THE ROYAL ENGINEERS JOURNAL.—AUGUST, 1919. Pages 49—96.

THE ROYAL ENGINEERS JOURNAL.

Vol. XXX. No. 2. AUGUST, 1919.

CONTENTS.

DEEDS OF THE ROYAL ENGINEERS

Now ready, *Deeds of the Royal Engineers*, compiled in the R.E. Records Office. Extract from the Preface :—

"It is hoped that the following pages may assist lecturers on Royal Engineer history, and may help members of the Corps generally to become familiar with some of the more striking events and personalities in the long and illustrious history of the Royal Engineers."

Chapter 1.—A Short History of Military Engineers in England.
" 2.—The Soldier Artificer Company at the Siege of Gibraltar.
" 3.—The Royal Engineers and the Battle of Waterloo.
" 4.—The Royal Sappers and Miners in the Crimean War.
" 5.—The Blowing in of the Cashmere Gate at Delhi.
" 6.—The 23rd Company, Royal Engineers, in the Indian Mutiny and in China.
" 7.—The 23rd Company, Royal Engineers, at Ladysmith.
" 8.—Royal Engineer Company Histories.
" 9.—The Royal Engineers and the Victoria Cross.

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Authors alone are responsible for the statements made and the opinions expressed in their papers.

Royal Engineers War Memorial Service.

A SERVICE " in memory of all ranks of the Royal Engineers who have given their lives in the service of their King and Country " was held in Rochester Cathedral on Tuesday, 22nd July. The number of Officers of the Corps who have fallen is 1,081, and of Other Ranks 17,833. His Majesty the King, Colonel-in-Chief of the Corps, was represented by Prince Arthur of Connaught, and the congregation included many distinguished soldiers and a large number of relatives and friends of the fallen. The service was solemn and deeply impressive, and was sweetened by the exquisite playing of the Band. One of the most solemn moments was when the people, at the Bishop's bidding, stood in silence, remembering, " with thanksgiving and with honour before God and man all ranks of the Royal Engineers who have died," and then kneeling, joined in the hymn " O valiant hearts, who to your glory came." The Dean of Rochester delivered a sympathetic and inspiring address. Quoting the motto of the Corps he pointed out how ubiquitous in the late war had been the call of duty and honour. Was it no consolation that the dead had not died in vain? This memorial service would have no true meaning for any man or woman unless it meant a fresh dedication of themselves to duty—duty to country and to home.

After the Benediction, pronounced by the Bishop, the " Last Post " was sounded, followed by the " Dead March in Saul." Then the Regimental Call merged into the Reveille, and the service ended with the first verse of " God save the King."

THEIR GLORY SHALL NOT BE BLOTTED OUT;
THEIR NAME LIVETH FOR EVERMORE.

Ecclesiasticus xliv., 13—14.

GOD PROVED THEM, AND FOUND THEM WORTHY OF HIMSELF.

Wisdom iii., 5.

ORDER OF BATTLE OF ROYAL ENGINEER UNITS IN ALL THEATRES ON NOVEMBER 11TH, 1918.

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	Mesopotamia.	East Africa.	Foreign Garrisons.
Field Sqdns.		1, 2, 3		4th, 5th.				
Field Troops				3		7		
Field Cos.	414 (Lowland) 415 (Lowland). In process of disbandment. 402 (Highland). 403 ,, 405 ,, 440 (Cheshire). 441 (Glam.) 442 ,, 485 (E. Anglian). 487 ,, 488 ,, 493 (H. Counties) 494 ,, 645 (W. Lancs.) 641 (North'n.) 642 (London). 643 (E. Anglian). 644 (N. Mid.) 646 (London). 649 (W. Riding).	2, 5, 7, 9, 11, 12, 15, 23, 26, 55, 56, 57, 59, 61, 62, 63, 64, 67, 68, 69, 70, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 86, 87, 89, 90, 91, 92, 93, 94, 96, 97, 98, 103, 104, 105, 106, 121, 122, 123, 124, 126, 129, 130, 150, 151, 152, 153, 154, 155, 156, 157, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 218, 219, 222, 223, 224, 225, 226, 227, 228, 229, 231, 233, 234, 237, 247, 248, 249, No. 5 (R.A.), No. 5 (R.M.), 400, 401, 404 (Highland), 406 (Renfrew), 409, 410, 411, 412, 413 (Lowland), 416 (Edinburgh), 419, 421, 422, 423 (W. Lancs.), 427, 428, 429, 430, 431, 432, (E. Lanc) 438, 439 (Cheshire), 446, 447 (North'n), 455, 456, 457, 458, 459, 460, 461 (W. Riding), 465, 466, 467, 468, 469, 470, (N. Midland), 476, 478, 479, (S. Midland), 483 (E. Anglian), 490, 491 (H. Counties), 497 (Kent), 502, 503, 504, 505 (Wessex), 509, 510, 511, 512, 513, 517, 518,	54, 95, 101, 102, 128, 474 (S. Mid.), 475 (S.Mid.), 477 (S.Mid.), 528 (D'ham).	65, 66, 85, 436 (Welsh), 437 (Welsh), 484 E.A., 486 E.A., 495 Kt., 496 Kt., 519 Ln., 521 Ln., 522 Ln.	17, 38, 99, 100, 107, 108, 127, 131. 420 (W.L.) 449(North'n.) 500 (Wessex) 501 ,, 506 (Hants.)	71, 72, 88. 448 (North'n.) 450 ,, 451 ,,		

