prove of interest, as they are taken from

actual experiments in loading cavalry regiments at Meerut and Ambala proceeding to Afghanistan :—

Date.	Description of Military traffic loaded.	Loading began.	Loading finished.	Time occupied
1878. October ...	15			H. M.
	5 Officers	P. M. 4-10	P. M. 6-10	1-54
	181 Rank and File			
	87 Followers			
	147 Troop Horses.....			
	14 Officers' chargers			
	160 Maunds Baggage			
" ...	15			
	1 Officer	P. M. 3-40	P. M. 5-41	2-1
	3 Rank and File			
	500 Followers			
	172 Ponies			
	12 Bullocks			
	883 Maunds Baggage			
" ...	16			
	6 Officers	P. M. 5-53	P. M. 6-50	0-57
	124 Rank and File			
	86 Followers			
	128 Troop Horses			
	21 Officers' chargers			
	193 Maunds Baggage			
" ...	18			
	8 Officers	A. M. 5-50	A. M. 6-47	0-57
	128 Rank and File			
	92 Followers			
	180 Troop Horses.....			
	21 Officers' chargers			
	106 Maunds Baggage			
	47 Do. Ammunition			

This is nearly double the time occupied at previous experiments ; but as these horses were proceeding on Field service, the commanding officers, as a rule, exercised great care in loading and allowed no undue haste for fear of injuring the animals.

Exercising horses in entering and leaving dummy wagons is considered to be of little utility, as these experiments are generally carried on when the station is quiet, and no trains passing, and under quite different circumstances from what would exist when proceeding on active service with the

attendant noise and bustle, the whistling of engines, &c., so calculated to excite the animals.

Open wagons adapted for carrying guns, should be so constructed that the ends will fall down as well as the sides.

Old rails and sleepers which are always available at stations, are very suitable as ramps for loading or unloading guns, when the platforms are much lower than the floors of the wagons.

In loading heavy ordnance, great care should be taken to equalize the weight on the wagon axles, by placing sleepers or thick planks longitudinally under the wheels, so as to distribute the weight, as much as possible, over the floor of the wagon. The low-sided wagons are sufficiently strong for the conveyance of the heaviest siege ordnance used in India, *viz.*, the 40 pounder Armstrong Gun, which, with carriage and limber and 10 rounds of ammunition, weighs about 4 tons. To economise the carrying capacity of wagons, some high Military authorities recommend the dismounting of guns when in transit by railway; and again remounting them at the point of debarkation, as this can be done very rapidly by trained artillery men, and they consider that efficiency would not be impaired by adopting this course. This method would certainly reduce haulage considerably, as well as make all possible use of the wagons.

No opportunity occurred for fairly ascertaining the time taken in ^{*}loading guns, as the platforms were generally too low, and the opening in the sides of the trucks too narrow to ^{*}permit of a proper test.

Recently on the despatch of the 13th Bengal Cavalry from Meerut to Bombay *en route* for Egypt, five of the special trains each conveying a troop complete, with commissariat, hospital and transport equipment, were loaded up as follows :—

Date.		TRAINS	Time occupied.
			Minutes.
1882.			
July	31	1st Train	40
"		2nd "	37
August	1	3rd "	18
"		4th "	50
"		5th "	50

A number of camels were forwarded by rail, but the process of loading them in the ordinary way is very tedious and somewhat cruel. The animals should be made to kneel, and be secured in that position with ropes and tarpaulins, and then slung into the wagons with a crane. Four can be loaded in a high-sided truck with their heads towards the centre.

The following tables, taken from the report submitted by the Committee assembled at Delhi, under the presidency of Lieutenant-General Sir Charles Reid, K. C. B., show the actual time occupied, in both loading and unloading from the ordinary station platform, as also by the "end" loading system, of a unit of each of the three arms of the service, *viz.*, Infantry, Cavalry and Artillery; also, the measurements of guns, the strength of a unit of Pontoon and Telegraph equipment and the supplies necessary for seven days for each unit of the service, with the vehicles necessary for conveyance.

TABLE

*Table showing probable difference in time between "side" & "end"
Gauge compiled from*

	TIME OF EMBARKATION.				NUMBER OF	
	Ordinary		End loading.		Broad.	
	Broad	Metre	Broad	Metre		
	Hrs.	Mins.	Hrs.	Mins.		
Battery of Heavy Artillery ...	4½	0	3	0	102	1 1st Class ... 3 2nd " ... 4 3rd " ... 22 Open sided ... 9 Covered Goods ... 3 Horse Boxes ... 48 Cattle Trucks ... 6 Brakes ... 6 Low-sided ...
Battery of Horse Artillery ...	2½	0	2	0	84	1 1st Class ... 5 2nd " ... 5 3rd " ... 33 Double Horse Boxes ... 16 Cattle Trucks ... 6 Covered Goods ... 12 Open ... 6 Brakes ...
Battery of Field Artillery ...	3	0	1½	0	67	1 1st Class ... 5 2nd " ... 5 3rd " ... 20 Horse-Boxes ... 11 Cattle-vans ... 12 Low-sided ... 9 Covd. Wagons ... 4 Brakes ...
Battery of Mountain Artillery	2	3	1	½	30	28 Covered Goods ... 2 Horse-Boxes ... 1 Saloon ... 3 2nd Class ... 3 3rd " ... 2 Brakes ...
Regiment of British Cavalry	...	...	*1	...	+182	2 1st Class ... 15 2nd " ... 17 3rd " ... 94 Double Horse-Boxes ... 23 Cattle-vans ... 24 Covered Goods ... 1 Powder-van ... 6 Brakes ...

* Troop of 80 horses only unsaddled.

A.

loading and composition of Trains both for Broad and Metre
Sub-Committee Reports.

VEHICLES.				NUMBER OF TRAINS.		Order of Vehicles	TIME OF DISEMBARKATION.					
Metre.				Broad.	Metre.		Ordinary.		End loading.			
							Broad.	Metre.	Broad.	Metre.		
							Hrs.	Mins.	Hrs.	Mins.		
184	{	...	...	3	0	{ Baggage, Men, Guns, Carriages, Powder. }	2	..	1½	...		
181	{	1 1st Class	...	8 or 2	3	{ Horses, Men, Guns, Baggage, Cattle. }	2½	...	1½	..		
											7 2nd "	...
											8 3rd "	...
											68 Horse-Boxes	...
											18 Cattle Trucks	...
											17 Covered Goods	...
											16 Open Trucks	...
6 Brakes	...											
181	{	1 1st Class	...	2	3	{ Baggage, Men, Horses, Guns, Ammunition. }	1½	...	½	...		
											7 2nd "	...
											8 3rd "	...
											40 Horse Wagons	...
											19 Cattle-vans	...
											28 Low-sided	...
											22 Covered	...
6 Brakes	...											
88	{	72 Covered Goods	...	1	3	At pleasure.	1	¾	½	¾		
											1 1st Class	...
											4 2nd "	...
											5 3rd "	...
											6 Brakes	...
{	{	...	...	8	...	...	...	...	...	¾		

* † Quarter-Master-General's Return of Units.

Table showing probable difference in time between "side" & "end"
Gauge compiled from Sub-

	TIME OF EMBARKATION.				NUMBER OF
	Ordinary		End loading.		
	Broad.	Metre.	Broad.	Metre.	
	Hrs.	Hrs.	Hrs.	Hrs.	
Regiment of Native Cavalry	...	...	* $\frac{5}{6}$	...	+130 { 1 1st Class ... 14 2nd " ... 6 3rd " ... 80 Double Horse-Boxes ... 24 Cattle-vans ... 8 Covered-vans ... 1 Powder-van ... 6 Brakes ...
Regiment of British Infantry	1	...	1 $\frac{1}{2}$	...	+100 { 2 1st Class ... 28 2nd " ... 26 3rd " ... 1 Double Horse-Boxes ... 2 Cattle-vans ... 34 Covered-vans ... 1 Powder-van ... 6 Brakes ...
Regiment of Native Infantry	$\frac{3}{4}$	...	1	...	+44 { 1 1st Class ... 23 2nd " ... 7 3rd " ... 1 Double Horse-Boxes ... 1 Single " ... 8 Covd. Wagons ... 1 Powder-van ... 2 Brakes ...
One Company of Sappers and Miners	...	...	...	...	+11 { 1 1st Class ... 3 2nd " ... 2 3rd " ... 2 Covered-vans ... 1 Powder-van ... 2 Brakes ...
Pontoon Train (one Unit)	†1	†1	...	...	88 { 2 Composite ... 4 3rd Class ... 34 Low-sided ... 38 Cattle Trucks ... 1 Powder-van ... 4 Brakes ...
Telegraph Train (one Unit)	† $\frac{1}{2}$	† $\frac{1}{2}$	...	...	51 { 2 Composite ... 6 3rd Class ... 18 Low-sided ... 20 Cattle Trucks ... 1 Powder-van ... 4 Brakes ...

* Troop of 80 horses only unsaddled. † Quarter-Master-General's Return of Units.

loading and composition of Trains both for Broad and Metre
Committee Reports.—contd.

VEHICLES.		NUMBER OF TRAINS,		Order of Vehicles.	TIME OF DISEMBARKATION.			
Metre.		Broad.	Metre.		Ordinary.		End-loading.	
					Broad	Metre.	Hrs.	Hrs.
{		3	...	...	...	...	*½	...
		3	...	{ Ammunition and camp equipage in rear. }	1	...	1½	...
		1	...		Ditto	½	...	1
		...	...	...	...	...	...	...
{	2 Composite	...	...	{	...	...	...	...
	6 2nd Class	...	...					
	80 Low-sided	...	...					
	74 Cattle Trucks	...	...					
	1 Powder-van	...	...					
126	4 Brakes	...	...	2	2	...	...	...
{	2 Composite	...	...	{	...	...	...	...
	0 3rd Class	...	...					
	21 Low-sided	...	...					
	20 Cattle-vans	...	...					
	1 Powder-van	...	...					
68	4 Brakes	...	...	2	2	...	...	...

For one Train conveying half Units.

TABLE

Statement showing the actual Measurements of all Guns, Siege of War, dated Fort William,

					L E N G T H.			
					Weight	Over all	From end of cascabel to centre of trunnions.	From the centre of the trunnions to the muzzle face
RIFLED GUNS.					Cwt.	Inches.	Inches.	Inches.
Muzzle loading.	64 Pr. Mark III	...	...	...	64	118	47.75	71.25
	40 " " II	...	...	...	35	120	46.25	73.75
	25 " " "	...	...	...	18	98	37	61
	16 " " "	...	...	...	12	78	30.8	47.2
	9 " " "	...	...	...	8	72	30.75	41.25
	7 " " "	...	...	...	6	74.5	30	44.5
	7 " Steel...	...	...	...	200 lbs	41	17.2	23.8
Breach loading	40 " " "	...	...	...	35	121	47.125	73.875
	12 " " "	...	...	...	8	72	33.25	38.75
	9 " " "	...	...	...	6	62	25.5	30.5
Smooth-bore Ordnance.								
Cast-iron.								
Guns	24 Pr.	...	...	...	50	122	57	65
	18 " "	...	...	...	42	116.2	53.2	62
Howitzers	10 inch	...	...	...	40	66	32	34
	8 " "	...	...	...	21	52.75	25.95	26.8
Mortars	10 " "	...	...	...	16 1 14	28	...	...
	8 " "	...	...	...	8 1 16	22.5	...	...
Bronze.								
Guns	9 Pr.	...	...	...	10	74.05	35.75	38.8
	6 " "	...	...	...	6	65.03	31.006	33.334
Howitzers	24 " "	...	...	...	10	54.9	28.3	26.6
	12 " "	...	...	...	6 2 0	50.6	25.2	25.4
Mortars	5½ inch	...	...	...	1 1 10	15.1	...	...

B.

*and Field, in India, which would likely be issued in time
25th January 1876.*

B R E A D T H.			Weight of ammu- nition per 100 rounds.	R E M A R K S.
Breadth across the should- ers.	Length of trun- nions,	Total breadth.		
Inches.	Inches.	Inches.	lbs.	
22.75	6	34.75	7,200	* Future rifled Siege train guns for which there are at present no carriages available.
17.875	5	27.875	4,700	
13.	3.5	20	2,900	
12.4	3.5	19.4	1,900	
10.25	3.5	17.25	1,075	
10.25	3.5	17.25	825	
6.33	2	10.33	4,500	
17.874	4.033	27.75	1,350	
10.25	3.5	17.25	1,013	
10.25	3.5	17.25	...	
17	6	29	3,200	Present Smooth-bore Siege Train Ord- nance.
16	5.42	26.84	2,400	
22	6	34	9,300	
18.2	5	28.2	4,800	
20.75	5	30.75	9,100	
16.5	4	24.5	4,600	
9.88	3.12	16.22	1,125	Smooth-bore Field Batteries in reserve.
7.8	3.5	14.8	750	
11.1	3.42	17.94	2,600	
9.85	3.6	17.05	1,325	
8.85	3.27	14.89	1,600	

TABLE

*Return of Dimensions and Weights of Guns, Material and Pro-
Railway, dated Fort*

NATURE OF ORDNANCE.		DESCRIPTION OF CARRIAGES.
FIELD ARTILLERY.	12 Pr. B. L. R. Armstrong 8 cwt.	Carriage, Travelling Field Wagon, Ammunition Field Forage Wagon with limber Store Wagon with limber N. P.
	9 Pr. B. L. R. Armstrong 6 cwt.	Limber Travelling Field Store Cart
	9 Pr. M. L. R. Gun 8 cwt.	Carriage Travelling Field
	7 Pr. M. L. R. Gun steel 200 lbs	Carriage Field
		Ammunition wagon
HEAVY FIELD ARTILLERY.	40 Pr. B. L. R. Armstrong 35 cwt.	Forage wagon
	8 Inch Mortar cwt. 8, gr. 1, lbs. 16	Limber Field
		Do.
	5½ Inch Mortar bronze cwt. 1, gr. 1, lbs. 10	Block Trail Carriage with limber
		Mortar with bed
SIEGE ARTILLERY.		Carriage Travelling
		Limber for do
		Two Mortars with bed
		Carriage Platform
	24 Pr. S. B. 60 cwt. } 18 Pr. S. B. 42 cwt. }	Carriage Travelling Siege
	Howitzer 10 inch, 42 cwt.	Carriage Travelling fitted for Bullock draught
	Howitzer 8 inch, 22 cwt.	Carriage Travelling
	Mortar 10 inch, cwt. 16, gr. 1, lbs. 14	Mortar with bed
		Carriage Travelling

NOTE.—This table requires very careful revision, the dimensions given in shown mounted, but no account has been taken of the additional heights, lengths their limbers, but never their ammunition and stores. To remedy these defects William, Ferozepore and Fatehgarh for future reference A, L, M.

C.

jectiles, compiled from the enclosure with Circular No. 23
William, 1st November 1874.

Weight.	DIMENSIONS.			Weight of 100 rounds projectiles.	REMARKS.
	<i>Vide Lithographed Drawings.</i>				
	Length	Breadth	Height.		
Cwt.	Ft. In.	Ft. In	Ft. In	Cwt.	
12	10 6	6 4	5 0	10 $\frac{3}{4}$	* Dimensions of wagon given only.
13	10 4	6 4	6 6	..	
27	11 9*	6 8	7 0	..	
27	10 8*	6 4	6 9	..	
11	12 3	6 4	5 9	...	
12	12 9	6 6	6 4	..	Other Carriages probably the same as for 12 Pr. see above. Wheel track from out to out 5' 2'
12	10 6	6 4	5 0	8	
12	10 4	6 4	5 0	8 $\frac{1}{2}$	
..	10 0	6 4	5 0	...	
..	10 10	6 4	6 0	...	
..	12 4	6 4	6 0	..	
..	...	...	..	7 $\frac{1}{2}$	
42 $\frac{1}{2}$	11 9†	6 9	5 0	85 $\frac{1}{2}$	† Wheel track 5' 6"
16	...	...	...	38 $\frac{1}{2}$	
12	8 0	5 9	4 4	..	With pole.
8 $\frac{1}{2}$	10 6†	5 8	5 6	...	† Wheel track 4' 8"
3	..	..	..	16 $\frac{1}{2}$	
...	8 0	5 9	4 9	...	
42	13 0	...	..	28 $\frac{3}{4}$	Length of axle 7' 1 $\frac{1}{2}$ " 18 pr. projectiles 21 $\frac{1}{2}$ cwt. wheel track 6 feet.
49	28 0	7 1	5 0	80 $\frac{1}{2}$	
46	..	...	...	41	
32	...	...	...	...	
18 $\frac{1}{2}$	8 8	5 8	4 8	...	

the drawings do not always agree with the scale. The guns in some cases are
or weights. The weights of the wagons some times apparently include that of
blank forms have been circulated to the Officers in charge of the Arsenal at Fort

TABLE D.

Statement shewing the Vehicles' strength of a unit of Pontoon and Telegraph Equipment with weights and dimensions.

PONTOON TRAIN.									
ONE UNIT SUFFICIENT FOR 100 YARDS OF BRIDGE.									
Description.	Number.	Number of Wheels.	Outside dimensions.					Weight.	
			Length without poles.	Width.	Height.	Width of track.	Distance apart of axles.		
			ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	cwt.	qrs. lbs.
Pontoon Wagons	16	4	22 0	6 11	7 7	6 8	10 0	32 0	6
Trestle	5	4	18 1	6 10	6 0	5 8	10 0	32 3	0
Chess Carts	21	2	11 8	6 9	6 0	5 2	...	20 6	0
Store Carts	5	2	12 9	7 0	5 1	5 2	...	Variable.	
TOTAL ...	47								

TABLE E.

Telegraph Wagon Train.

ONE UNIT SUFFICIENT FOR 20 MILES OF WIRE.									
Description.	Number.	Number of Wheels.	Outside dimensions.					Weight.	
			Length without poles.	Width.	Height.	Width of track.	Distance apart of axles.		
			ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	cwt.	qrs. lbs.
Wire Wagons	12	4	13 7	6 4	6 4	5 2	7 5	30 2	0
Office	4	4	11 0	6 4	9 0	5 6	8 0	23 2	0
Store Carts	3	2	12 9	7 0	5 1	5 2	...	Variable.	
TOTAL ...	19								

TABLE II.

Telegraph Mule Train.

BROAD AND NARROW GAUGE.									
Description of Rolling-stock.									
									No.
Composite	...	...	...	...	...	...	...	...	1
3rd Class	...	...	...	...	...	...	...	...	1
Low-sided Open Goods	...	...	...	...	...	...	...	...	1
Brake	...	...	...	...	...	...	...	...	1
Cattle Trucks	...	...	...	...	...	...	...	...	2
Total Vehicles									6

*Supplies for Seven Days for each unit of the service
and the vehicles required are,—(vide Table A.)*

	Cattle.	Sheep.	Rations.	TOTAL VEHICLES.	
				Broad gauge.	Narrow gauge.
	No.	No.	Mds.		
Regiment, British Infantry	40	44	521	7	11
" Cavalry	21	29	780	8	10
Battery, Royal Horse Artillery	7	7	278	4	4
" Field	7	7	244	4	4
" Heavy Field Artillery	5	4	808	8	10
" Mountain	5	4	414	4	4
Regiment, Native Infantry	...	...	152	1	2
" Cavalry	...	...	521	8	4
Company of Sappers and Miners	...	1	26	4	

One wagon for each Regiment and Battery should be added for carriage of Regimental Bazaars and supplies of followers.

ROLLING STOCK

For the carriage of guns some open trucks are not well adapted, as only about five feet of the side flaps fall down. The sides should be made to open in their entirety.

The great advantage of having the goods stock so constructed as to be easily convertible for the carriage of troops, horses or third class passengers, is very apparent.