ORDER OF BATTLE OF ROYAL ENGINEER UNITS IN ALL THEATRES ON NOVEMBER 11TH, 1918.—*Cont.*

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	Mesopotamia.	East Africa.	Foreign Garrisons.
Field Cos. (*cont.*).		520 (London), 526, 527 (Durham), 529 (E. Riding), 546, 547(Kent), 549 (Lancs.) 550 (Glam.), 648 (H. Counties).						
Army Troops Cos.		20, 25, 42, 133, 134, 135, 136, 138, 141, 142, 144, 145, 146, 147, 148, 149, 167, 213, 214, 215, 216, 217, 221, 230, 232, 235, 236, 238, 239, 245, 280, 281, 282, 283, 284, 288, 289, 290, 7th (RM.), 552, (Aberdeen), 554 (Dundee), 556, 557 (Glam.), 559, 560 (Hants), 565 (Wilts), 567 (Devon), 573, 574 (Cornwall), 577 (Sussex)	158 (A and C Secns.) 285. 8 (Monmouth)	14, 35, 220 555 (Lancs.) 569 (Devon). 570 ,, 571 ,,	37, 137, 139, 140, 143, 286, 287			
Siege Cos.		1, 2, 4 (Royal Anglesey), 1, 4, 6 (Royal Monmouth).						
G.H.Q. Troops Co.		29.						
Electrical and Mech. Cos.		350, 351, 352, 353, 354, 355, 356				300		
Army Workshop Cos.		1, 2, 3, 4, 5						
Adv. Park Cos.		Adv. R.E. Parks: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12		389	4			

ORDER OF BATTLE OF ROYAL ENGINEER UNITS IN ALL THEATRES ON NOVEMBER 11TH, 1918.

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	Mesopotamia.	East Africa.	Foreign Garrisons.
Base Park Cos.		1, 24, 32	246	13, 46	33	47		
Works Cos.	18, 34, 553 (Aberdeen). 561 (Hants). 562 ,, 563 ,, 564 ,, 566 (Wilts). 576 (Cornwall).	6, 22, 39, 572, 575, 578						558 (Glam.) Gibraltar.
Artizan Works Cos.		51, 52, 58, 60, 159, 240, 241, 242, 243, 244, 1501, 1502, 1503, 1504, 1505, 1506						
Boring Secns.		1, 2, 3, 4, 5						
Fd. Survey Bns.		1, 2, 3, 4, 5 ("Depôt.")						
Fd. Survey Cos.			6	7	8		No. 6 Topo. Secn.	
Obs. Groups.		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 27	25, 29	28	26			
Sound Ranging Secn.	Exptl. Sound Rg. Observation Secn. (West Lavington).	A, B, BB, C, CC, D, DD, F, G, GG, H, I, J, K, L, M, O, P, R, S, T, U, W, Y, Z, "Experimental."	E.	N, NN, V.	Q, X.			
Inundation Secn.		1						

ORDER OF BATTLE OF ROYAL ENGINEER UNITS IN ALL THEATRES ON NOVEMBER 11TH, 1918.

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	Mesopotamia.	East Africa.	Foreign Garrisons.
Reserve Survey Co.	19th (S/ton.)							
Anti-Aircraft Searchlight Secn.		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77	34					
Anti-Aircraft Searchlight Cos.	1, 2, 3, 4, 5, 6, 13 (Tyne), and 7, 8, 9, 10, 11, 12, 14, 15, 16, 17 (London).							
Field Searchlight Co.		50						
H.Q. and Depôt of Electrical Engrs.	Tyne, EE. London, EE.							
Emergency Secns.	1, 2							
Fortress Cos.	21, 30, 166. 590 Dundee. 591 Edinburgh. 592 ,,							616 Devon. Gibraltar.

ORDER OF BATTLE OF R.E. UNITS IN ALL THEATRES ON NOVEMBER 11TH, 1918.—*Cont.*

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	Mesopotamia.	East Africa.	Foreign Garrisons.
Fortress Cos. (*cont.*).	594 Edinburgh. 595 N. Riding 596 E. ,, 597 E. ,, 598 Kent. 599 London. 600 Cinque Ports. 602 London. 603 Hants. 604 ,, 605 ,, 606 Dorset. 607 Devon. 608 Cornwall. 609 Glamorgan. 610 ,, 611 Lancs. 612 Renfrew. 613 Lancs. 614 ,, 615 ,,							
Fortress Works Cos.	3, 16, 49 580 (Kent). 581 (E. Riding).							
Tunnelling Cos.		170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 250, 251, 252, 253, 254, 255, 256, 257, 258						
Water Supply Cos.				359, 360				
Water Works Co.				357				

ORDER OF BATTLE OF ROYAL ENGINEER UNITS IN ALL THEATRES ON NOVEMBER 11TH, 1918.—*Cont.*

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	Mesopotamia.	East Africa.	Foreign Garrisons.
Forestry Cos.		361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371						
Special Bde. Cylinder Cos.		A, B, C, D, E, F, G, H, J, K, L, M, N, O, P, Q.						
Special Bde. Mortar Cos.		1, 2, 3, 4						
Special Bde. Projector Cos.		Z						
Depôt.	Reserve Mounted Depôt Aldershot Reserve Depôt, Sp. Bde., Devonport Reserve Met. Secn. (Stonehenge). 20th T.F. Depôt (Gillingham).	H.Q. and Depôt. Sp. Bde.						
Base Depôt.						1		
Camouflage School.	1 (Regents Park).							
Camouflage Park.	1							
Experimental Cos.	Exp. Tung. Secn. (Chattenden). Claremont Park Mun. Design Exp. Station, (Richmond)							

ORDER OF BATTLE OF ROYAL ENGINEER UNITS IN ALL THEATRES ON NOVEMBER 11TH, 1918.—*Cont.*

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	Mesopotamia.	East Africa.	Foreign Garrisons.
Experimental Stations (Sp. Bde.)	Wembley. Porton.							
Anti-Gas Estab.	1 (Gower St.)							
Meteorological Secn.	1	1	1	1 (included in Fd. Survey Co.)	1			
Depôt Cos.								
Groups of Depôt Cos.	No. 1, No. 2 (Chatham).							
Reserve Battalions	1 Chatham R.A.R.E 2 Chattenden, Beaumaris. 3 Newark, R.M.R.E. 4 Deganwy, Monmouth. 6 Irvine.							
Bridging Battalions.	1, 2, 3 and Hqs. Bdg. Training Centre.							
Pontoon Parks (H.T.)		1, 2, 3, 7	5	13				
Pontoon Parks (H.T.) (A.S.C. Units)		6, 8, 9 10 11, 12						

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.

Unit.	France.	Italy.	Egypt.	Mesopotamia.	N. Russia.	Salonika.	E. Africa.	Home.
G.H.Q. Signal Co.	G.H.Q. Sig. Co., included in "L" Sig. Battn.	G.H.Q. Sig. Co.	G.H.Q. Sig. Co.		G.H.Q. Sig. Co. Archangel Syren Sig. Co.	G.H.Q. Sig. Co.	G.H.Q. Sig. Co. (late Lindi Sig. Co.)	G.H.Q. Sig. Co.
Army Sig. Cos.	1st, 2nd, 3rd, 4th, 5th.							Special Sig. Co., Ireland.
Corps Sig. Cos.	A, B, C, D, E, F, G, L, N, O, P, R, S, T, X, Y. Tank Corps.	J. Corps Sig. Co.	U, V, W.			M, Q.		XXIII.
Cavalry Corps Sig. Sqdn.	Cavalry Corps Sig. Sqdn.							
Divisional Sig. Co.	Guards, 1st, 2nd, 3rd, 4th, 5th, 6th, 8th, 9th, 11th, 12th, 14th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 24th, 25th, 29th, 30th, 31st, 32nd, 33rd, 34th, 35th, 36th, 37th, 38th, 39th, 40th, 41st, 42nd, 46th, 47th, 49th, 50th, 51st, 52nd, 55th, 56th, 57th, 58th, 59th, 61st, 62nd, 63rd, 66th, 74th.	7th, 23rd, 48th.	10th, 53rd, 54th, 60th, 75th	13th	1st Archangel Div. Sig. Co. 2nd Ditto.	22nd, 26th, 27th, 28th.		64th, 67th, 68th, 69th Cyclist.
Divisional Sig. Sqdns.	1st, 2nd, 3rd.		4th, 5th.					

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.—*Cont.*

Unit.	France.	Italy.	Egypt.	Mesopotamia.	N Russia.	Salonika.	E. Africa.	Home.
Cavalry Bde. Sig. Troops.	1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 9th.		10th, 11th, 12th, 13th, 14th.					Cyclist Bdes., 1st, 2nd, 3rd 4th, 6th, 7th, 8th, 9th, 10th.
Infantry Bde. Sig. Secns.					236, 237, included in Syren Sig. Co.	228th.	Reserve Bde. Sec.	Nos. 221, 222, 223, 224, 225, 226, 227 (Mixed).
Air-Line Secns.	Nos. 5, 6, 7, 8, 9, 10, 11, 13, 16, 18, 19, 20, 27, 28, 29, 30, 31, 32, 33, 35, 36, 40, 43, 44, 45, 47, 48, 50, 51, 52, 53, 56, 64, 66, 70, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 100, 101.	Nos. 34, 54 and 102.	Nos. 21, 23, 24, 42, 68—all horsed. N.12, N.14, N.15. Nos. 61, 62, 69—all motor. No. 103 (British Indian). No. 105, ditto	22, 25, 63, 67, all horsed.		Nos. 1, 2, 3, 4, 38—all horse. Nos. 39, 60, 65—104 all Motor.	41, 46, 49 (included in L. of C. Sig. Co.)	T1, T2, T3, T4, T5, T6, 71 M.A.L. 72 M.A.L.
Sig. Construction Cos.	Nos. 1, 2, 3, 4, 5, 6.							
Cable Secns.	H, J, K, L, N, O, P, R, AA, AD, AK, AN, AP, AR, AS, AU, AW, AY, BD, BE, BF, BL, BM, BP, BT, BV, CC, EE, GG, GQ, LC, LZ, MM, OO, QQ, RR, SD, SS, SV, TT, VV, WE, TT, ZZ.	M, BU.	AG, AO, BQ, BR, BS, DC, GY, HH, KK, NA, NB, NN, UU.	BA, BC, BH, BJ, BX, DA, DB, FA, FB		AB, AE, AH, AJ, DK, DL.	AV, AX (included in other Units).	DE, DG.