In any case of emergency wagons, fitted with wooden planks for seats, could also be easily adapted for the transport of European Infantry. Native troops and passengers seem to prefer them without alterations, as they are thus enabled to sit down or recline on their bedding.

Thirty-five natives can be comfortably carried in a goods wagon during the cold season, and about 30 in the hot weather. Brackets should also be fitted up at the ends to hold lamps for night travelling.

About seven hundred of the Sindh, Punjab and Delhi wagons are now permanently altered, so that at short notice they can be made available for the conveyance of troops, horses or passengers.

In the approved pattern, the breast bars are sunk in the floor of the wagon when not in use, and ventilation is obtained by moveable sliding panels.

The new loading board introduced connecting the platform with the floor of the wagons, has much facilitated the trucking of horses; it has moveable iron catches attached to the sides, so as to fix the doors of the wagons at

right angles to the truck, and thus not only forms a lead, but also prevents the horse's feet from slipping between the wagon and platform. *See plate No. III.*

It was found that the ordinary iron panelled goods wagons, with the floors covered and all chinks or crevices carefully closed, were rendered spark proof and quite safe for the carriage of gun-powder and ammunition.

If the rolling-stock of all Indian Railways were reduced, with a very few exceptions, to two standard types, it is considered that both military and commercial requirements would be fairly met.

1. A low-sided open truck with ends and sides to fall down.
2. A covered goods wagon with fittings for troops or horses, proper ventilation and lighting provided for.

The first description of vehicle is well adapted for the conveyance of field and heavy guns, carriages, pontoons, telegraph wagons, timber, ballast, minerals and rails. It should be from 16 to about 20 feet long, 8' 6" wide inside, and 18 inches deep; the bolsters required for long heavy timber to be moveable. These wagons are also suitable for end or side loading, whether for military or commercial purposes.

The second description of wagon is useful for troops, horses, cattle, ordnance, commissariat stores, baggage, camp equipage, &c., as well as for all commercial purposes. This

vehicle should measure 18' long, 8' 6" wide and 8' high; the door not to be less than 6' 6" high and 5' 8" wide, with side doors opening in 3 parts; the lower flap to form a connection between the wagon and platform to load or unload horses; while the two upper portions form a lead. The ventilators not to be less than 4' 6" from the floor, to prevent horses jumping out.

There should also be a small aperture or trap door at each end of the wagon on a level with the floor, to enable the syce to remove the litter during the journey.

Low-sided trucks can also be fitted with temporary sides to carry mules or ponies, as had to be done during the Abyssinian expedition.

MODEL HORSE WAGON.

The model horse wagon as shown in drawings Nos. IV. & V. which was built by Mr. Sandiford, Locomotive Superintendent, Sindh, Punjab and Delhi Railway, has been approved of by a Committee of Military and Railway officers, also by Government, and recommended for general adoption on all broad gauge railways.

The following is a description of the wagon, partly condensed, from the printed (Colonel Medley's) report :—

Inside length of wagon	...	...	18' 0"
„ breadth	„	...	8' 6"
Height of wagon	...	...	8' 0"
„ doors	...	...	6' 9"
Breadth	„	...	5' 0"

The door is in three parts—the lower door flap 2' 6" high falling down, forming a bridge between the platform and wagon for the horses to pass over.

Length available for each horse from breast bar to end of wagon...	6' 6"
Space available for syces, grass, &c., in centre of wagon between breast bars...	5' 0"
Panel openings for ventilation, height	2' 3"
" " " " breadth	3' 0"
Height of ventilators from floor of wagon	4' 6"

* The length of the wagon was considered by the military members of the Committee as sufficient for the largest artillery horses procurable in the batteries at Mian Mir, and they would not recommend any increase.

The breast bars are provided with two catches or rests, so that they can be fixed 3' 9" from the floor when carrying horses and 3' for ponies.

The floor recess (in which the breast bars rest, when not in use) are covered at bottom with an iron plate, and the breast bars are only half let into the sockets, the floor battens at the side being champered. This is the best arrangement that can be arrived at, as the breast bars resting wholly on the floor are objectionable for ordinary goods traffic, and even for loading horses.

In the Russian type, where the breast bars are hung from the roof by chains, the disadvantage of the recess arrangement does not arise, but that type is objected to by

many owing to the bars having to be lowered over the horses' heads, and on the whole the breast bars working from below seem generally preferred.

The wooden boarding is raised to a total height of five feet from the floor, so as to protect the horse thoroughly from coming in contact with the iron sides of the wagon.

The provision of an inner wooden casing to the roof is impracticable, except at a great cost, and would add to the weight of the wagons, while experiments show that it would not sensibly reduce the temperature.

The floors are grooved so as to prevent horses slipping.

The lower portion of the door is 2' 6" high, and when lowered forms a bridge or communication between the wagon and loading platform for the horses entering or leaving the vehicle. To make the flap higher would render it too unwieldy, and would, besides, interfere with the ventilation.

Two rings are fixed to the front of each breast bar to carry the bhoosa or grass nets; rings are also fitted to the breast bars to secure the horses' heads.

The mine holes are 1½" diameter. It is not desirable to increase the size more than is really necessary, as they add to facilities for thefts when the wagons are carrying grain, and are also liable to admit sparks.

The bottom of the panel or ventilating openings are 4' 6" from the floor of the wagon, so as to prevent the possibility of horses or ponies jumping out, as has sometimes occurred when the height was less.

The side panels for ventilation slide horizontally, a great advantage over the old method of falling downwards and outwards, or inwards and upwards and secured to the roof of the wagon. It has been so arranged that the sliding panels when closed effectually exclude sparks and rain. When the panels open inwards and are secured to the roofs of the wagon, they interfere with the horses' heads, and sometimes frighten the animals. Again, when the panels fall outwards the operation of opening and shutting is attended with a little danger.

It need hardly be added that this wagon, in an emergency is suitable for the conveyance of troops or passengers, for military stores of all description, as well as for ordinary commercial purposes.

It has been suggested that if European soldiers are allowed to have their kits with them, they can be used as seats, and so avoid the necessity of fitting up wooden benches. A covered wagon should hold 16 men with camp equipage and baggage complete, or 20 with kits and two hill tents; thus having a complete detachment in each vehicle.

CHAINS *versus* BREAST BARS.

A proposal was made to substitute a $\frac{5}{8}$ " chain for wooden breast bars. The chain to be covered with leather or some soft substance to prevent the horses' chests being chafed, the necessary rigidity to be obtained by fixing a screw shackle at one end of the chain; the other end to be

fixed permanently, and hung by a hook to the side or roof of the wagon when not in use, so that it would not interfere with the loading or unloading of ordinary traffic.

When wooden breast bars are not fixtures, they are very liable to be lost or broken, and frequently get separated from the wagons to which they belong, and are not to be found, when required, in case of any unexpected movement of cavalry or artillery, and are also liable to be broken by restive horses. This has frequently occurred, and owing to the consequent loss of control over the animals, the attendants have sometimes been injured. A chain breast bar would prevent the occurrence of such accidents.

Probably in point of economy the chains would also be cheaper in the end, as although more expensive in the first instance, a chain would last as long as a wagon, if not longer. The chains could also be more quickly fastened than a wooden breast bar.

Although the chain was approved of by certain military officers, the proposal evidently did not meet with the views of the Committee assembled at Mian Mir, for the following reasons as given in their report:—

1. " Very great difficulty found in protecting the horses' chest from chafing against the chain. Covering it with leather, also wrapping grass rope, and some hemp, found to be ineffective.

2. Some parts of the chain must be left exposed under any circumstances to allow of attaching, &c.

3. The tightening up of the chain is not a quickly effected process, and all arrangements are expensive.

4. The strain thrown on the sides of the wagon is most injurious; the weight of four (sometimes eight) horses is constantly thrown on the chain in stopping and starting. This draws the sides of the vehicles in even when strongly stayed by wrought iron knees.

5. No two wagons are the same exact width and are constantly altering in shape, so it is impossible to make the gear interchangeable.

6. The ends of the chains dangle down and get jammed in the doors preventing their being closed.

7. The arrangement is costly, and certainly not so safe as the breast bar, properly secured as in the last pattern wagon, in which also the difficulty of stowing the pole when not in use is got over; also the hitch about the window. At the same time it is possible to use chains, but it is not so good a plan as bars."

The only reasonable objection appears to be the strain thrown on the sides of the wagon, but as the latest patterns of wagons built for Indian Railways are entirely of iron, even this objection to the chain will die out as wooden wagons disappear; for it is only to the latter that the 4thth para. of the summary of objections to the chain would apply.

In the case of wooden wagons, however, there is a way of overcoming this objection, if the side pillars of the

wagons to which the chain is fastened are strengthened on the outside by a bar of T iron; the strain which is thrown on the chain in the way described would not injure the wagon.

The other objections could no doubt be overcome. The chain should be well covered with *moony*, coir, hemp or manilla string before the leather covering is put on. This should be of rather stout leather, and should cover every part of the chain, except the screw shackle at one end, which need not be longer than 6 inches. The hook at the side of the wagon should not project more than 1½ inches from it; thus, after the screw shackle is tightened, there would only be about 6 inches of iron at one extremity of the chain unprotected by leather. For this part a special covering could easily be improvised, to be buckled on after the chain is tightened. A piece of sheep skin, horse blanket, or *nunda* wrapped round the shackle would serve the purpose of protecting a horse's chest from being galled, if there is any necessity at all for such protection.

The entire shackle would, however, be so near the side of the wagon that, even if left uncovered, it could hardly ever come in contact with a horse's chest, for, to do so, the animal's shoulder would have to be squeezed into a right angled corner, and this is, if not entirely impossible, at least a very improbable contingency.

A point that must also not be forgotten is that wooden breast bars have been in use for years, and no objection has.

been raised on the score of their liability to chafe a horse's chest; yet wood is just as liable to do so as a leather covered chain. The correctness, moreover, of the theory that the chain would lose its covering has not yet been sufficiently tested.

With reference to the 5th objection, it may be stated there is no need for these chains to be made interchangeable, they should be fixtures so far as being permanently attached to the wagon.

The sixth objection is purely imaginary; for it is proposed to hang the shackle end of the chain to the roof when not in use, making it impossible for the chain to get jammed in the door.

It is admitted that the chain is very probably more expensive in the first instance than the wooden bar, but it is also contended that the first cost is the sole expense in connection with it, and that in the end, it will be cheaper than the wooden bars, which are so liable to be broken.

AMBULANCE CARRIAGES.

See Plates Nos. VI. & VII.

A number of 3rd class carriages have been constructed by the Sindh, Punjab and Delhi Railway to form an ambulance train for the sick or wounded.

The seats for ordinary passengers can be removed when necessary, and replaced by suitable hospital fittings, stretchers

or cots; large doors open at the sides sufficiently wide to admit the entrance of a *dooly* without moving the patient, as it is not advisable to transfer badly wounded men from the doolies on which they were conveyed from the field.

Sir Charles Reid's suggestion, to suspend the doolies by slings or transverse straps fixed to the sides of the carriage, has the approval of the medical authorities.

There are also end doors and projecting flaps over the couplings, so that medical officers, nurses and attendants can pass easily from one carriage to another. Each carriage can carry 8 cots. The carriages are marked with a Geneva cross.

In a great emergency, of course, covered goods wagons could be easily adapted for the conveyance of the wounded, although, owing to the stiff springs, single roof, often iron, want of sun shades, &c., they would not be so comfortable for the patients as 3rd class carriages.

The Sindh, Punjab and Delhi pattern hospital carriage (see *Plate No. VIII.*) was generally approved of by the medical officers of the Delhi Committee. It contains 8 beds with W. C. accommodation. The doors are at the side, but end communication is required.

It is generally admitted that first class padded or cushioned carriages should not be used in the conveyance of the sick as they are liable to retain infection, and are not so easily cleaned and disinfected as vehicles not so fitted.

TRUCKS FITTED WITH CANVAS OR TARPÁULIN
ROOFS AND AVAILABLE FOR OPEN OR
COVERED STOCK.

(See Plate No. IX.)

Mr. Henry Davies, Assistant Traffic Manager, Sindh, Punjab and Delhi Railway, has recently patented a contrivance for covering open trucks, for which he claims the following advantages :—

1st.—Reducing the different descriptions of rolling-stock to one type.

2nd.—Suitability of the vehicle for military or commercial purposes.

3rd.—Economy in construction and maintenance.

4th.—Saving in dead weight of vehicle and consequently haulage as compared with the present type of box wagon.

Mr. Davies has furnished the following description of his invention :—

“The contrivance to which I have recently drawn attention was primarily intended as an improved method of sheeting open railway trucks, and superseding the use of loose tarpaulins, but upon further considering the question, I have been able to add some improvements by which it will be found that an open truck can be adapted for any purpose of freight by railway, viz., third class passengers, horses,

merchandise, military transport, such as horses, cattle, stores, ordnance and ambulances,

The contrivance is very simple and consists of the following specification :—

Upright standards of iron or wood are fixed at the required height on to the ends of the truck at their centres, one at each end ; and on these standards is fixed, longitudinally, a round tubular or other bar as a ridge pole, and another similar bar parallel to it is fastened by moveable arms to the standard, so that it can be moved backwards or forwards across the truck. The upper bar works within a given radius, that is, it should fall at right angles to the lower or fixed bar, and be raised back, say ten degrees, on the other side of it.

The cover or sheet may be of sail or other cloth or canvas, either dressed or undressed, and it is made in two parts ; both parts are attached by one end to rods fixed outside one end of the vehicle, both pointing towards the line of the ridge in a sloping position.

When not in use the sheets are folded up and kept in receptacles placed over the rods to which they are attached, or they may be strapped or tied to another rod conveniently placed for the purpose. The receptacles may be boxes or canvas expanding bags. The covers are provided with hooks along the innerside and with eyelet holes along the outerside.

When required for use the covers are drawn out, and the innerside of one of them is hooked on the fixed bar, whilst

the other is hooked on to the moveable bar, which is pushed over the other, so as to overlap it, and thus cover the ridge bar.

Attached to the standards at the centre ends of the truck, are two rods of iron with hooked ends which are intended to support the sheet over the load; being moveable they are easily fastened on to the side bars referred to in the following para:—

A bar runs along either side of the truck above the sides of it; this bar is carried on upright supports which are fastened partly on to the sides of the truck, so that the upper half can be raised for the purpose of sheeting the truck, by means of a hinge. When not in use this side bar can be lowered to the sides of the truck.

As the flap door of a truck is usually in the centre of the sides, the bars should be hinged on either side of the door with arms meeting across it, and hooked on to a T shaped standard on the door itself. The bar can have one or two rails to form a resistance to outward pressure and to protect the goods, as required.

By the means above described, a pent roof cover from the ridge-pole to the sides of the truck, clear of the load, from which rain will be turned off as from the roof of a house, is obtained.

The lower sides of the covers are made tight by means of a rope kept rove through the eye-let holes, and passed under hooks fixed points downwards along the frame of the vehicle. The covers are drawn to one end and terminate with a small flap over the arm rods, to which flap an end curtain is drawn

up and attached. This prevents men having to get between trucks to tie the sheets down and may be the means of saving life.

For low-sided trucks, without gable ends, that is to say, built with square bodies, the covers must be attached to the arm rods, on the centre end standards, with a flap depending a short way down, to which the end curtains will be drawn up and fastened at both ends as in the case of the high-sided truck at one end. No receptacle for the covers is needed in this case, as only the end covers need be folded, and they can be strapped to the end frame work. The rods at either end will slide down from their inclined position to a level one by means of a guide rod.

The stanchions or standards at the side should be of stout wood, and raised about two feet above the frame work; then an iron rod carrying a longitudinal bar, as in the other case, should be hinged on to the wooden standards, so as to allow the bar to rise or fall; two or three rails may run along the frame, so as to resist outward pressure.

As a general rule, the covers can remain on the trucks, if only thrown back to admit of goods being taken out or put in which will save them being folded, drawn out and hooked again.

In folding them merely double up the sides inwards, and then double up the length in a fold.

To be able to utilise an open truck, either as an open truck or as a covered wagon, at any time, is a great desideratum, especially when the stock of the latter class is found to be inadequate to meet the requirements of the traffic. Moreover, the sheeted truck is always preferable to the iron covered wagons in use in India, as the high temperature in the hot season renders them unsuitable for the conveyance of animals, wines, provisions and perishable articles.

If the experiment were tried, it would be found that an open wagon with square frames, say 3 ft. high and fitted with a ridge pole arrangement, might prove to be suitable for the conveyance of third class passengers, cattle, ordnance, and commissariat stores, ambulances and general merchandise, excepting very bulky or lengthy articles, which exceed the proper dimensions of the floor area.

The truck should have centre folding doors, with a flap at the bottom, 7 ft in width. For third class passengers on the occasion of *Melas* or religious gatherings, when there is a large pilgrim traffic the travellers could obtain ingress and egress through the door-way, the flap being lowered to rest on the platform for the purpose, which would prevent accidents such as occur through people slipping between the carriage and the platform. For this class of traffic seats are not really necessary, as natives prefer to sit on the floor. The canvas could be hooked up to the longitudinal side bar, and give light and air. By day the moveable ridge pole could be

pushed back which would give ventilation from the top if required.

For mules and oxen there needs no further alteration. For horses, two breast bars would be required across the truck to form two stalls and an intermediate space for the syces and fodder, as at present arranged in horse wagons. These breast bars when not in use fit in the flooring, and when required for use are raised on to brackets at each side.

There would require to be no alteration in the construction for ordnance and commissariat stores. The door way would easily admit heavy guns. The ambulances could be fastened to the rods running along the side above the top of the frame work, and be supported underneath by iron trestles hinged on the floor and raised for the purpose.

For general merchandise the open wagon would be able with suitable axles to carry the same load as a 10-ton iron or wooden covered wagon.

The cost of the canvas-covered open truck is estimated approximately at Rs. 1,750, as against Rs. 2,100 for the covered built wagon, and the tare weight of the canvas covered vehicle is approximately 6 tons 2 cwt., against 7 tons 5 cwt. for the other, a difference of over a ton."

It costs 1.66 pie to haul a ton one mile, so the saving which might accrue by using a lighter wagon would be very considerable.

The mileage of goods vehicles on the Sindh, Punjab and Delhi Railway, the average weight of which with their loads

was 11.77 tons, during the half-year ended 30th June 1882, amounted to 2,13,81,608 miles.

The saving that might have been effected had each vehicle been lighter by 1 ton 3 cwts. the advantage claimed by Mr. Davies for his patent would amount to about two lacs of rupees.

MILITARY TRAIN UNITS.

Each train consisting of 35 vehicles, and running at a speed of 22 miles per hour, exclusive of stoppages, is estimated to carry the following military units or portions thereof :—

1. A third of a British or the whole of a native infantry regiment with followers, baggage, tents and ammunition complete or,—
2. 1½ Troops of cavalry do do do.
3. Half battery of horse artillery do do.
4. Do. do. of field do do do.
5. Battery of mountain do do do.
6. One company Sappers and Miners with half of a Pontoon and Field Telegraph train.

Only six-wheeled trucks must be used for pontoons and telegraph train, so that chess carts, office and stores wagons can be loaded two on each truck.

When there are heavy gradients, such as exist on the Bhoire and Thull Ghâts, and between Jhelum and Attock, these trains might, probably, have temporarily to be divided into two.

If these units were adhered to, of course the number of vehicles per train would vary according to the strength of the corps, nature of the campaign, whether on Indian or foreign service, and according to the scale of the equipment, whether with light or heavy camp *impedimenta*.

The speed of the trains could be accelerated or decreased according to the number of the vehicles on each train.

It will be necessary to have the train units corresponding, in degree, with the ship units, in the event of Indian troops proceeding on foreign service.

The importance of forwarding troops in complete units was explained by General Sir Herbert Macpherson in a speech recently delivered in Scotland; he remarked, "the Commander-in-Chief in India, General Sir Donald Stewart, in his able organisation of the Indian expedition to Egypt insisted that every ship should be a perfect machine in itself. The result was, if the Indian contingent had to land at any place on the Red Sea Coast, the army would have moved in a correct formation in any direction. The transport arrangements were complete, the hospital fully equipped, and the commissariat in excellent order; so that the troops could be maintained for three months without any external assistance whatever, there being abundance of food for the men, together with forage and grain for the horses and animals"

In the event of native or British troops, especially cavalry, proceeding from India to Europe, the train unit should coincide or correspond with the ships or steamers re-

quired for their conveyance, whether proceeding from Karachi, Bombay or Calcutta.

MARSHALLING AND ARRANGEMENTS NECESSARY FOR TROOP TRAINS.

Trains should be marshalled to suit and accommodate the arm of the service requiring transport, whether Infantry, Artillery, Cavalry or Sappers and Miners, and so that each unit fixed by the Military authorities may travel complete in itself.

Sixteen or seventeen trains each way in 24 hours is about the maximum number that can be worked on a single line, with an average distance of twelve miles between crossing stations. Loaded troop trains could, of course, be despatched much faster, say one every hour, but this would prevent the return of empty vehicles, and would stop the despatch of trains from the point of departure, and consequently no advantage would be gained.

Halts should not occupy more time than is entered in the time-table, as, if exceeded, the carrying capacities of the railways are curtailed, for the plant and engines cannot then return to the starting points in time to preserve continuity in the despatch of the remaining troop trains.

Troop carriages, as a rule, are changed at the junction with a foreign line, or at the rest-camp nearest thereto; but the vehicles can run through, if necessary, by special arrangement with the respective Traffic Managers. Carriages should

only be changed at halting stations, where troops have to rest for the day or night.

A stoppage of 20 minutes every 6 hours should at least be allowed for necessary purposes : if this is arranged the halts at other stations should only be long enough to suffice for engine and station purposes. When long halts, or unnecessary delays occur at intermediate stations, the men are apt to become restive.

Second class carriages with retiring accommodation should always be supplied for invalids, also for women and children.

In the hot weather a number of *mussuks* should be attached to the side rails of the carriages, this not only tends to keep the water cool, but also permits of the men helping themselves *en route* when necessary. In addition extra *blistees* should be in attendance at each station.

The sweetmeat vendors should also be present with a good supply of plain wholesome eatables, unless orders to the contrary are issued by the Commanding Officer, which is sometimes the case when cholera or other epidemics are prevalent.

Troops, to the extent of two carriage loads can be forwarded by mail trains, and eight by passenger.

Eighteen vehicles is the minimum, and 35 the maximum for a troop special train.

Wagons laden with ammunition and baggage should be always placed at the end of the train, so as to be as far away as possible from the sparks emitted by the engine.

At every engine changing station, the horse boxes or horse wagons should be cleaned of all litter, and if necessary the vehicle sprinkled internally with disinfecting fluid.

Two loading boards should be carried in each train conveying horses, so that any sick or troublesome animal can be removed if necessary.

When horses or cattle are being loaded or unloaded, Engine Drivers should avoid sounding their whistles as much as possible.

Troops' baggage, when loaded in brake-vans, must be securely locked in the compartment, and the key or keys handed to the officer in charge.

UTILIZATION OF ROLLING-STOCK AND WORKING OF TRAINS DURING EXTENSIVE MOVEMENTS OF TROOPS, OR PRESSURE OF OTHER TRAFFIC.

The following is the substance of several circulars issued during different periods, when heavy traffic had to be dealt with, with the object of utilizing the plant to the best advantage and meeting both military and public demands.

During pressure of traffic, and when there is great demand for rolling-stock, every exertion must be made by the staff to unload and reload carriages, wagons, trucks, &c., so as to enable them to be despatched by the first train leaving after their receipt.

Certain trains in the time-table are so arranged as to pass the principal stations shortly after the day's work is done, and the most suitable trains will be directed to pick up loads at intermediate stations, so that cases of wagons standing for hours waiting for train room should not occur.

Station Masters of engine-changing stations will daily ascertain from the 'Through Guards' Reports, the number of empties each train has detached at the different stations, from which it is their duty to arrange to work loaded wagons off, and they should run the earliest train for which a full load can be obtained, and not wait till Stations advise them of the number of loaded wagons that are waiting despatch. For instance, if Ludhiana has a good supply of wagons early in the day, the Station will have ample time to have a full train in readiness by noon, and Phillour should then start a train to clear them off with the least possible delay.

Empties should be worked by trains which arrive at the destination of these vehicles in the early morning or forenoon, so that there will be time to re-load and despatch the trucks the same day.

In the register a strict check is kept of all vehicles received and despatched daily from each station. In the Daily Report, Station Masters must show the number, name of owner and description of vehicles; also No. of Train Up or Down, date and hour received; the same information should be given when despatched.

When there are wagons on hand, loading and unloading must be done on Sunday in the same manner as on week days, so long as the pressure of traffic continues.

If goods or live-stock are not actually waiting in the station premises to be despatched, Station Masters must demand written applications for all transport required, stating date, hour, description of traffic and destination. All definite particulars must be obtained from the Commissariat and Military Departments, and from the public or general traders, as the case may be, before telegraphing to District Traffic Managers for wagons.

If the latter when supplied, are not loaded up at once, demurrage should be levied ; and if not required, haulage of the empty vehicles must be charged in addition.

This should prevent excessive applications for rolling-stock, which is sometimes made by the Civil and Military authorities, as also the public, before they really have any definite idea of the transport required or the date of despatch.

Station Masters must be careful not to order stock unnecessarily. At the same time when they receive written orders, or are satisfied that traffic is ready for despatch, they must telegraph to District Traffic Managers for vehicles immediately, and failing a supply in 12 hours, advise the Traffic Manager at Lahore.

Station Masters must cut off foreign wagons returning empty towards the parent line, and utilize them, as far as possible, for all traffic, both local and through, proceed-

ing in that direction. This will ensure the Sindh, Punjab and Delhi Railway stock being fully occupied in the conveyance of military stores, live-stock, and also material for the military frontier railways.

The contents of vehicles booked short of final destination arriving from foreign lines, can be re-booked, and sent on with the original load in the same wagons as received.

Indus Valley (State) Railway empty wagons returning from the East Indian Railway, Delhi, Ghaziabad, &c., may be loaded at any station for any station in the direction of Multan, Rohri or Karachi; Punjab Northern (State) Railway stock in the same way to Lahore or any intermediate station; and finally that of the East Indian, Oudh and Rohilcund, Bombay, Baroda and Central India or Madras Railways, may be loaded to any station in the direction of, on the parent line, or beyond it.

It is incumbent on Station Masters at junctions, engine-changing and other stations, where goods, local or mixed trains become terminal, to make arrangements in concert with District Officers for the running of goods trains, so as to reduce delays to foreign stock to a minimum. With strict and careful attention to these orders, and a judicious selection of the weekly goods trains, as also the additional facilities afforded by the mixed and local services, delays to through wagons at junctions should not exceed one or two hours.

Loaded or empty foreign stock must, as far as possible, be despatched by mixed trains, but should the regular service of foreign railways bring wagons at such hours that to do so over this line would involve considerable delay, goods trains should be so selected that, through traffic, whether from the East Indian Railway at Ghaziabad, Punjab Northern (State) Railway at Lahore, or Indus Valley (State) Railway at Multan or Kotri, may be forwarded at once.

These goods trains should run through the whole distance as arranged for in the time-bill; in case of such being delayed at an engine-changing station, or overtaking another which is timed to start thence earlier, if time permits to do so without detention, foreign wagons should be detached from the former and attached to the latter, so as to ensure their speedy despatch. These trains must work all local and intermediate traffic *en route* as well as through.

As no free time is granted at junctions or allowance made for Sundays, it is necessary that, although 36 hours are fixed for unloading and 24 for reloading back to parent line, this work should be done within 12 hours or less if possible, when the wagon arrives early in the day, but in no case should the latter be delayed longer than 24 hours.

With heavy military or other traffic, it is necessary to keep a strict watch to prevent blocks at junctions; the following orders must therefore be observed:—

Immediately, a block is apprehended, say at Lahore, this Station will advise the nearest engine-changing station to stop up goods trains, and such orders must be strictly obeyed; wagons containing live-stock and camel or cattle equipments must, however, be excepted, and pushed on at once; these should invariably receive priority over commissariat stores and ordinary goods. Should the block become serious and continue for any length of time, further instructions will be issued by the Traffic Manager; but to prevent inconvenience to the staff, no train must be stopped at any other than an engine-changing station. Phillour and Montgomery must, therefore, keep a careful note of all advices of the running of trains from Saharanpur and Multan, and request those stations to stop up-trains in cases of urgency to prevent their own yards becoming blocked.

RAILWAY STAFF.

As railway establishments are kept at a minimum, and are only strong enough to meet the ordinary and regular traffic of the line; the Military authorities should give the earliest possible information in the event of an anticipating a large movement of troops, so that timely and due provision for an extra staff may be made.

As this, however, may not always be practicable or even advisable, Sir Andrew Clarke's (late Minister of Public Works for India) proposal to establish a military railway corps would

most readily solve this difficulty. His plan is, to have soldiers trained in the different branches of railway work, so that in the event of war, when extra pressure is thrown upon railways, they would be available as guards, or made use of in such appointments for which they might be fitted, reverting to their regiments after the pressure was over.

It has also been suggested that soldiers should be trained in the use of signals, points and general shunting arrangements. Likewise that the railway servants should learn the names of the different parts of a gun, how to fit up ambulance carriages and the use of the different military stores and appliances, how to handle and load them in wagons. In short, that a regular Indian Railway Military Transport Corps should be organised. The Germans have a very complete system.

CONCLUSION.

It has already been stated that orders in regard to military requirements by train, should emanate from one authority to prevent confusion.

This also applies to general railway management; and in the event of a great movement of troops and war material, the Director General of Railways should be paramount, so that all conflicting railway local interests might be set aside with a strong hand, when Imperial demands require concentration of the powers of our Indian Railways whether State or Guaranteed.

To show that the carrying powers of the Sindh, Punjab and Delhi Railway, are not over estimated, it may be mentioned that during the Hurdwar fair, for 18 days in April 1879, about a quarter of a million of pilgrims were carried, in addition to the ordinary traffic of the line, and the running of several troop trains; or on an average nearly 14,000 passengers per day. Of course, to do this, every description of vehicle was employed—goods wagons (covered and open) cattle trucks, &c. The conveyance of these pilgrims was, however, an easy matter, compared with the transport of an army, inasmuch as no halts had to be specially provided for them, and they were conveyed by the ordinary passenger and goods as well as by special trains.

As regards the Sindh, Punjab and Delhi Railway it may be remarked that all the troops, horses, live-stock, and war-material were conveyed with punctuality and absolute safety; not the slightest accident or loss having occurred to life or property, notwithstanding that a very heavy public traffic passed over the railway during the different campaigns.

All the arrangements with the Quarter-Master-General, Commissariat and other Military Departments, and also with the Officers in Command, were conducted with the utmost harmony. A mutual desire to assist and promote the main object in view was apparent on all sides.

Karachi being the natural base of all operations on the north-west frontier and Afghanistan, the immediate con-

struction of a railway bridge at Sukkur is a question of vital importance. Government having constructed a pier at Karachi, where vessels can load and discharge direct, and with the continued improvement taking place in the depth of the Karachi harbour, the bridge over the Indus at Sukkur seems the only link wanting in the railway chain to connect Karachi with the whole railway system of India.

From Karachi, troops could, if necessary, be concentrated at Lahore in two or three days, and as the harbour now safely admits ships and transports of the heaviest draught, the Military authorities have an immense power in their hands, in addition to the facilities already existing at the ports of Bombay and Calcutta.

The port of Karachi however, has the great advantage of being two or three days nearer England, not only on account of the shorter distance from Aden, but because it is favoured by the direction of the currents during the monsoon, so that in the event of any great crisis in the history of India, necessitating troops being urgently sent from Europe, Karachi doubtless would be the port *par excellence* of arrival.

APPENDIX.

Extract from the Proceedings of the United Service
*
Institution of India.

Discussion on a paper read at the United Service Institution of India, Simla, by David Ross, Esq., Traffic Manager, Sindh, Punjab and Delhi Railway, on the transport by rail of troops, horses, guns and war-material.

COLONEL THE HON'BLE SIR ANDREW CLARKE,
*
K. C. M. G., C. B., C. I. E., R. E., IN THE CHAIR.

THE HON'BLE SIR ANDREW CLARKE remarked, that as he saw several gentlemen present interested in the Railway communications of the country, he had no doubt they would like to offer some observations or suggestions on the subject of Mr. Ross's paper, which the meeting would be glad to hear.

COLONEL MEDLEY, R. E., Consulting Engineer to Government for Guaranteed Railways, Lahore, said that Mr. Ross's paper had been so good and practical that it covered all the ground. The first idea which he thought would strike every body was the enormous carrying power of a Railway compared with a Road. One practical point which arose in connection with this was that the carrying power of a single line was very much increased by the number of crossing stations. Fortunately, before this heavy traffic had come upon the railway, they had had a very heavy famine traffic under the

influence of which a considerable number of extra crossing stations had to be put in, and which very greatly increased the carrying powers of the line. It was difficult to say of course at what distance exactly the single line crossing stations should be put in, but the average was about six or seven miles on the Sindh, Punjab and Delhi Railway.

He quite agreed with what Mr. Ross had said as to the importance of having separate platforms and sidings for military purposes. At Multan they were found so necessary that *kuchas* platforms had to be put up as quickly as possible. The Lahore platform had to be lengthened; an urgent requisition was made for a platform at Meerut; and one had also to be erected at the Mian Mir station, on the Multan line. There was no doubt that every station to or from which troops were likely to be moved should have a separate siding platform quite apart from those used for the regular traffic.

As to the covered goods wagons that were used for horses, Mr. Ross has said that eight horses were comfortably put into each. He thought, however, that in the case of large horses they were rather cramped for room in the ordinary pattern of wagon, 16 feet long. In the new pattern for wagons ordered by Government the dimensions were 18 feet long, and he would certainly recommend that in all future wagons Government should stick to those dimensions as affording sufficient space for the accommodation of 8 large horses. With reference to the patterns of carriages for ~~trains~~, the Sindh, Punjab and

Delhi Railway Company were now converting a large number of first, and old composite carriages, into third class carriages on the American principal, which he thought would be found well adapted for troops, and was far better than the present pattern of third class carriages. They possessed the advantage of having a passage through the centre of the carriage with end doors, and in these carriages men could walk about and stretch their legs, and there might be no halting, if emergency required it, for you might tack on a *buffet* or *restaurant* carriage and give the troops their food on the road,

This pattern of carriage also has a privy attached to it. These were all the remarks that now occurred to him. Mr. Ross's paper, combining as it did, so much practical experience, was he thought very valuable and interesting.

MR MOLESWORTH, C. I. E., Consulting Engineer to the Government of India, said that it had often struck him that it might possibly be an advantage at the Lahore Station, where there was a junction of three railways, the Multan, Ghaziabad, and Punjab Northern to run the siding right through the cantonments, joining the Multan and Ghaziabad Lines and the Military Station, in military ground, where loading platforms and all appliances might be provided, and where all the troops and transport arrangements would be under Military Command, and would not interfere with the ordinary traffic at Lahore Station.

Another thing which struck him as a possibly good appliance in loading horses was a sort of sling, which might be

on wheels so as to be moved to any point of the platform; refractory horses sometimes seemed to have all the refractory powers taken out of them by being slung, and the use of this appliance might save much time and labour.

In Ceylon, when pressure on the traffic occurred, Mr. Molesworth said he put up seats in the goods carriages to make them available for passengers, by a very simple plan, which he described by a sketch on the board with chalk, as consisting of planks with sockets and hinges extended within the wagons from side to side. They were fitted in or removed in a moment, took up little room in store and answered very well for the purpose for which they were required.

COLONEL MEDLEY said there was one more point which he had omitted to mention, and that was with reference to the iron goods wagons. It was found in Sindh in the hot weather when horses were conveyed in these wagons that the heat of the iron was so great that it burnt and blistered their skins, and it became necessary to line the wagons with wood. That he fancied would always have to be done in future.

Another point was that it was rather curious that the experiments, carried on by various Committees at Lahore and Agra in loading, were not followed by the issue of practical instructions. When he went down to look at the arrangements there, he found on questioning the Assistant Quarter-Master-General, that no instructions whatever had been issued for loading, as the result of these experiments, which continued to be carried on under the old regulations. It seemed

to him that when these Committees were formed and certain results arrived at the quicker those results were put on paper and disseminated by authority the better, even if they had to be corrected afterwards.

THE HON'BLE SIR ANDREW CLARKE admitted that there was much force in what Colonel Medley had said with reference to issuing fresh instructions. The truth, however, of the matter was, that before revised instructions could be prepared, the first thing which had to be done with regard to the Committee's reports on the subject of experiments in loading, both on the broad and narrow gauge, was to request the Railway authorities to make very considerable alterations in their rolling stock. While this was being done the recent operations on the frontier summoned to the front, first Major LeMessurier and then Colonel Macgregor, who were the officers employed in working out the details of the requisite alterations.

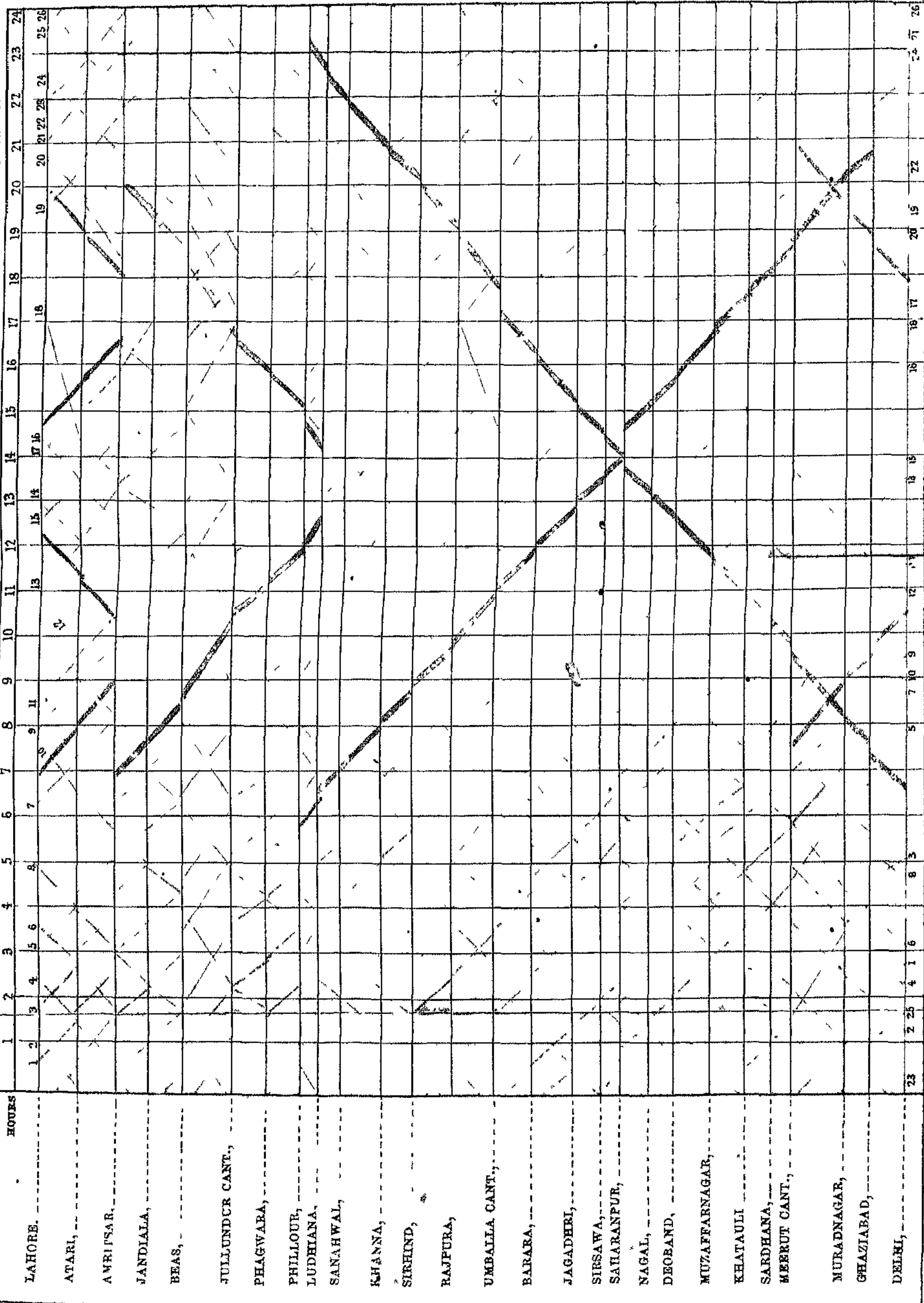
Little knowing what was now in the future, Major LeMessurier had just written to him (Sir Andrew Clarke) asking for permission to come back to India in order to complete the instructions not only regarding the experiments made by the Committees, but also with respect to the still more useful results which Mr. Ross had just described. It appeared to him (Sir Andrew Clarke) that at the present moment no paper could be read or published so opportune as that by Mr. Ross; and as it contained a great amount of useful and suggestive information, he thought it would be very desirable that all Military and Railway authorities should have it in

their hands as soon as possible. With this view he hoped he might ask the Secretary to have the paper passed through the press at once and copies sent for distribution.