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.—*Cont.*

Unit.	France.	Italy.	Egypt.	Mesopotamia	N. Russia.	Salonika.	E. Africa.	Home.
Cable Secns. (*cont.*).	1 (3 Detachment) Sec. for Cavalry Corps.							
Area Sig. Detachments.	Nos. 1, 2, 3, 4, 5, 6, 7, 8, 8a, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40.							LA, DA, Sig. Co.
Light Railway Sig. Cos.	Nos. 1, 2, 3, 4, 5 (including Nos. 1 to 21 Maintenance Secns.)		No. 1 and No. Light Railway Sig. Secns.			Railway Telegraph Co		
Signal Schools	1st, 2nd, 3rd, 4th, 5th Army Schools Cavalry I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XIII, XV, XVII, XIX, XXII, Tank Corps.	Army Sig. School.	School of Instruction, Zeitoun. Two Corps Sig. Schools	Army Sig. School, Baghdad.	Sig. School, Anhayeh.	Army Sig. School.		Army Sig. School, Dunstable.
L. of C. Sig. Unit.	The Sig. Bn. (including Nos. 1 to 6 Railway Telegraph Cos. and Nos. 1 to 5 Telegraph Construction Cos.) and Signal *personnel* at G.H.Q. and on L. of C.	L. of C. Sig. Co., No. 6 Telegraph Construction Co.	M (L. of C.) Sinai (L. of C.) South Palestine. L. of C. North Palestine. L. of C. Signal Cos.	No. 2 (L. of C.) Sig. Cos. River Wireless Sec.		(L. of C.) Sig. Co.	L. of C. Sig. Co.	

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.—*Cont.*

Unit.	France.	Italy.	Egypt.	Mesopotamia.	N. Russia.	Salonika.	E. Africa.	Home.
Wireless Observation Groups.	No. 1 G.H.Q. Observation Group and Nos. 1, 2, 3, 4, 5, 6, Army Wireless Observation Groups.	No. 7 Army Wireless Observation Group.	No. 2 G.H.Q. Wireless Observation Group.	No. 4 G.H.Q. Wireless Observation Group.		No. 3 G.H.Q. Wireless Observation Group.		Wireless Observation Group (Home).
Sig. Base Depôt.	Sig. Base Depôt.		Headquarters of a Sig. Base Depôt for 500 men.	Signal Park and Depôt, Baghdad Advanced Sig. Park.		Sig. Base Depôt.	Signal Depôt.	S.S.T.C., Bedford.
Motor Wireless Secns.	Nos. 7, 8, Light Motor Wireless Secns.		Southern Motor Sec.	No. 5 Wireless Section No. 2 Lorry Station (included in 2nd L. of C. W/T Sqdn.).			No. 1 Motor Lorry, No. 1 Light Motor Lorry.	
Park Secns.			Nos. 6, 12 & London	Nos. 18, 19, 20, 21, 22, 23, 25, 31. (All included in No. 2 Wireless L. of C. Sig. Sqdn.)		Nos. 7, 8, 11 and 21.	No. 4. "A" Cavalry "B" Cavalry	No. 1.
Wagon Wireless Sec.			Northern No. 6, No. 9.			No. 5 Light Wagon Wireless Sec.	No. 4. Wagon Marconi Wagon.	No. 13.
Cavalry Wireless Sqdn.	1 for Cavalry Corps.		Desert Mtd. Corps Wireless Troop.	1st (Anzac). 2nd (L. of C.)				

"Wireless Signal Co."

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.—*Cont.*

Unit.	France.	Italy.	Egypt	Mesopotamia.	N. Russia.	Salonika.	E. Africa.	Home.
Messenger Dog Service.	Central Kennels No. 1 Sec., No. 2 Sec., No. 3 Sec.							War Dog School.
Carrier Pigeon Service.	Carrier Pigeon Service.	Carrier Pigeon Service.	Carrier Pigeon Service	Carrier Pigeon Service.		Carrier Pigeon Service.		Carrier Pigeon Service.
Tank Group Sig. Cos.	1st, 2nd, 3rd.							
Tank Bde. Sig. Co.	1st, 2nd, 3rd, 4th, 5th, 6th.							
Army Field Artillery Bde. Sub-Secs.	5th, 14th, 16th, R.H.A., 5th, 11th, 14th, 18th, 23rd, 26th, 28th, 34th, 38th, 48th, 52nd, 64th, 65th, 72nd, 76th, 77th, 84th, 86th, 93rd, 96th, 104th, 108th, 113th, 119th, 126th, 147th, 150th, 155th, 158th, 169th, 175th, 179th, 189th, 232nd, 242nd, 277th, 282nd, 293rd, 298th, 311th, 315th.				6th R.F.A			

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.—*Cont*

Unit.	France.	Italy.	Egypt.	Mesopotamia.	N. Russia.	Salonika.	E. Africa.	Home
Rl. Garrison Arty. Bde. Sub-Secs.	Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 17, 18, 19, 21, 22, 23, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 76, 77, 78, 79, 81, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 98, 99. Naval Siege Gun Sig. Sec.	Nos. 15, 24, 80, 94, 104.	Nos. 95, 96, 97, 100, 102, 103. No. 1 Heavy Artillery Sig. Secs. No. 2 Heavy Artillery Sig. Secs.			Nos. 20, 37, 61, 75, 82, H.Q. Heavy Artillery Sig. Sec.		
Sig. Co., with R.A.F. Independent Force.	One includes two Air-line Secs. and one Sig. Construction Co.							
Sig. Service Training Centre.								*Depôts:* Bedford A. Bedford B. Bedford C. Biggleswade. Fenny Stratford. Hitchin. Haynes Park. Wellingboro'. Cadet Battn.