In conclusion, Sir Andrew Clarke tendered to Mr. Ross the thanks of himself and the meeting for his thoroughly practical and interesting paper, which was rendered all the more valuable by Mr. Ross's recent experience in the actual movement of troops, attended, as this had been, with considerable success under the difficulties indicated in the Lecture. (Applause).

No. XIV.

TROOP TRAINS, RED; MAIL TRAINS, BROWN; MIXED TRAINS, GREEN; LOCAL TRAINS, BLUE LINES. TROOP TIME TABLE WITHOUT INTERFERING WITH MAIL AND PASSENGER TRAINS.



No. XI. / MAXIMUM NUMBER OF TROOP TRAINS WITH ALL OTHER TRAFFIC STOPPED.

HOURS.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
MOOLTAN, CANT.,	21		3	4	5	6	6	7	8	10	10	13	12	14	15	16	17	18	20	21	22	23	24	25
TATIPUR,																								
RASHIDA,																								
KHANEWAL,																								
KACHA KHUH,																								
CHANNU,																								
KASSOWAL,																								
CHICHAWATNI,																								
HARAPPA,																								
MONTGOMERY,																								
PAKPATTAN,																								
OKARA,																								
SATGHARA,																								
WAN RADHARAM,																								
CHANGA MANGA,																								
KOT RADHAKISHN,																								
RAEWIND,																								
KANA,																								
MEER MEER, WEST,																								
LAHORE,																								
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36

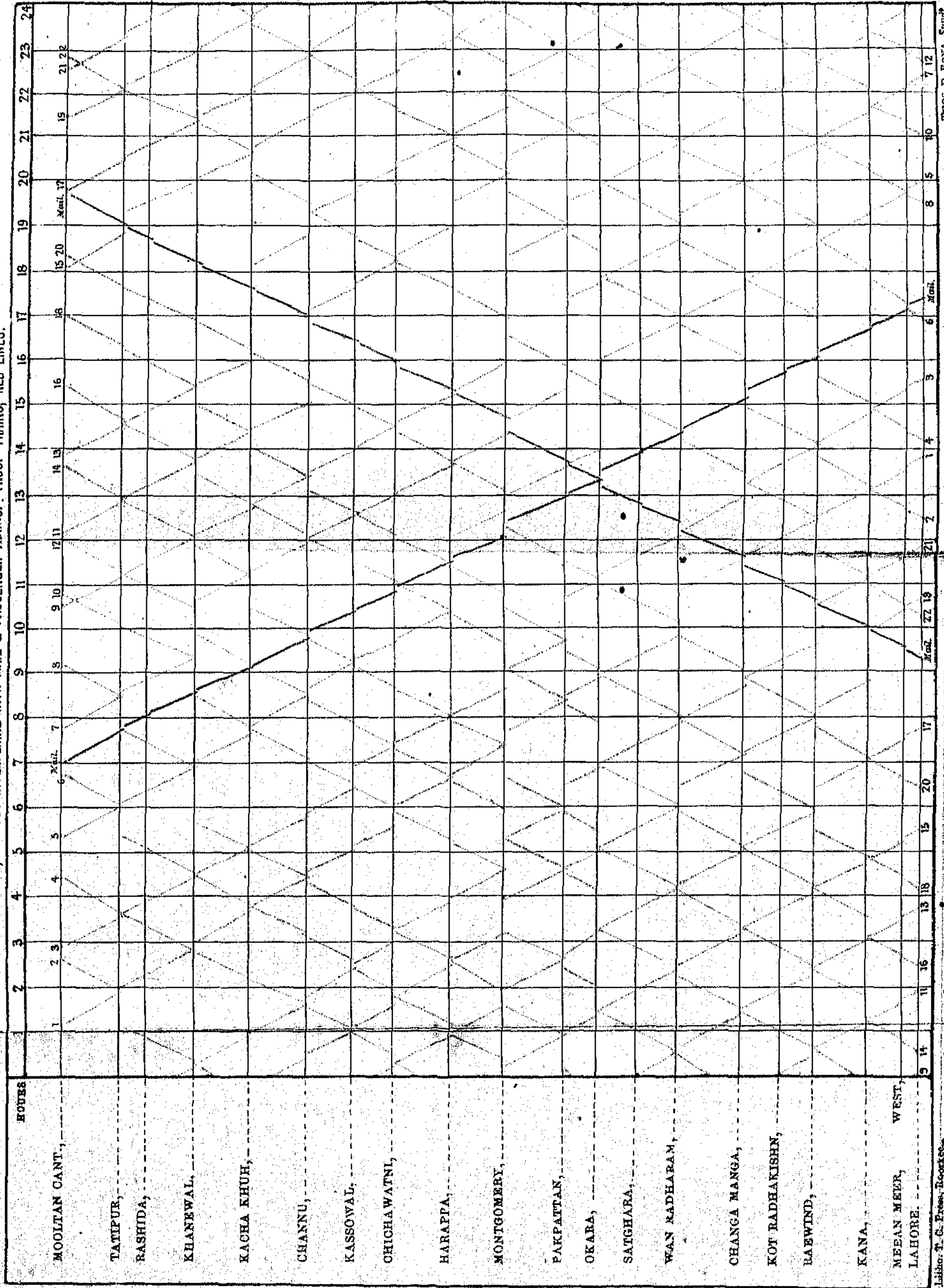
No. X. /

TROOP TRAINS, RED LINES. MAXIMUM NUMBER OF TROOP TRAINS WITH ALL OTHER TRAFFIC STOPPED.

HOURS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
LAHORE,-----	1	2	3	4																				
ATAEL,-----																								
AMRITSAR,-----																								
JANDIALA,-----																								
REAS,-----																								
JULLUNDUR CANT,-----																								
PHAGWARA,-----																								
PHILLLOUR,-----																								
LUDHIANA,-----																								
SANAHWAL,-----																								
KHANNA,-----																								
SIRHIND,-----																								
RAJPURA,-----																								
UMBALLA CANT.,-----																								
BARARA,-----																								
JAGADHRI,-----																								
SIRSAWA,-----																								
SAHARANPUR,-----																								
NAGAL,-----																								
DEOBAND,-----																								
MUZAFFARNAGAR,-----																								
KHATAULI,-----																								
SARDHANA,-----																								
MEERUT CANT.,-----																								
MURADNAGAR,-----																								
GHAZIABAD,-----																								
DELHI,-----																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

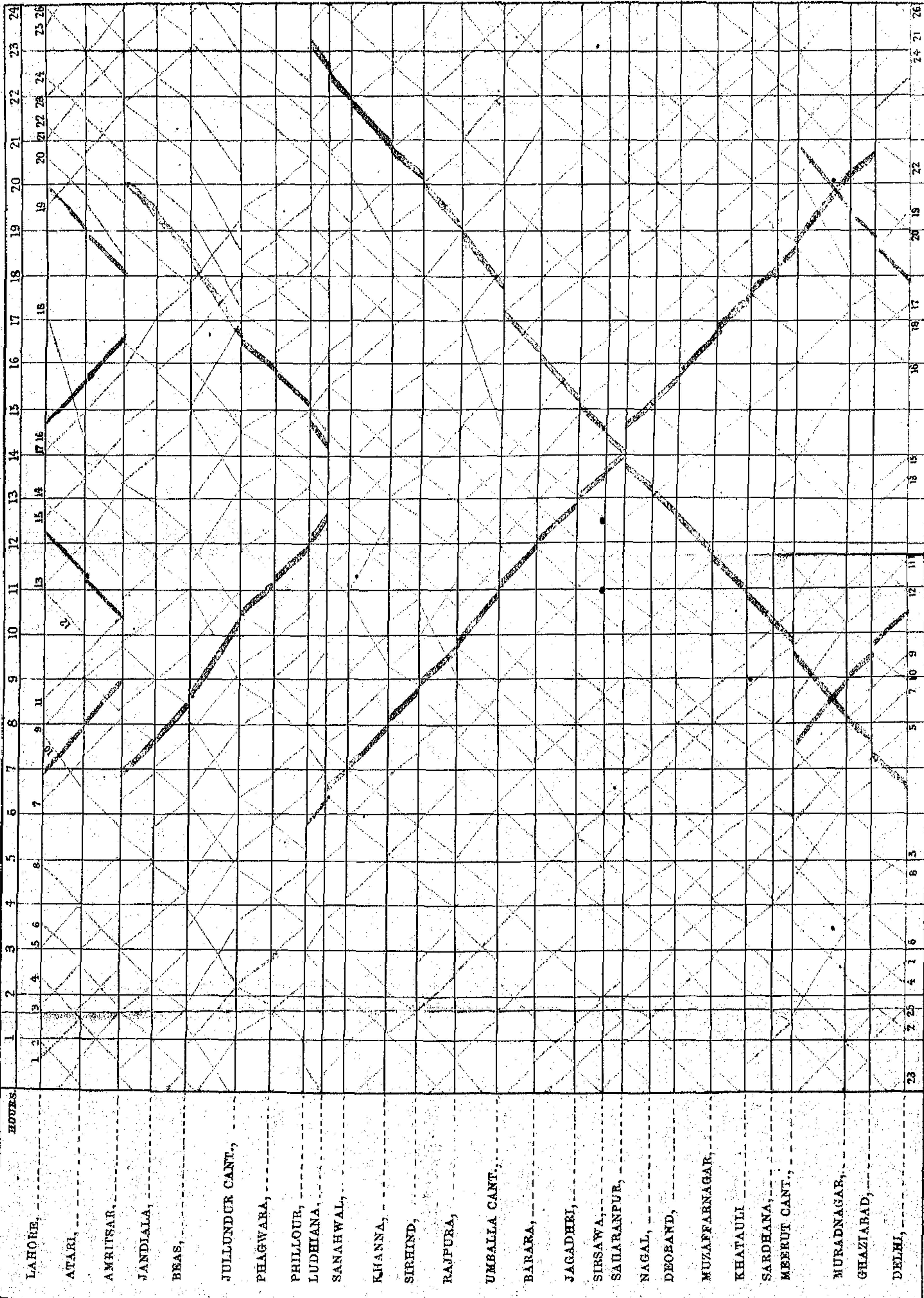
No. XV.

TROOP TRAINS, WITHOUT INTERFERING WITH MAIL & PASSENGER TRAINS. TROOP TRAINS, RED LINES.



No. XIV.

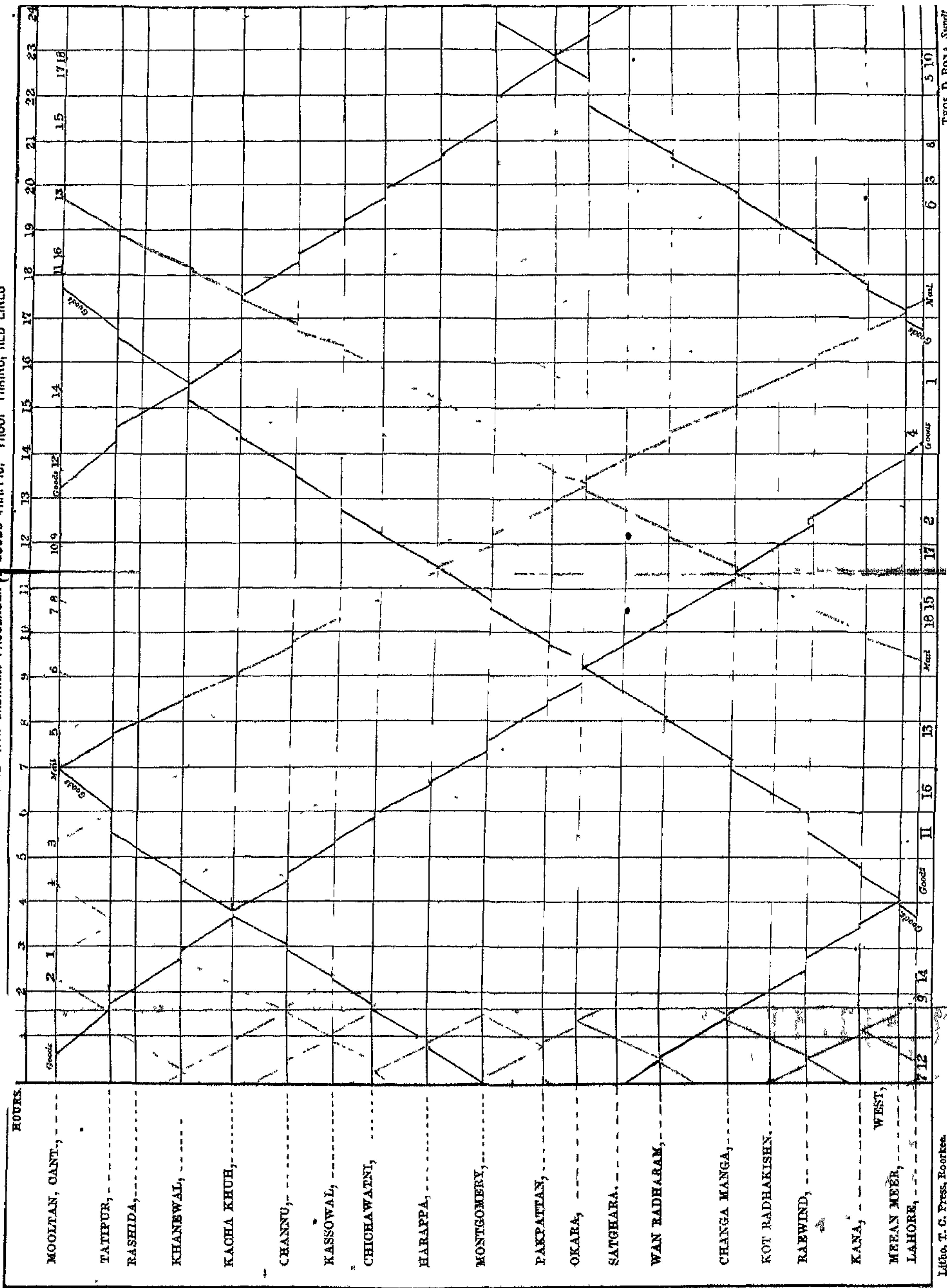
TROOP TRAINS, RED; MAIL TRAINS, BROWN; MIXED TRAINS, GREEN; LOCAL TRAINS, BLUE LINES. TROOP TIME TABLE WITHOUT INTERFERING WITH MAIL AND PASSENGER TRAINS.



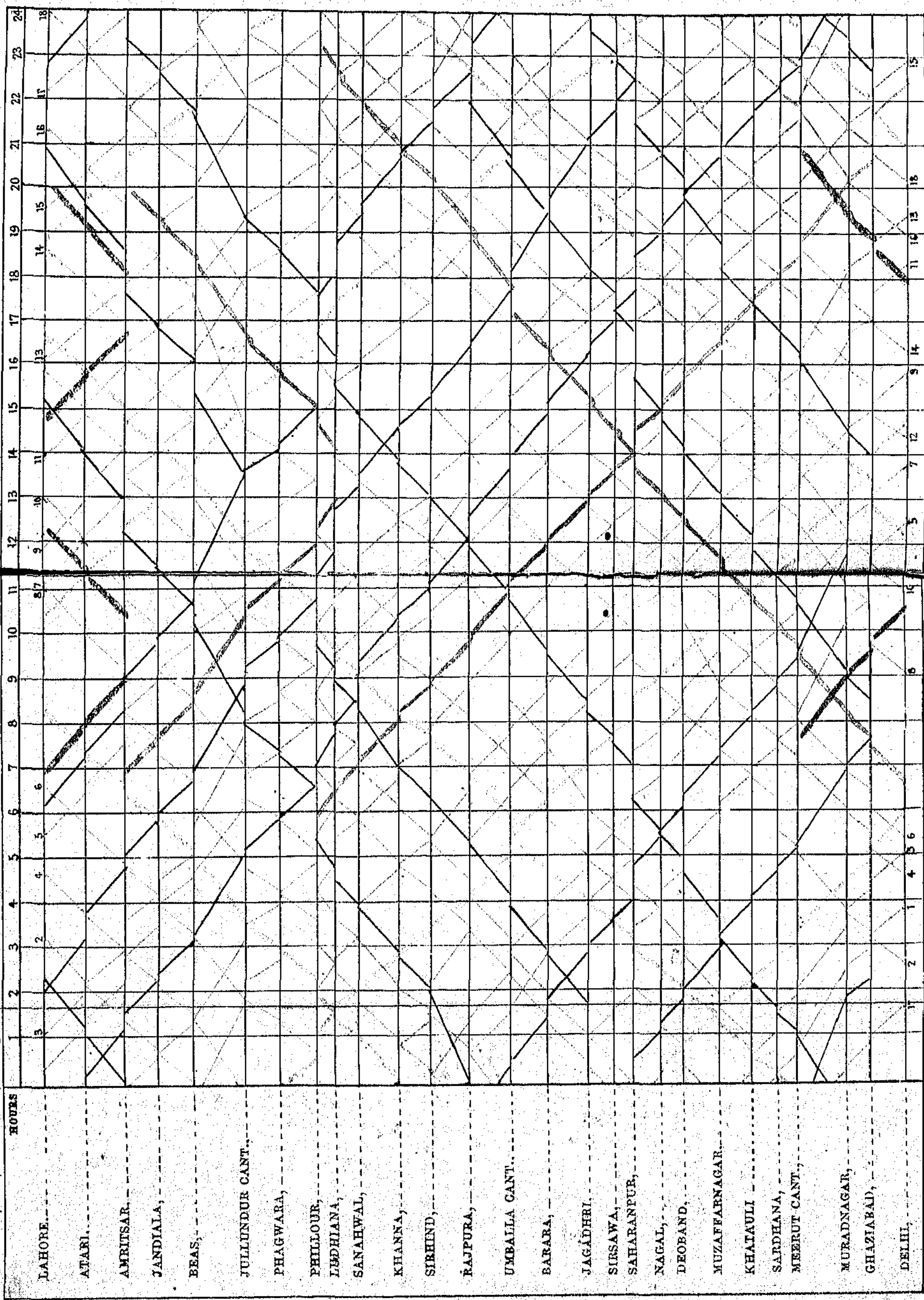
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Litho. T. C. Press, Rochester.

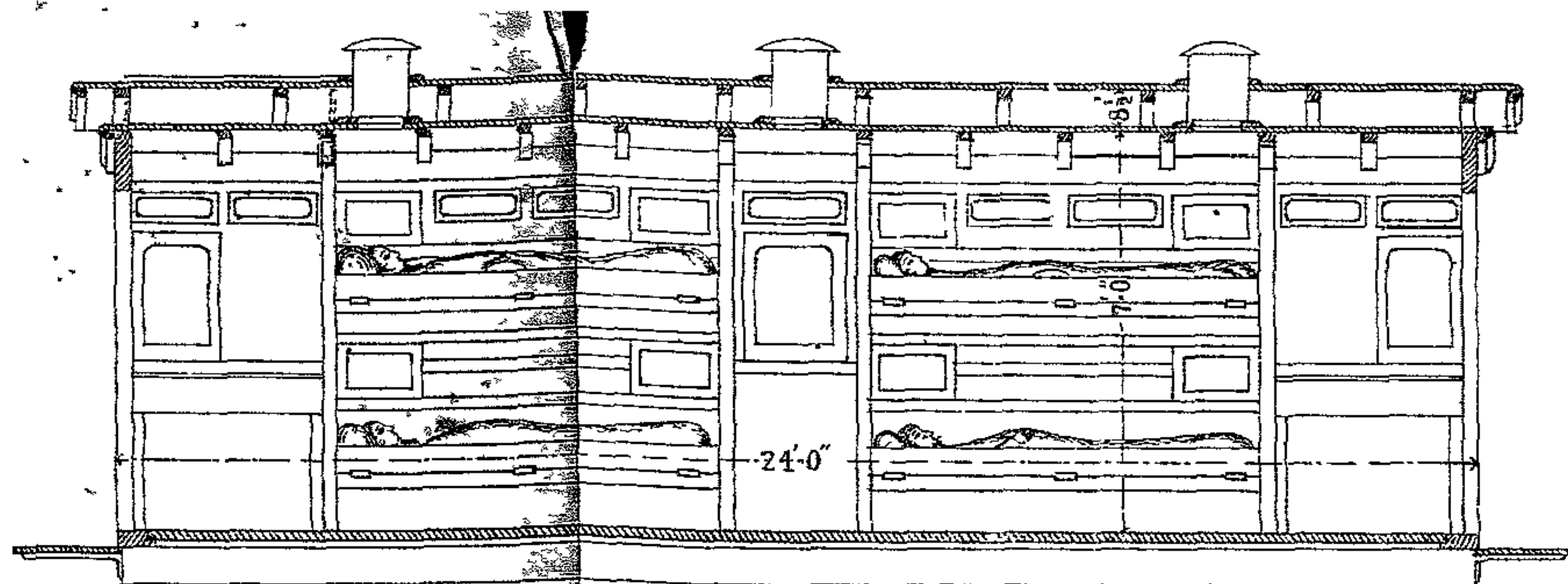
TOOP TRAINS WITHOUT INTERFERING WITH ORDINARY PASSENGER GOODS TRAFFIC, TROOP TRAINS, RED LINES



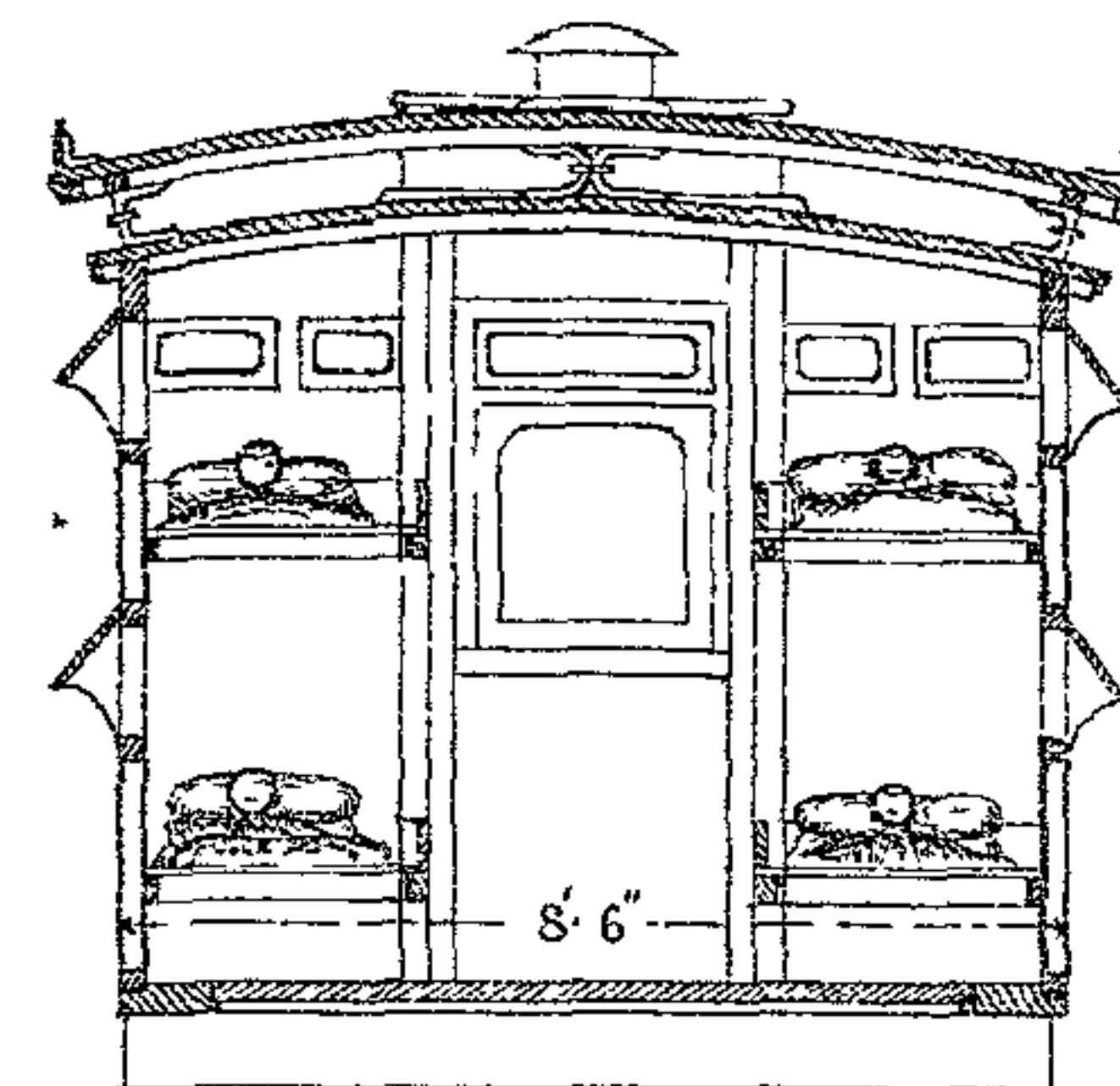
TRUP TIME TABLE WITHOUT INTERFERING WITH THE ORDY. PASSR. & GOODS TRAFFIC.



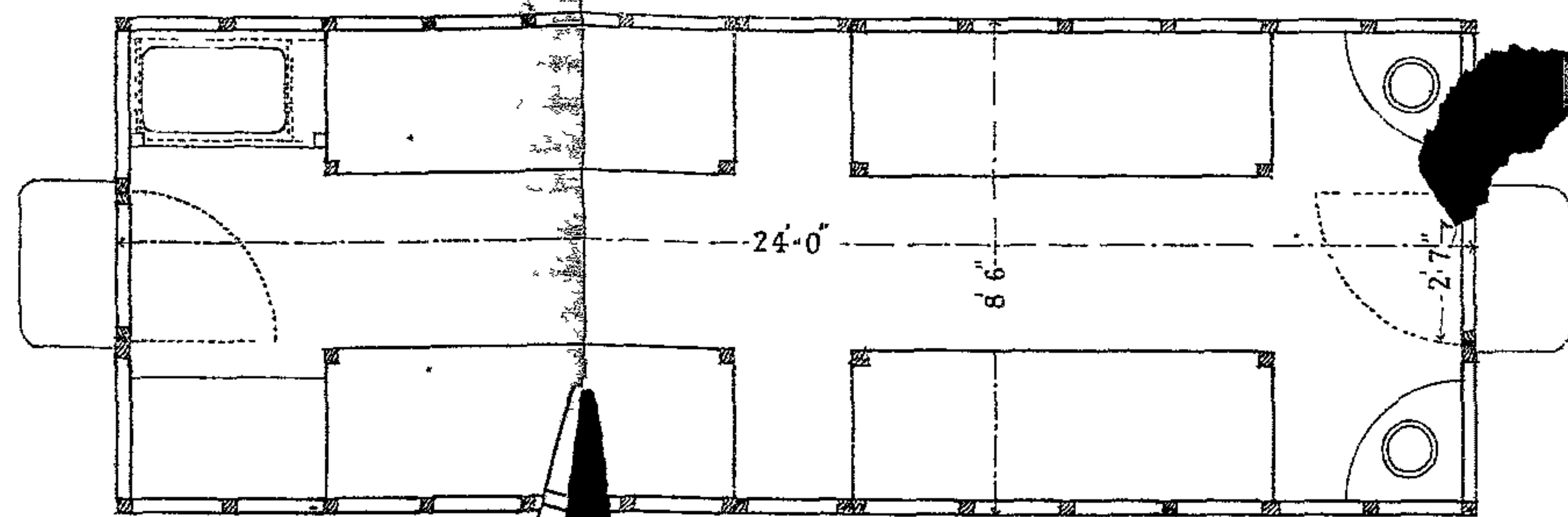
No. VIII.



LONGITUDINAL SECTION.



CROSS SECTION.



SECTIONAL PLAN.

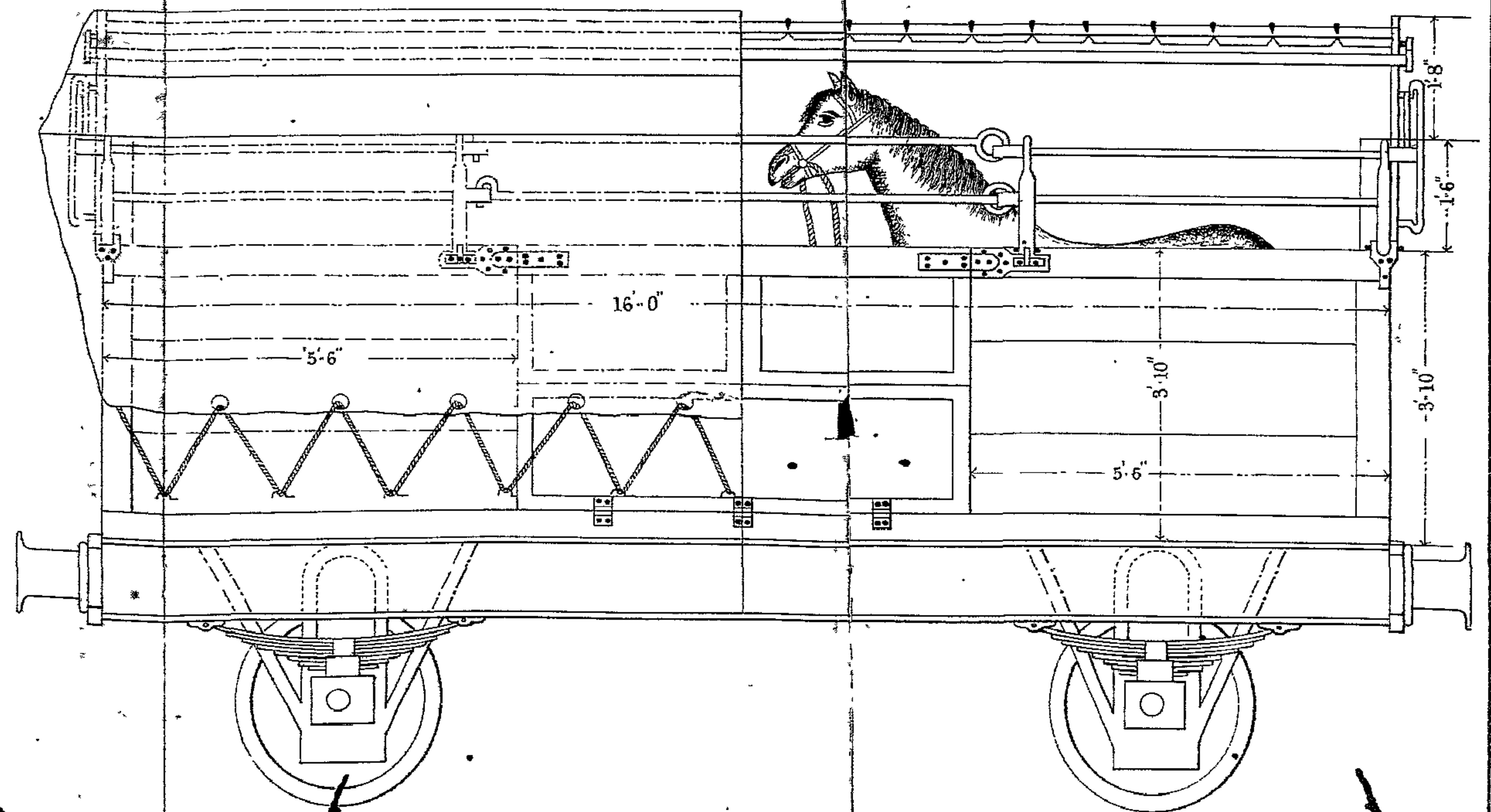
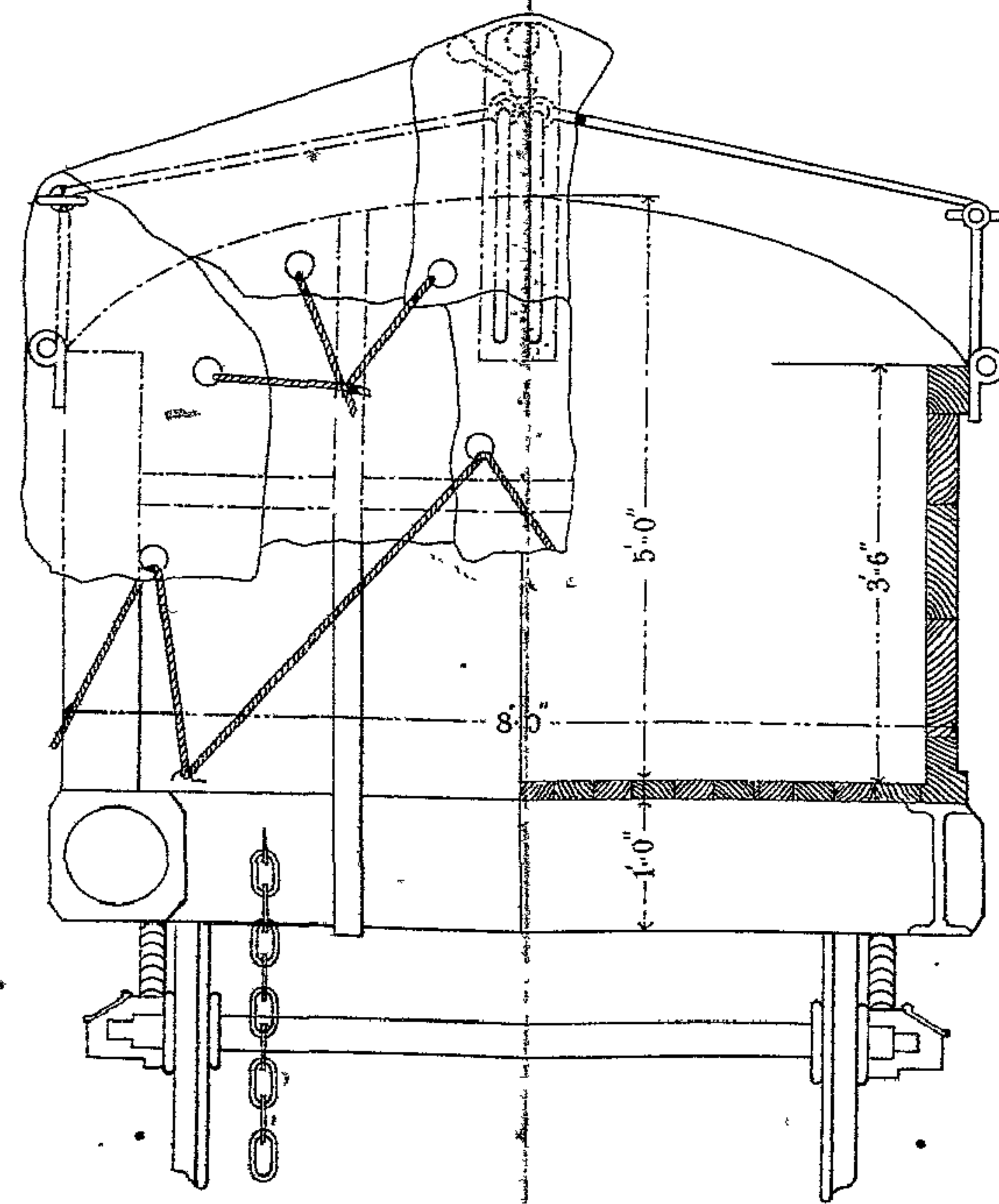
S. P. & D. R.

HOSPITAL CARRIAGE
TO CARRY 8 PATIENTS.