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.—*Cont.*

Unit.	France.	Italy.	Egypt.	Mesopotamia.	N. Russia.	Salonika.	E. Africa.	Home.
Sig. Secs. with Fortress Cos.								Forth Garrison (Nos. 591, 592); Clyde Garrison (No. 612); Tay and Aberdeen Garrison 590); Tyne Garrison (594); Humber Garrison (596 and 597); Tees Garrison (595); Thames and Medway (598 and 599); Dover Garrison (600 and 601); Harwich Garrison (21st); Newhaven Garrison (602); Mersey Garrison (611); Cardiff and Barry Garrison (609); Severn Garrison (610); Portsmouth Garrison 605; Plymouth Garrison (607 and 30); Portland Garrison (606); Fal-

DISTRIBUTION OF SIGNAL UNITS ADMINISTERED BY W.O.—*Cont.*

Unit.	France.	Italy.	Egypt.	Mesopotamia.	N. Russia.	Salonika.	E. Africa.	Home.
Sig. Secs. with Fortress Cos. (*cont*).								mouth Garrison (608); Queenstown Garrison (614); Berehaven Garrison (615); Belfast and Lough Swilly (613).
Miscellaneous Units.							Reserve Heavy Cable Detachment. Reserve Motor Despatch Riders.	K. Sig. Co. Signals Experimental Establishment.

(R.E. RAILWAY AND ROAD TROOPS).

Unit.	Home.	France.	Italy.	Egypt.	Salonika	East Africa.
Depots.	R.E. Railway Construction Troops Depôt. R.E. Railway Operating Troops Depôt. R.E. Road and Quarry Troops Depôt. H.Q. Railways and Roads Trng. Centre.	D.G.T. Base Depot			Base Depôt.	
Military Railways at Home.	Military Camp Railways. Woolmer Instructional Military Railway.					

ORDER OF BATTLE OF R.E. UNITS IN ALL THEATRES ON 11TH NOVEMBER, 1918.

(R.E. Railway and Road Troops).

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	E. Africa.
R.E. Railway Construction Cos.		8, 10, 109 to 114, 118, 119, 120, 259 to 264, 268, 296, 271, 275, 277, 278, 279, 280, 281, 282, 295 to 298. No. 3 R.A., R.E. (S.R.) Nos. 2 and 3, R.M., R.E. (S.R.)		115, 116, 265, 266, 272	117, 273, 267	
Railway Survey and Reconnaissance Secs.		1 to 7		106	108	
Railway Signal and Interlocking Co.		200				
Wagon Erecting Cos.		16, 17, 18, 66, 67, 70	One Sec.			
Broad Gauge Workshop Cos.		61, 62, 63, 78, 79, 80				
Broad Gauge Miscellaneous Trades Cos.		37, 38, 39, 82, 83				
Electrical Secns.		1, 2, 3				
Headquarters Secns. with A. Ds. L.R.		1 to 5				
Light Railway Operating Cos.		1, 2, 4, 6, 10, 11, 29 to 34	109 (one platoon only).	96, 203	107, 33	
Light Railway Train Crew Cos.		18 to 22		98		
Light Railway Forward Cos.		231, 232, 234 to 240				

ORDER OF BATTLE OF R.E. UNITS IN ALL THEATRES OF 11TH NOVEMBER, 1918.

(R.E. RAILWAY AND ROAD TROOPS).

Unit.	Home.	France.	Italy.	Egypt.	Salonika.	E. Africa.
Light Railway Miscellaneous Trades Cos.		23, 24				
Light Railway Workshop Cos.		25, 26				
Light Railway Tractor Repair Co.		28				
Training Schools.		Light Railway Training School. Light Railway (Forward) Training School. R.O.D. Training School.				
Railway Traffic Sections.		1 to 13 Two Railway Traffic Sections. (Medn. L. of C.).	Three Sections. (not numbered).	Five Sections. (not numbered).	No. 1	
Broad Gauge Operating Cos.		1 to 7, 9, 11 to 15, 20 to 31, 34, 40 to 53, 64, 65		71 to 77, 94, 95, 99 to 105, 201 202	19, 32, 204	
Road Construction Cos.		301 to 319, 330 to 347, 349				391, 392 (nuclei only).
Quarry Cos.		198, 199, 320 to 329, 348				
Quarry Maintenance Sec.		1				
Steam Boiler Repair Co.		Not numbered.				
Transportation Stores Cos.	R.E. Transportation Stores Co., Purfleet.	1 to 13	Stores Section.		Stores Park.	
Railway Labour Co.					270	

ORDER OF BATTLE I.W. & D.