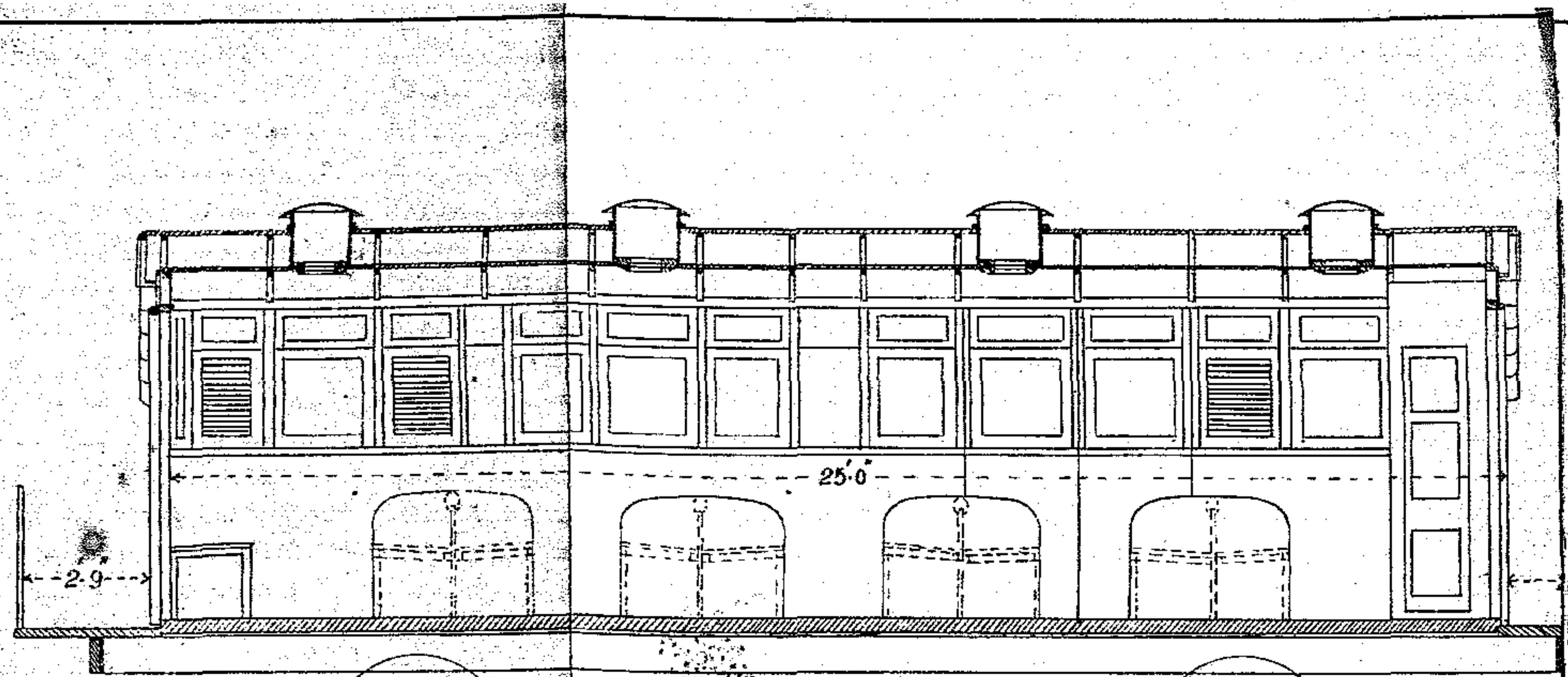
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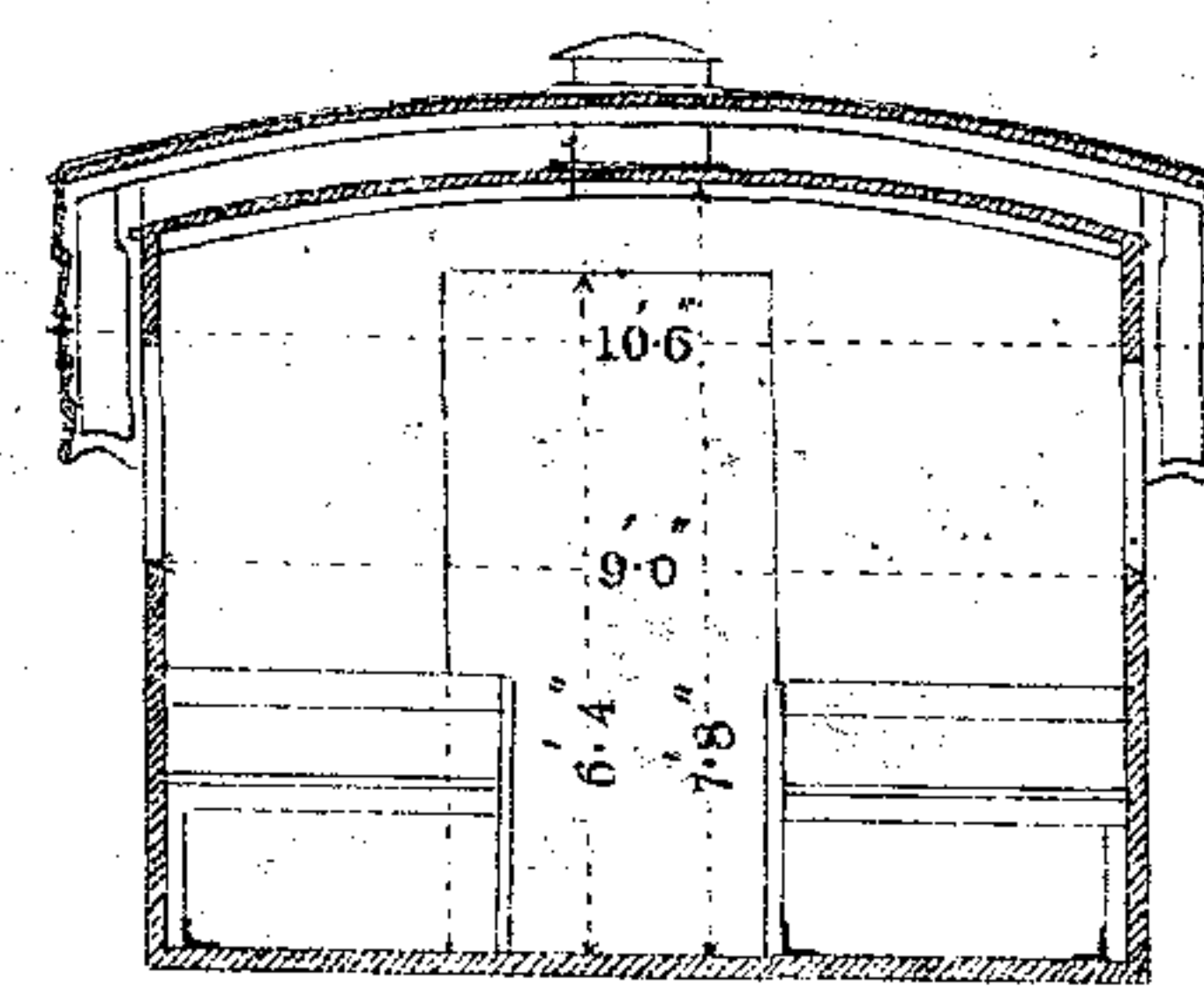
DAVIES' PATENT FOR SHEETING OPEN TRUCKS.



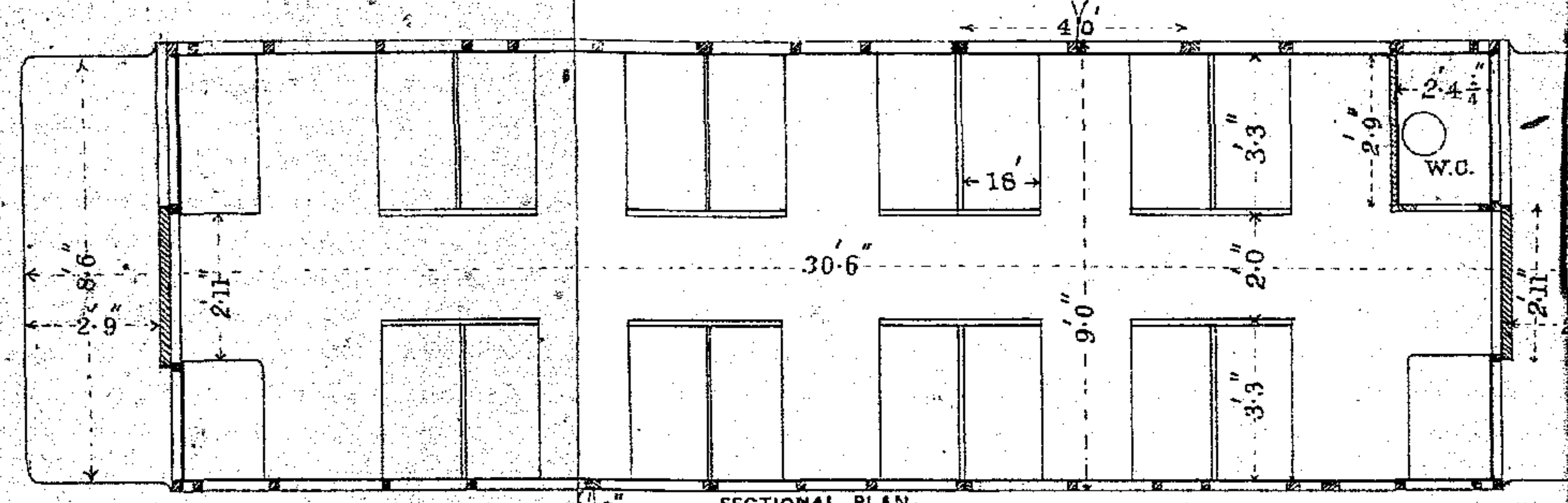
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LONGITUDINAL SECTION.



CROSS SECTION.



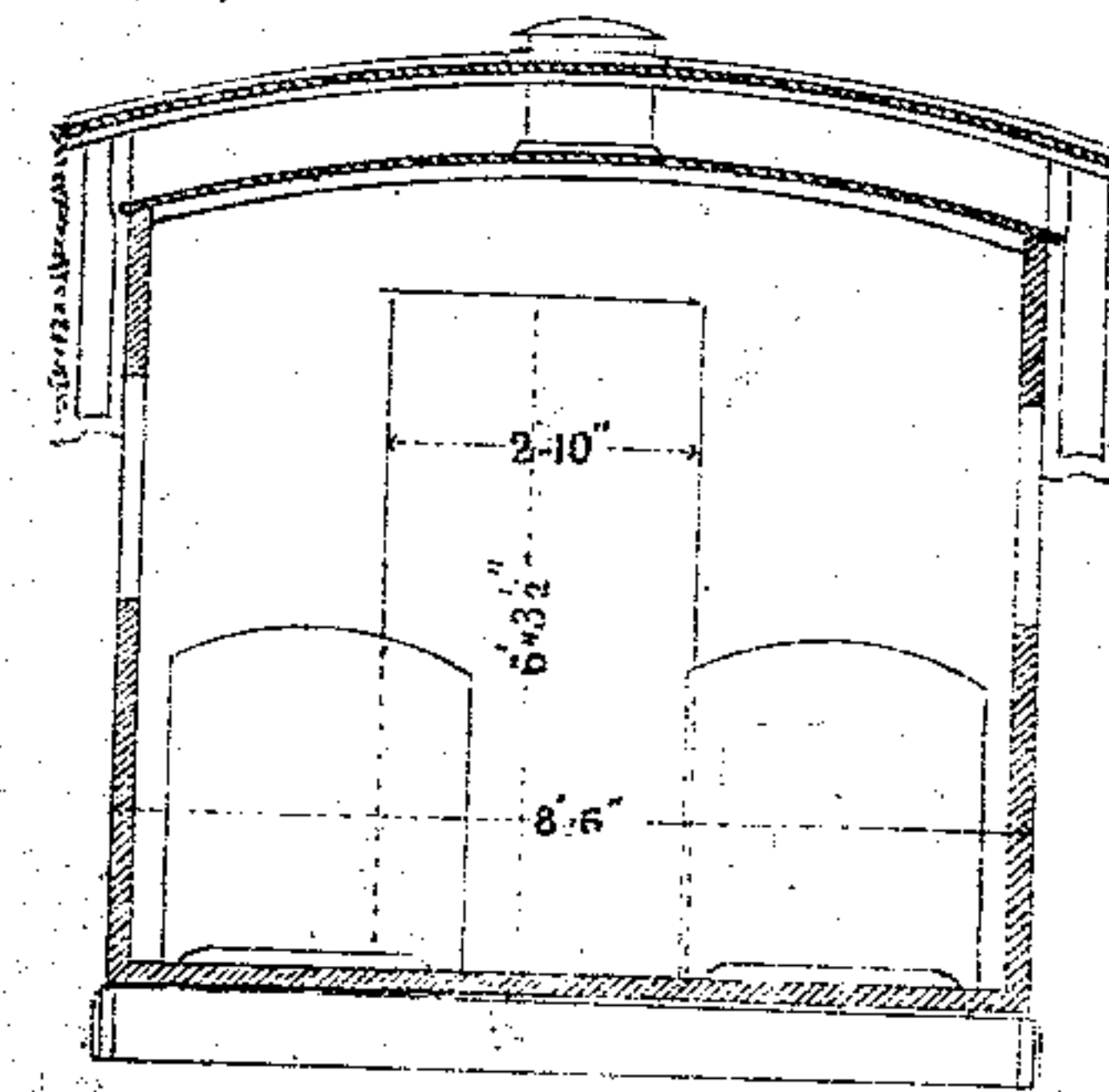
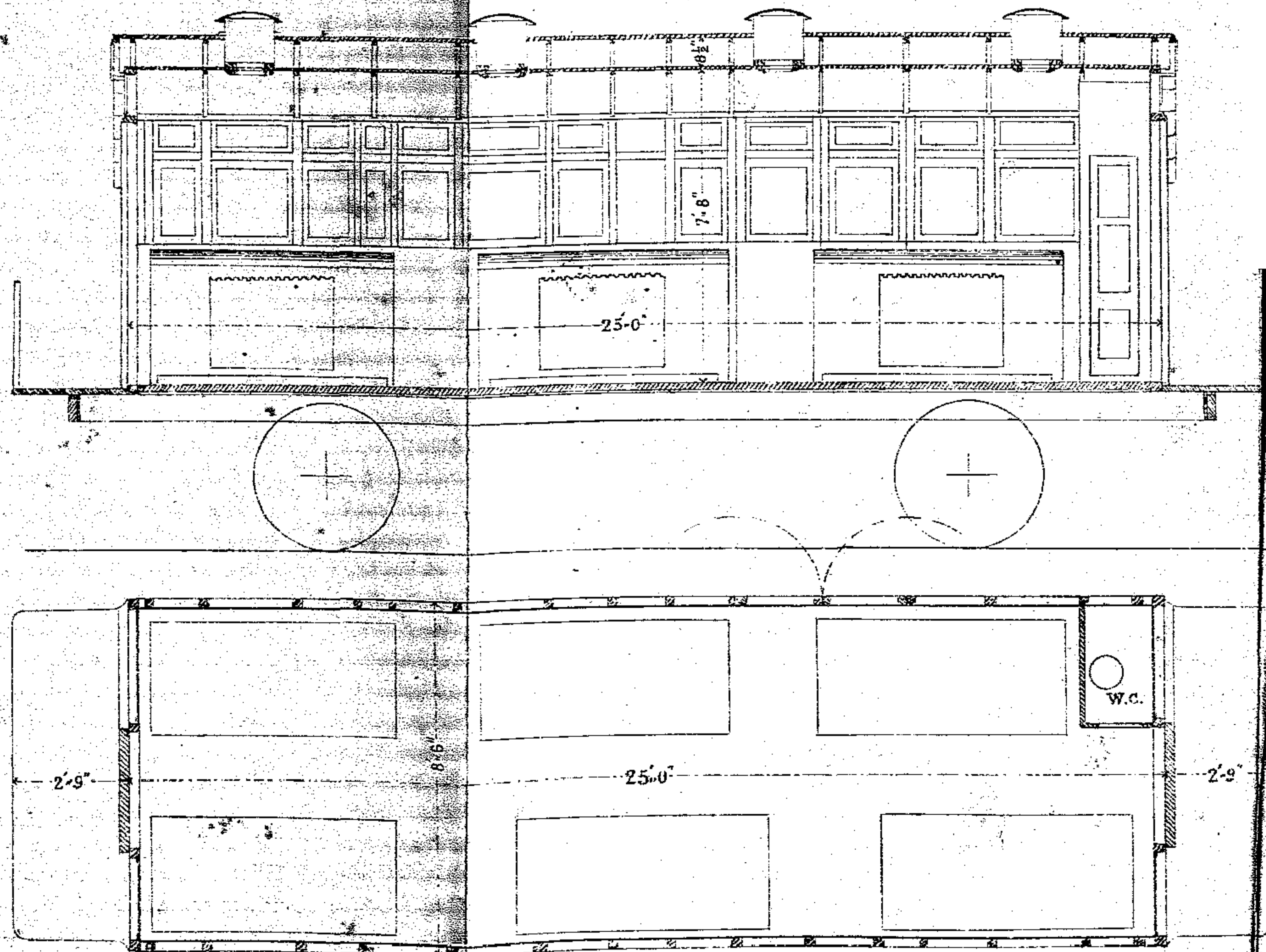
SECTIONAL PLAN.

S. P. & D. R.

AMBULANCE CARRIAGE

WITH SEATS

TO CARRY 40 PASSENGERS.



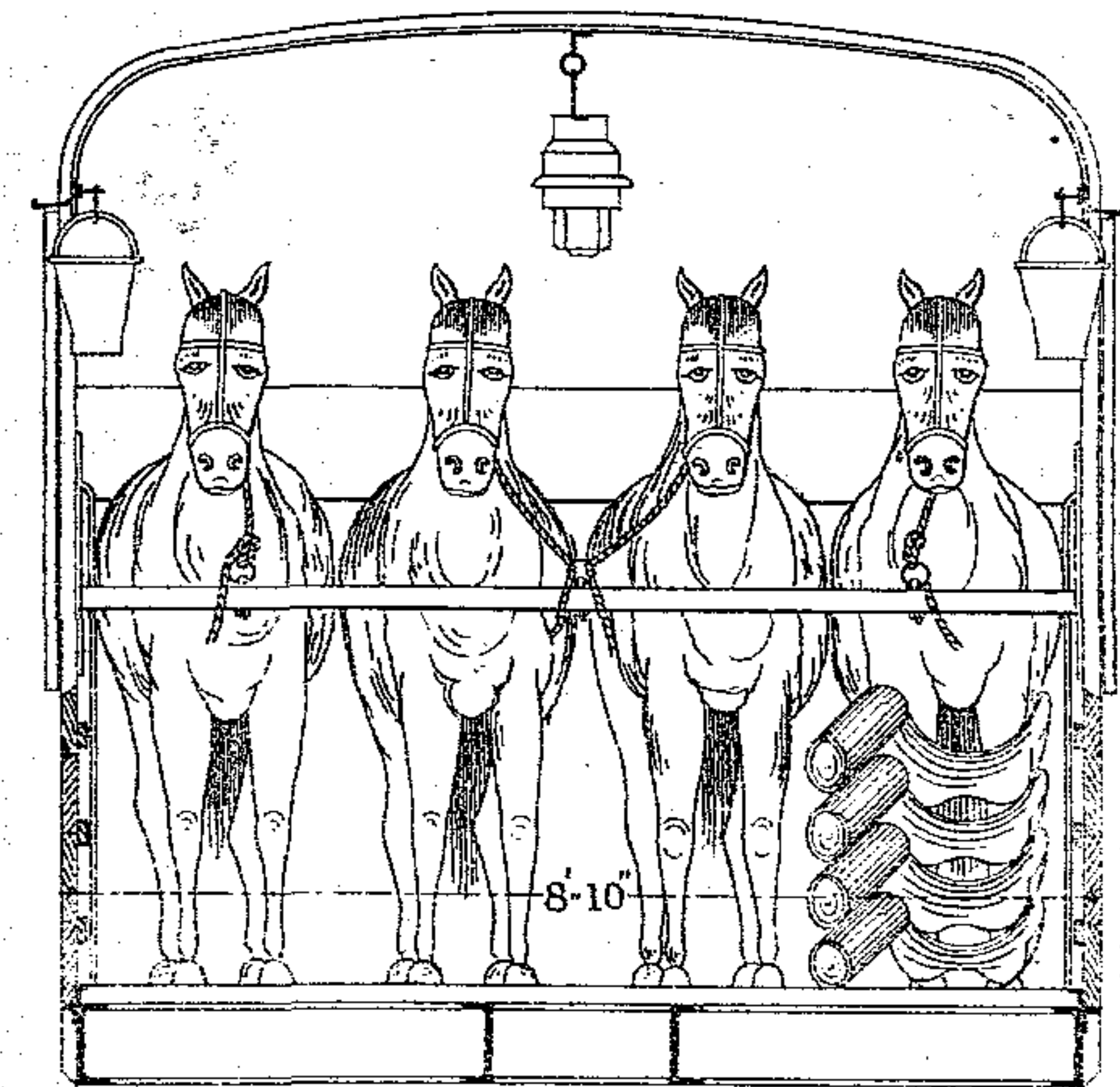
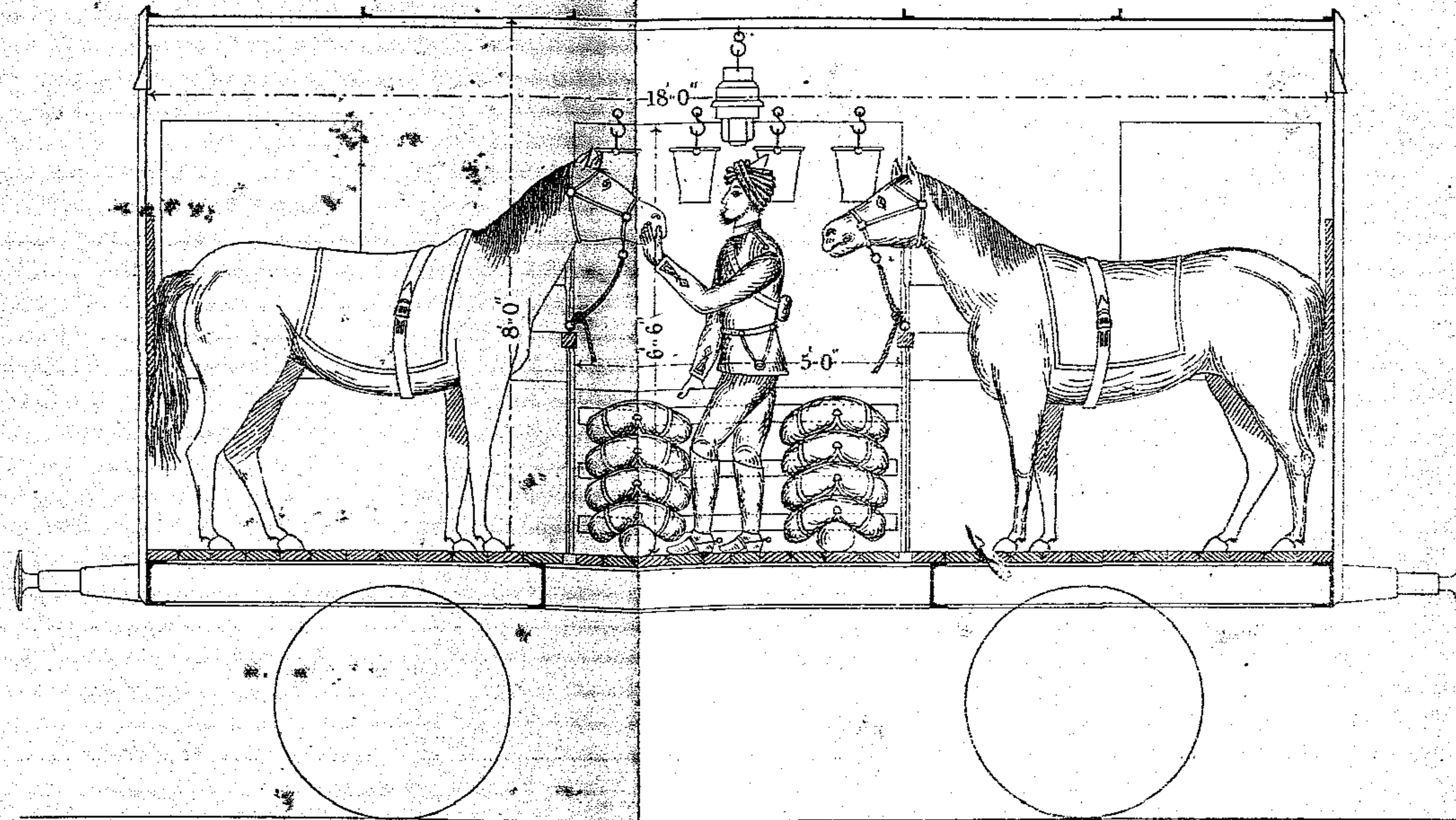
S. P. & D. R.

AMBULANCE CARRIAGE
WITH SEATS REMOVED
TO CARRY 6 DOOLIES.

No V.

S. P. & D. R.

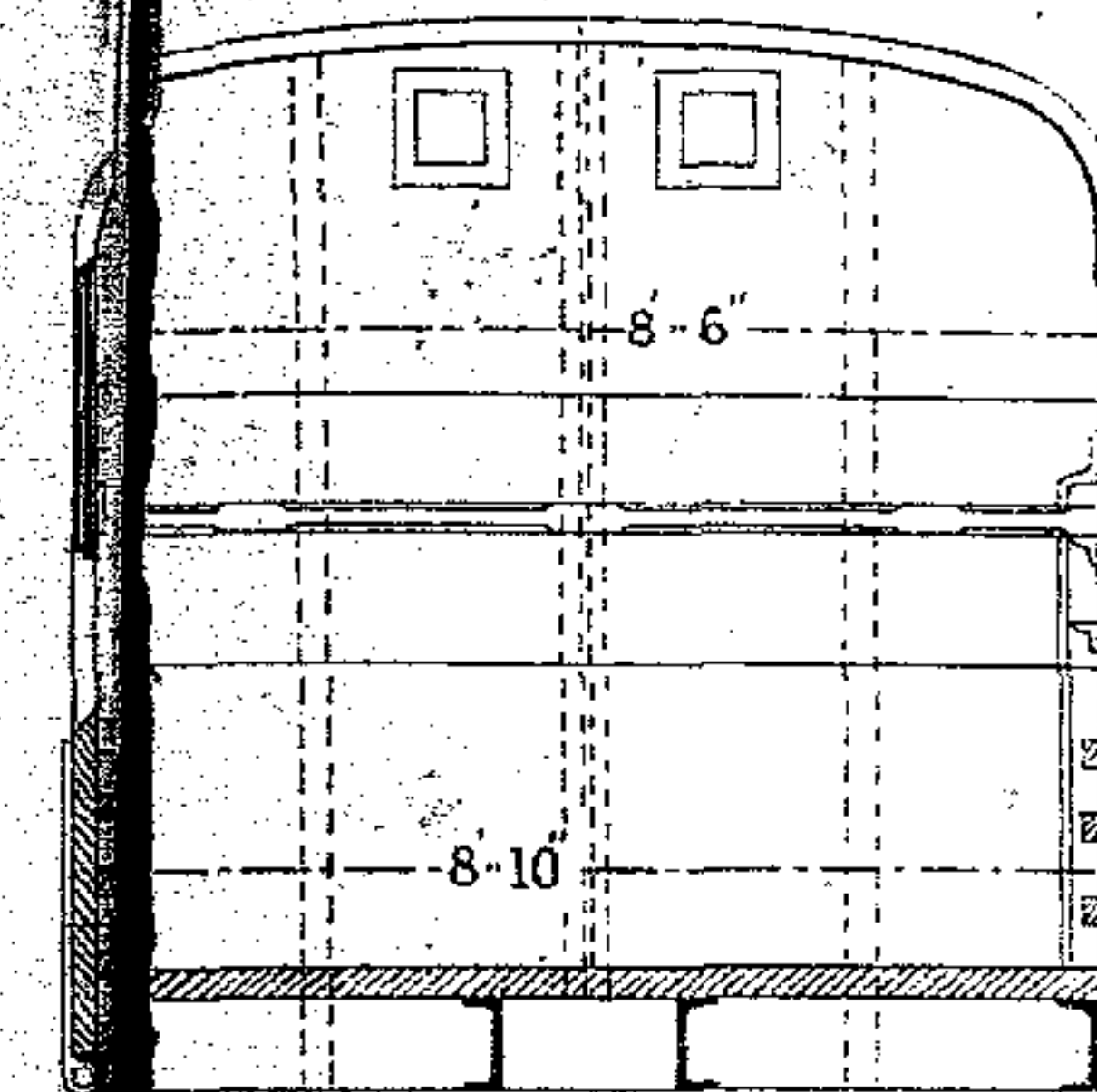
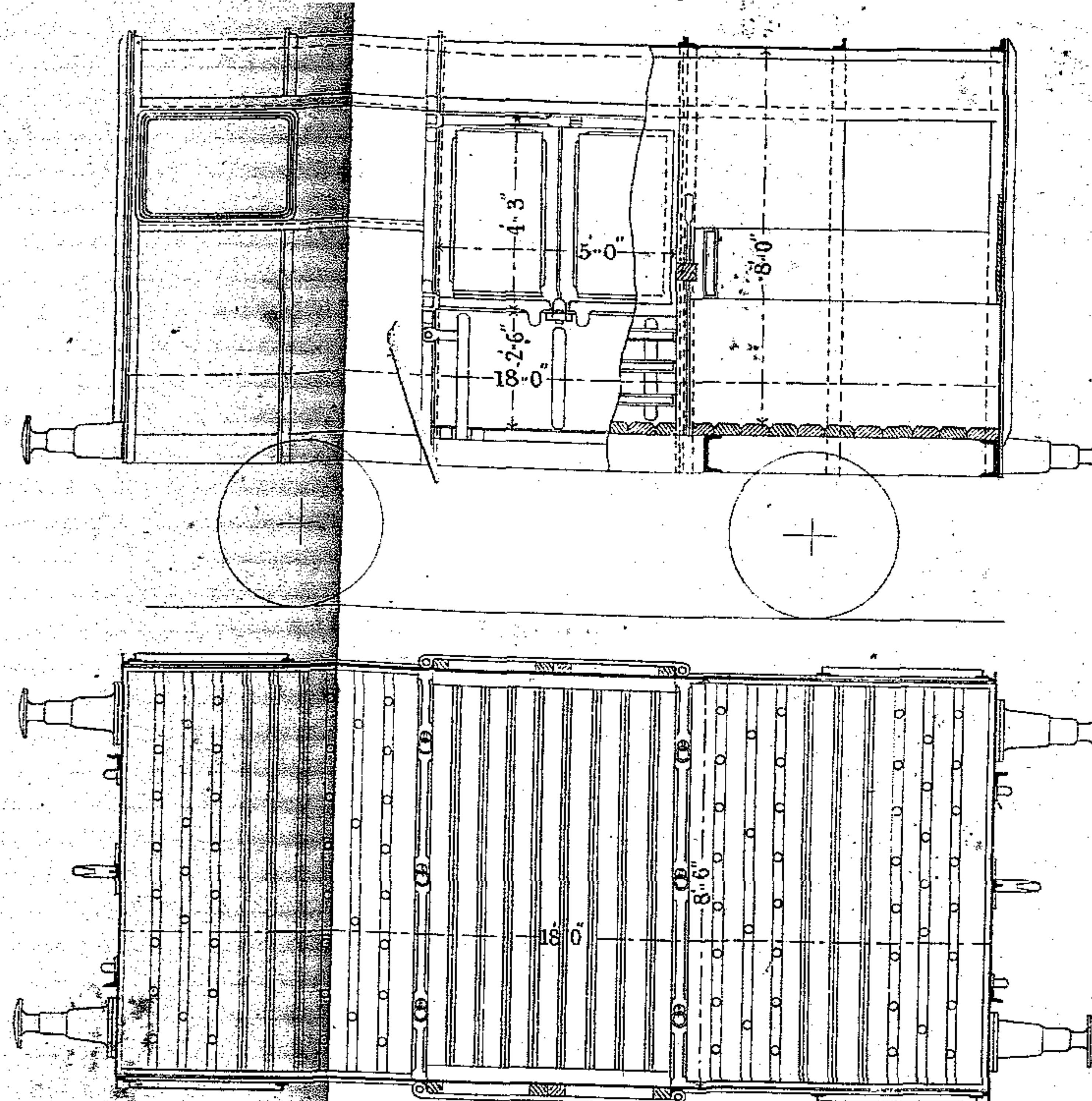
TRANSPORT OF HORSES.



Litho. T. C. Press, Roorkee.

THOS. D. BONA, Supdt.

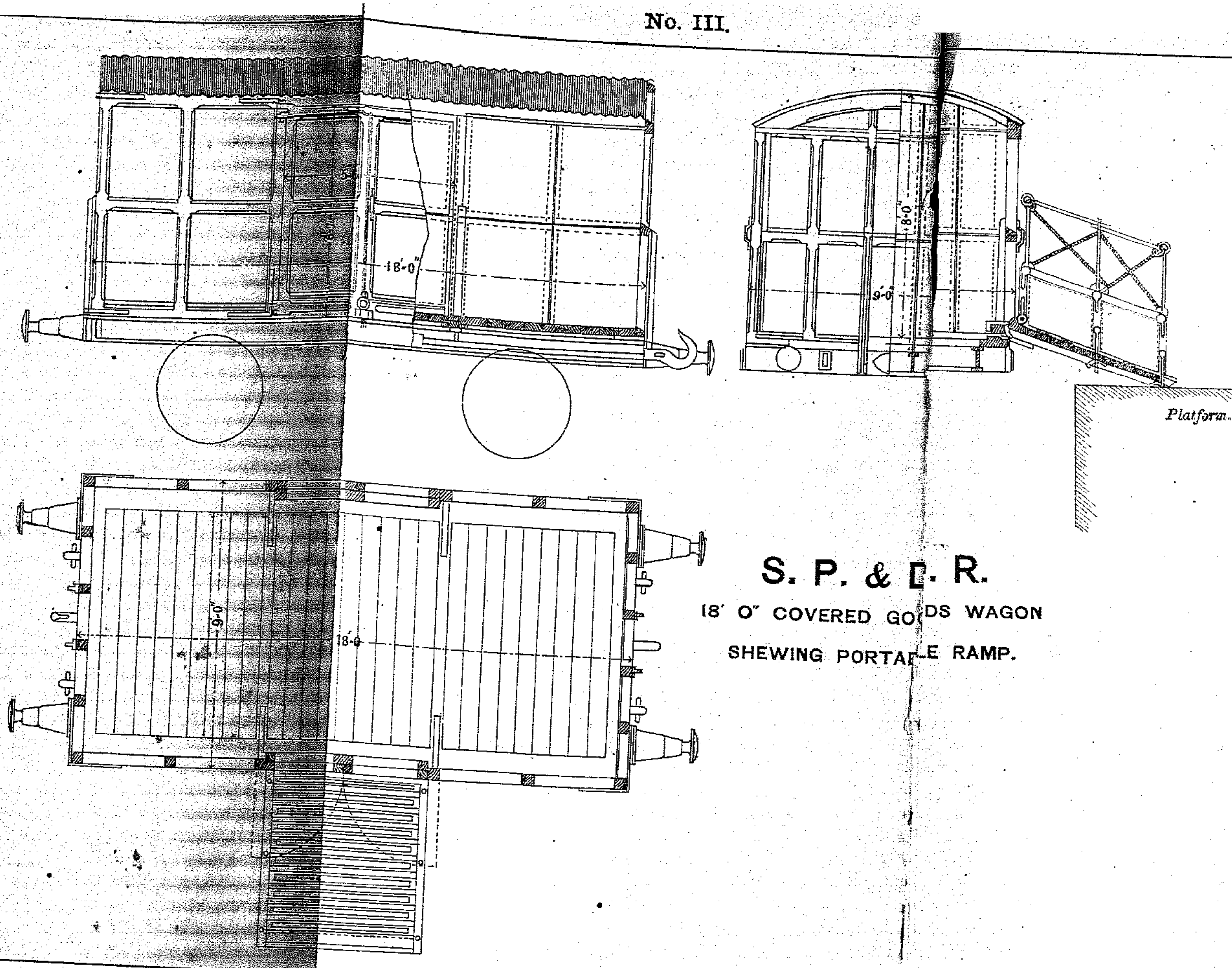
No. IV.



S. P. & D. R.

18' COVERED GOODS WAGON
TO CARRY 8 HORSES OR 10 PONIES.

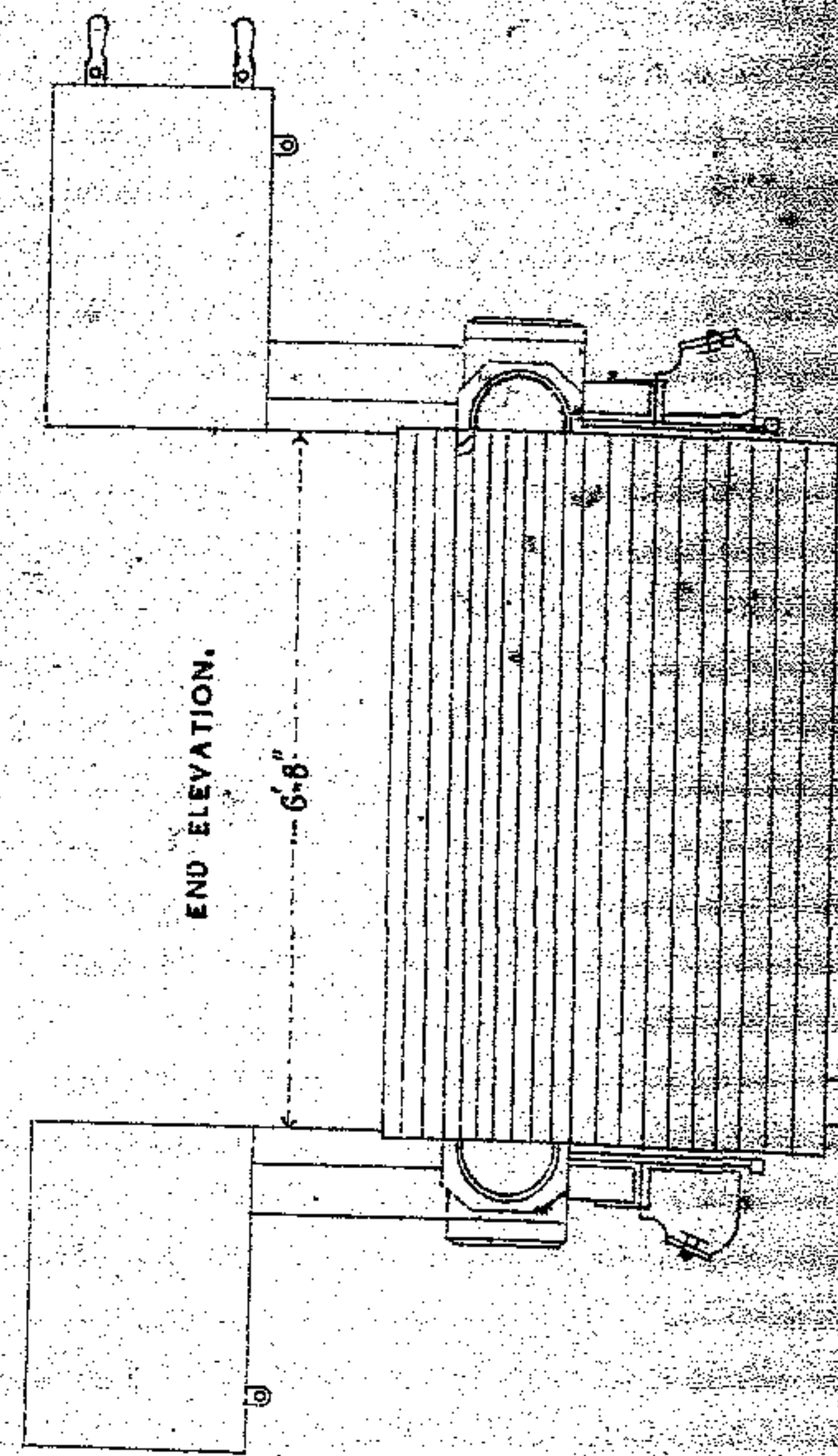
No. III.



Litho. T. C. Press, Roorkee.

THOS. D. BOWA, Supdt.