Unit.	Home.	France.	Mesopotamia.	Egypt.
Depôts	H.Q. Richborough. H.Q. Southampton. H.Q. Poplar. H.Q. Richborough Depôt (Richborough). Sanitary Est. Depôt Co., 1—6 (Richborough.)	I.W.T., H.Q. Secs. 1—16, 24—27. B.E.F. Common to Army Areas and the Lines of Communication. H.Q. of O.C. I.W.T. Troops located at Aire. *Docks :* No. 1 H.Q. Boulogne. No. 2 H.Q. Havre. No. 4 H.Q. Calais. No. 5 H.Q. Dunkirk. No. 6 H.Q. Dieppe. Docks, Cherbourg. No. 8 P.C. Co. R.E., Boulogne. No. 11 P.C. Co., R.E., Havre. *Port Construction Cos.:* C.E.P.C., H.Q. D.G.T., G.H.Q. No. 1 P.C. H.Q. Dunkirk No. 2 P.C. H.Q., Rang-de-Fliers. No. 3 P.C. H.Q., Oissel-Rouen. No. 1 P.C. Co., Lery. No. 2 P.C. Co., Quevilly y Rouen. No. 6 P.C. Co., Oissel-Rouen. No. 4 P.C. Co., Rang-de-Fliers. No. 5 P.C. Co., Les Forts-Bergues.	Following at Basra :—H.Q., I.W.T. Depôt Headquarters of following formations :—Vessels, Marine Engineering, Accounts. Dockyards and Shipbuilding, Native Craft, I.W.T. Stores, Buoyage and Pilotage. Conservancy and Reclamation, Camps, Coal Depôt, Barge Depôt, H.Q. Construction (Bagdad), H.Q. Construction (Euphrates). DETACHMENTS AT THE FOLLOWING PLACES :— *Camps :* Margil, Khora Creek, Tancoma (Abadan) NARROW SECTION:—Ezraz's Tomb Gumaijah Shargi South Station, Michriya C. Stn. Central Stn. Quadat Saleh, Majar Kahir, North Station, Ali Charbi, Sumar. BAGHDAD SECTIONS:—Zeur, Hinaidi, Advanced Base, Baghdad, Sadieyeh, Akab, Samarah, Diala, Baguaba. *Persian Lines of Communication :* Karun, Ahwaz, Muscat. UPPER EUPHRATES : I.O.V. and I.M.E. Dhibban, Riverhead, Hit, Ramadie, Madij, Abu Huyat, Uqbah, Feluja, I.W.T.O. MIDDLE EUPHRATES ; Hillah, Iseurieriyen, Musayib, Tawerij, Kufa, Hindia, Barrage, Magranal Delha and El Hassam, Jebeira,	Cairo, Secs. at Port Said, Suez, Kantara Ferry, Port, Alexandria, Ismailia, Kerch & Assonar, Behera, Assiont, Menufer, Girga, Minia, Mansourah. M.L.O.C. Taranto. EAST AFRICA. Port Amelia, Mozambique, Lindi, Dar-es-Salaam, Kilindini. RUSSIA. Murmansk.
Workshop and Shipyard Cos.	H.Q. Richborough, 11—17 Richborough, 19—27 Richborough, 37—40 Richborough, 43—48 Richborough.			
Construction Cos.	H.Q. Richborough, 96, 97 Richborough, 98 Poole, 99 Southampton, 100—103 Manston, 104 Poole, 105 Hawkings, 106—108 Amesbury, 109 Lulworth, 116 Poole, 117, 118 Richborough, 119 Slough, 120 Farlington, 121 Amesbury, 122 Poole, 131, 132 Richborough, 136 Richborough, 141, 142 Richborough.			
Marine Cos.	H.Q. Richborogh, 70—75 Richborough, 76 Poplar.			
Traffic Cos.	H.Q. Richborough, 56—61 Richborough,			
Train Ferry Cos.	H.Q. Richborough, 85, 86 Richborough, 87, 88 Southampton.			
T.F. Shore Co.	62 Southampton.			
Stores Cos.	H.Q. Richborough, 90—91 Richborough.			

ORDER OF BATTLE I.W. & D.—*Cont.*

Unit.	Home	France.	Mesopotamia.	Egypt.
Accounts Co.	95 Richborough.			
Mesopotamia Reserve Unit.	Glasgow.			
Marine Co. (Scottish Canal).	144 Glasgow.			
Craft Repair Co.	77 Poplar.			
Home Depôt.	Richborough.			
Tugmasters	Richborough.	No. 6 P.C. Co., Dunkirk. No. 7 P.C. Co., Ostend.	Madhetia, Jerboyian, Zenafiah, Daghara, Jellan, Afaij, Ebra, Khan, Jadwal, Diwanieh, Imam Hamzah, Rumetha, Hamadieh, Gus, Kifl, Shamiyeh, Chemas, Abu Sakair, Kala Abasiyah. LOWER EUPHRATES: Durraji, Samawah, Nasseriyeh, Waar, Shenafiah.	

AN INFANTRY CORK FLOAT FOOTBRIDGE AND LIGHT IMPROVISED FERRY BOAT.

By BRIG.-GENERAL E. N. STOCKLEY, D.S.O., Chief Engineer, XIX. Corps.

BRIDGING operations on the Western Front in the final phase of the war, during which successive canal and river crossings were made, showed that the crossing of a river by an Army may be divided into four stages :—

(*a*). The crossing of the Infantry Patrols, Covering Parties, and Advanced Troops by improvised light boats and foot bridges.

(*b*). The crossing of the Field Artillery and Divisional horsed transport, motor cars, and light motor ambulances, by the medium pontoon bridges.

(*c*). The crossing of the Corps Heavy Artillery with Caterpillars, Ammunition and Supply lorries, and other heavy transport, by the super-heavy pontoon raft-bridges with steel joist super-structure.

(*d*). The substitution of heavy trestle or steel girder bridges for the heavy pontoon bridges, and release of all portable equipment, for the next river crossing.

Of these, (*a*) being the first and tactically the most important it is very desirable that standardized equipment should be ready, and the sappers, who are to use it, drill-perfect. No universal pattern for this equipment has yet been worked out, and many different forms have been improvised from petrol cans, metal floats, straw bundles, timber and canvas floats, etc. The object to be aimed at is extreme portability, as these crossings must be made at many points, and usually at a distance from the recognized approaches, which are sure to be heavily shelled. The equipment must therefore stand some handling, and it is of the greatest importance that the float should not be rendered useless by a chance bullet.