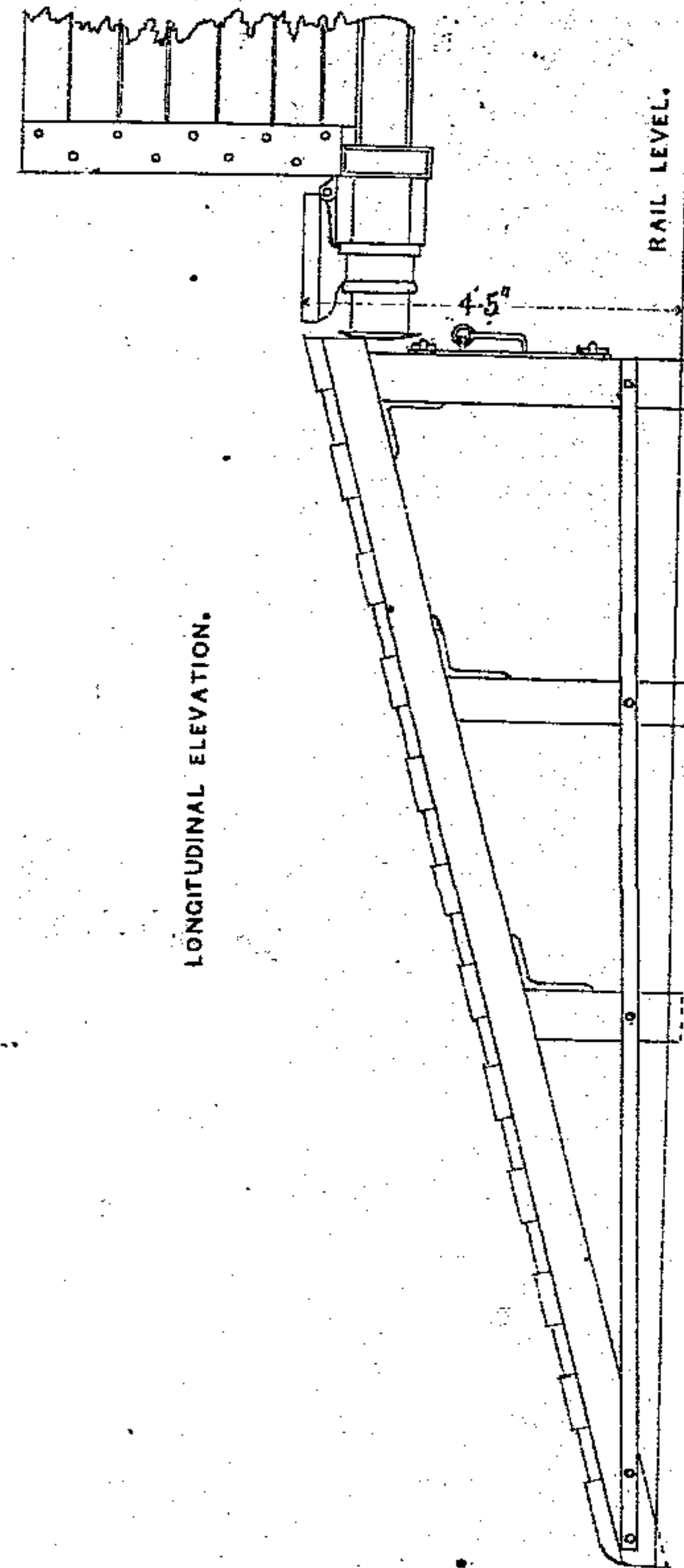
S. P. & D. R. RAMPS FOR MILITARY TRAIN. RAMPS USED FOR LOADING HORSES



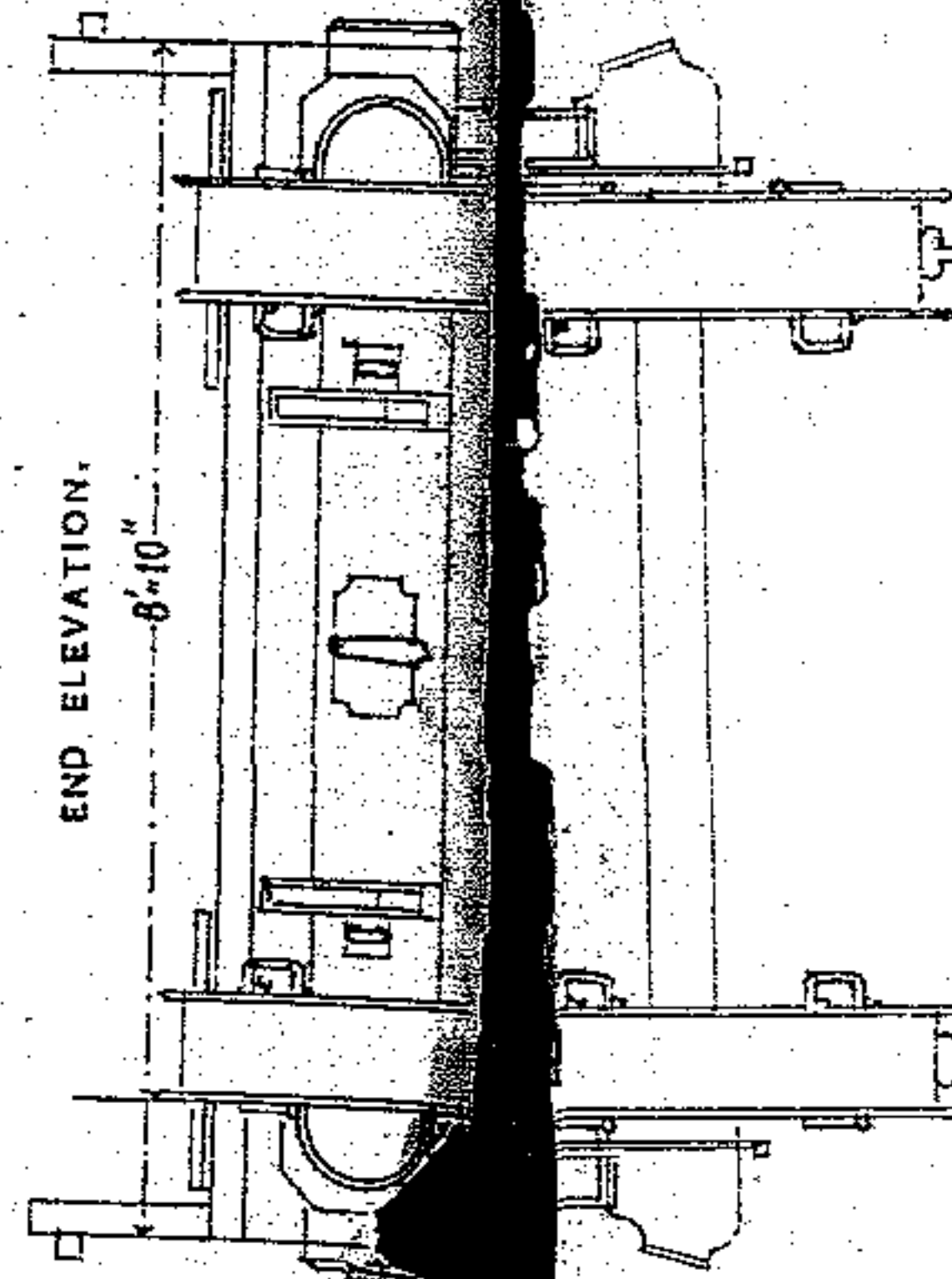
Litho. T. C. Press, Boonville.

No II.

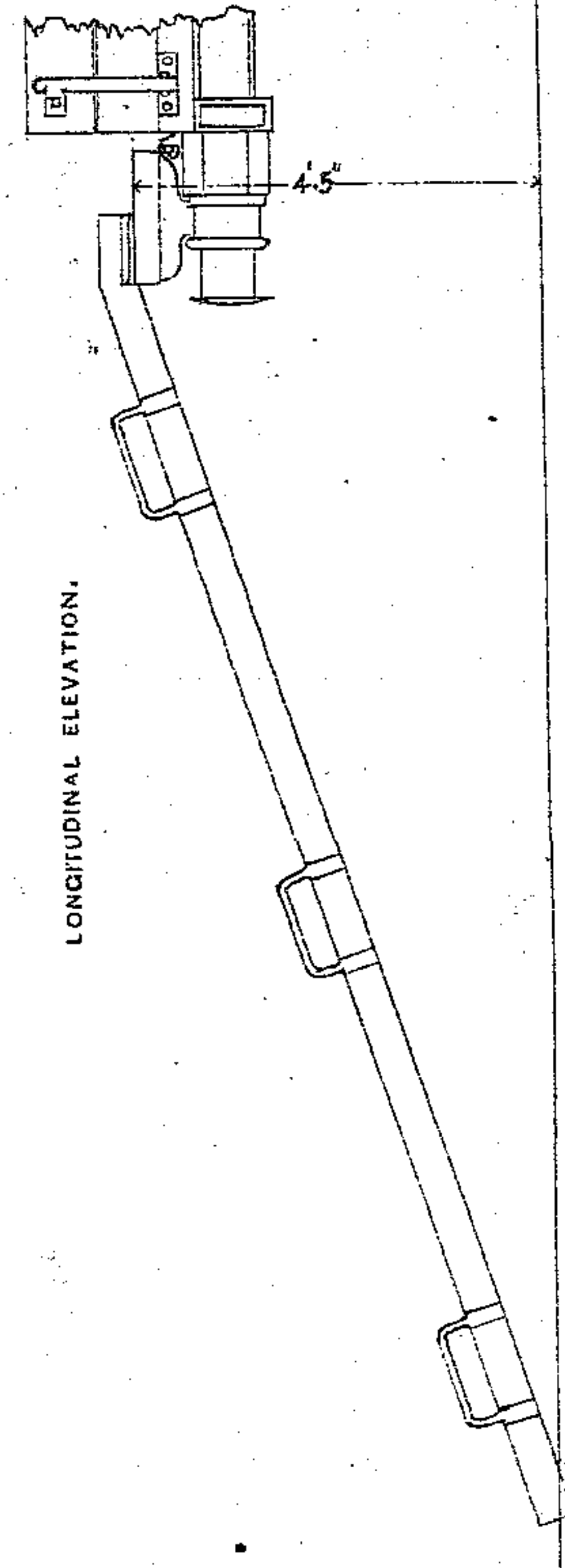
LONGITUDINAL ELEVATION.



GIRDERS USED FOR LOADING GUNS.



LONGITUDINAL ELEVATION.

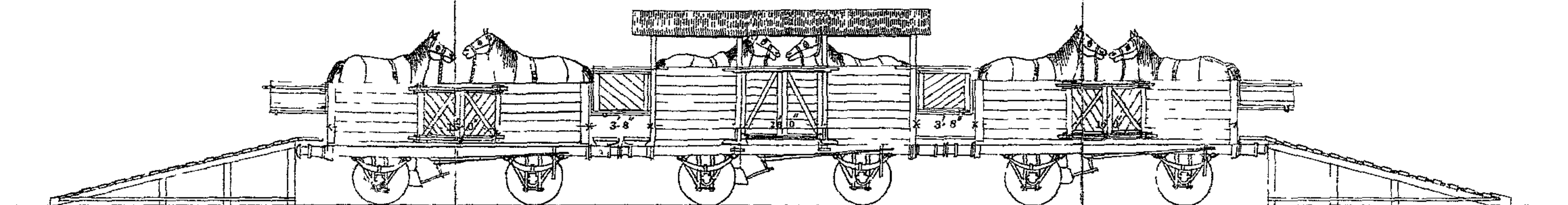


EROS, D. BONA, Supdt.

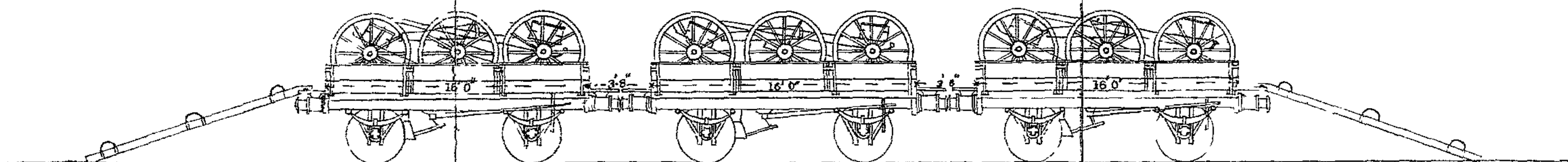
No. I

S. P. & D. R.

ARRANGEMENT FOR LOADING HORSES ON THE LINE OR IN A SIDING.



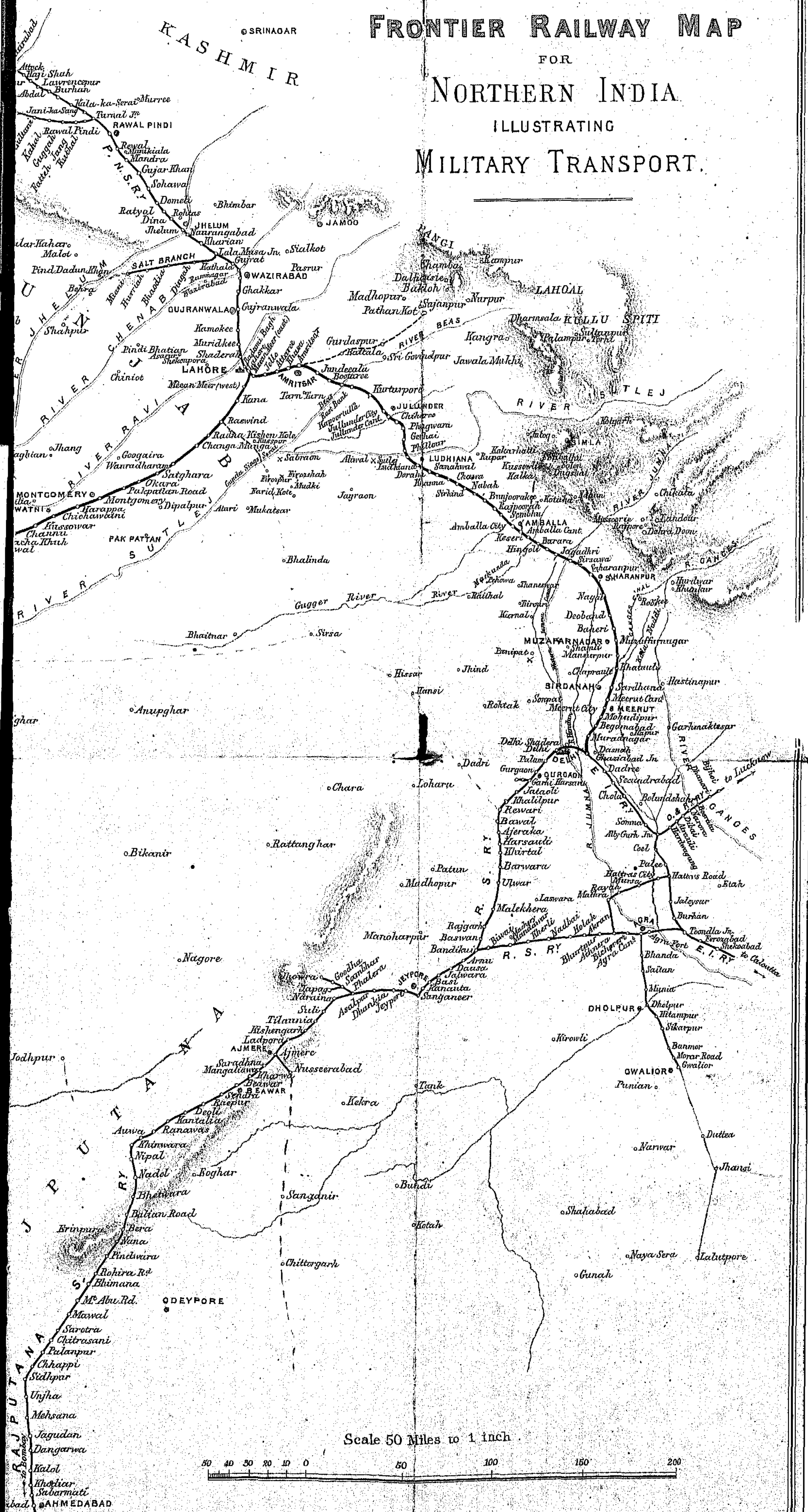
ARRANGEMENT FOR LOADING GUNS, &c., ON THE LINE OR IN A SIDING.



FRONTIER RAILWAY MAP

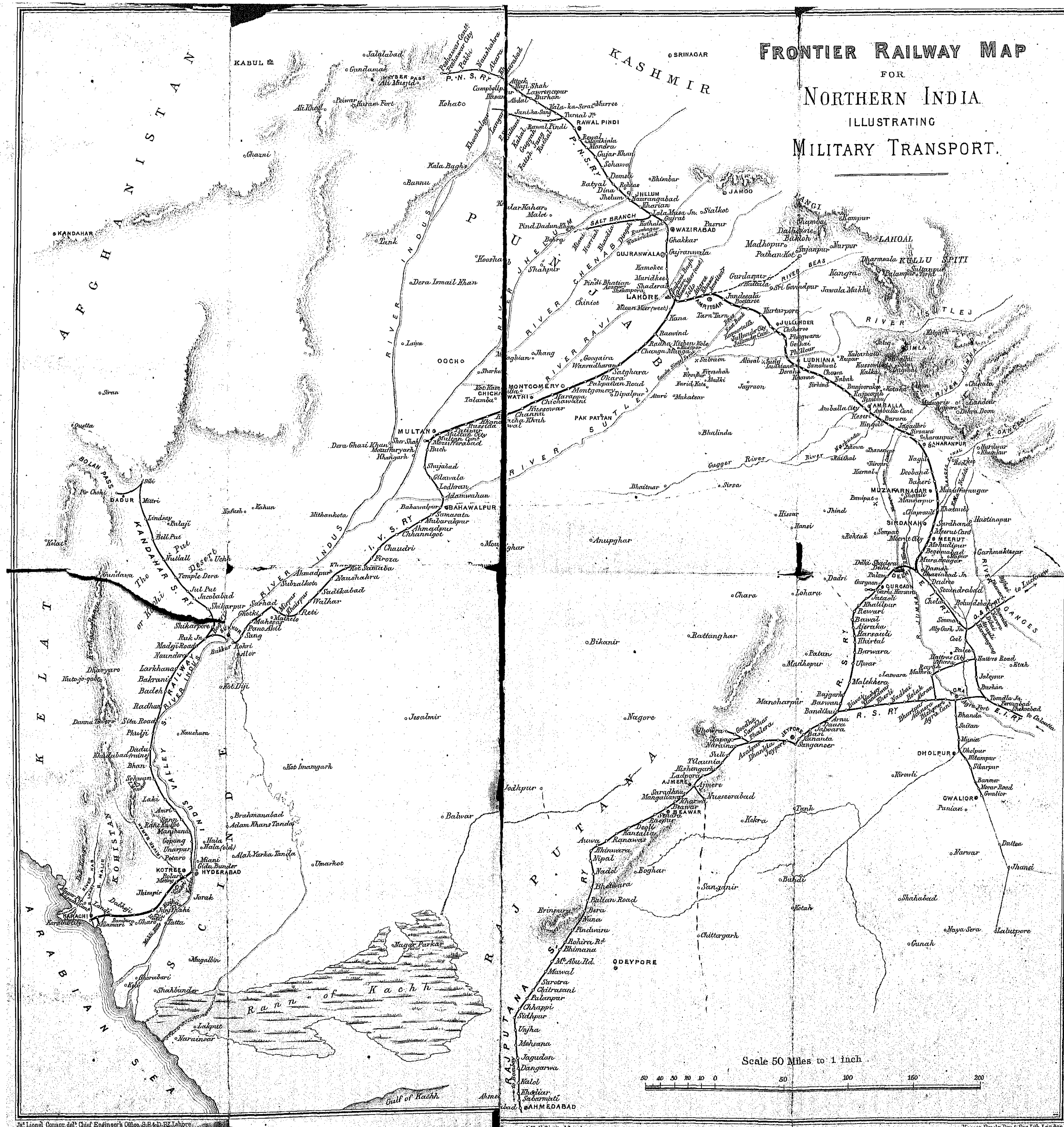
FOR
NORTHERN INDIA

ILLUSTRATING
MILITARY TRANSPORT.



FRONTIER RAILWAY MAP

FOR
NORTHERN INDIA
ILLUSTRATING
MILITARY TRANSPORT.



MILITARY TRANSPORT
INDIAN RAILWAYS

BY

DAVID ROSS, C. I. E.,
F. R. G. S.

WITH MAP, DRAWINGS,
AND
DIAGRAMS.

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