The lightest and least vulnerable pattern evolved is probably the Cork float bridge, and the pattern made up in the temporary Corps Workshops and issued to the three Divisions of this Corps for the crossing of the R. Scheldt, after practice on the R. Lys

at Courtrai, may give some useful ideas to those whose duty it may be to evolve the best universal pattern for future use. Two men can carry the float some distance across country, and a third the light 10-ft. bay of bridge to lay on the saddle. A river 120 ft. wide can be spanned in four or five minutes, if all stores come up in a consecutive stream as required, and only four men need be exposed simultaneously on the bank to boom out the bridge.

A N.C.O. of the Corps should remain in charge to check the tendency to overcrowd, and see that a two or three yard interval is kept by the Infantry, and four sappers should remain at hand with a spare float and bay in case of any break occurring. It is considered that four such bridges, each 120 ft., should be carried by a Divisional Bridging train in addition to its pontoon equipment.

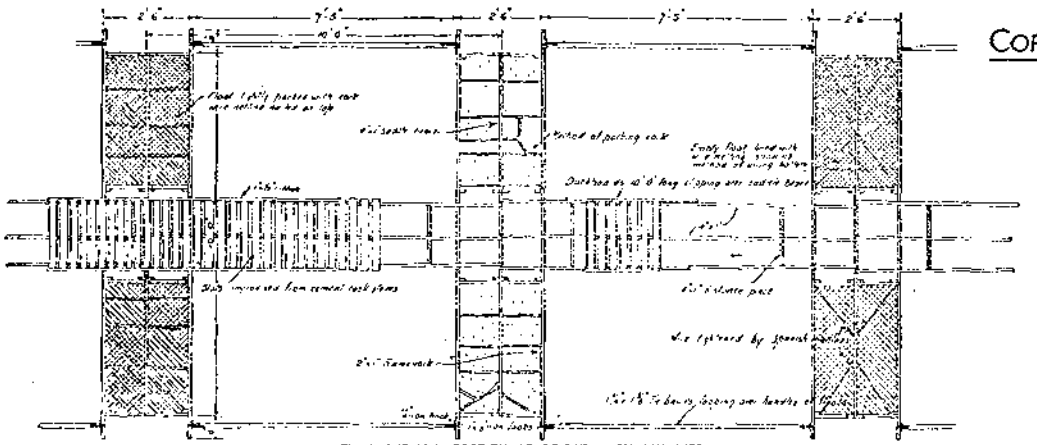
Plate I. shows the design of the Cork Float Bridge.

A useful type of light improvised portable boat was designed by the field companies of the 35th Division, and used by all three Divisions in the same operations. This was made from the waterproof trench shelter sheet, measuring 13 ft. × 10 ft., folded and tied on a light wooden frame, and proved of great value for the first crossing of the Infantry Patrols, and for subsequent continuous ferrying. At least eight such boats should be carried, each with a pair of light oars and a bailer, and enough cordage to use them as ferries on return trips. The sheets require additional waterproofing if much used. There should be a sapper in each boat to act as boatman and one on each bank to tend the rope.

Plate II. shows the design of the boat.

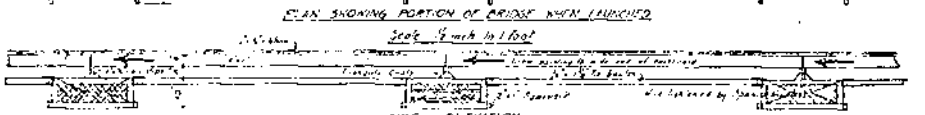
PLATE I.

CORK FLOAT FOOTBRIDGES

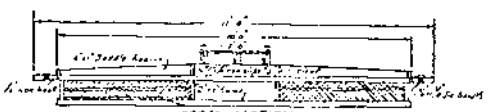


PLAN SHOWING PORTION OF BRIDGE WHEN LAUNCHED

Scale ½ inch to 1 foot



SIDE ELEVATION

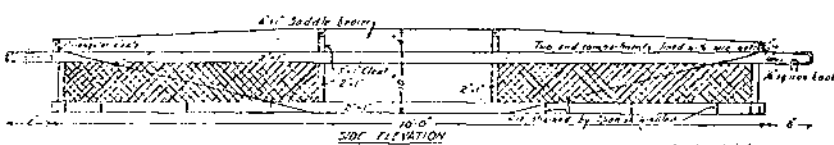


CROSS SECTION

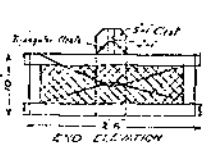
NOTE The following material is required in addition to that shown on drawing

2 - Launching ways 10'-0" x 3" x 2"
2 - Sacrificial transoms 5'-0" x 3" x 2"
12 - Pickets 3'-0" x 3" x 2"
4 - 2" Manila Lines 60'-0" long
2 - 1" do do do

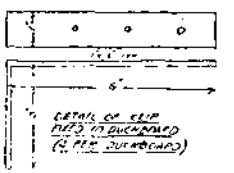
Scale for Details of Woodwork - 1" to 1'
Scale for Details of Ironwork - ½ Full size



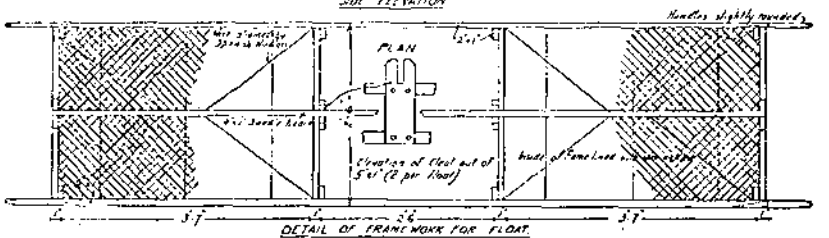
SIDE ELEVATION



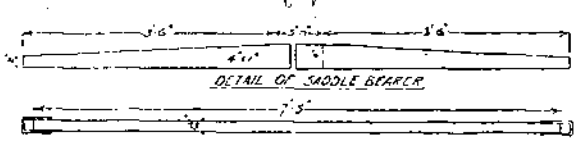
END ELEVATION



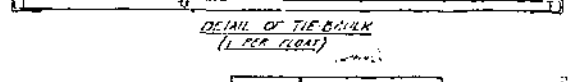
DETAIL OF CLIP FIXED TO DUCKBOARD (2 PER DUCKBOARD)



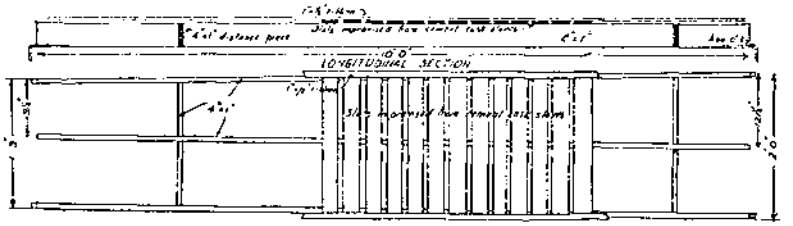
DETAIL OF FRAMEWORK FOR FLOAT



DETAIL OF SADDLE BEARER

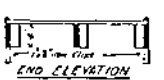


DETAIL OF TIE-BAULK (1 PER FLOAT)

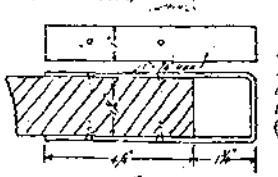


PLAN

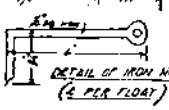
DETAIL OF DUCKBOARD



END ELEVATION



Detail of Iron Loop attached to the Baulk (2 per Baulk)



DETAIL OF IRON HOOK (2 PER FLOAT)

C.E.
111 COPIES - 6.2.19

PLATE II.

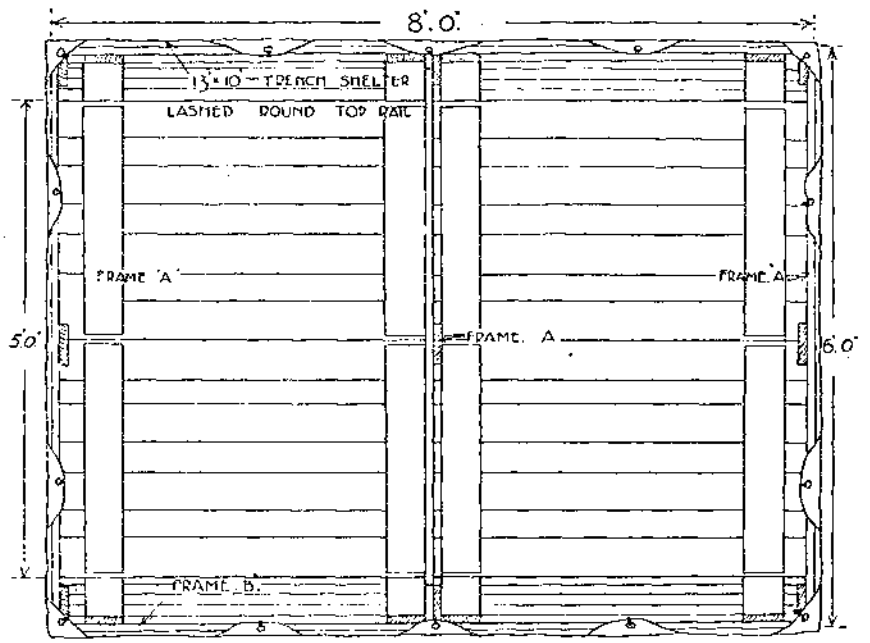
BIVOUAC SHEET BOAT.

Scale—½ in. = 1 ft.

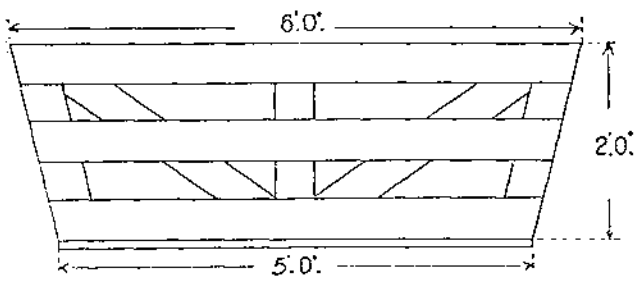
NOTE.—Framing about 5" × 2½". Bottom same form as "B" but wider.

All frames to be lashed together, not nailed.

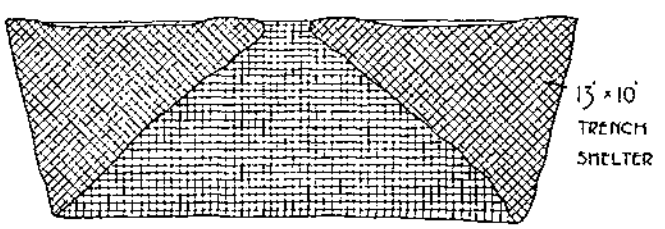
4 Carpenters 2½ hours per raft.



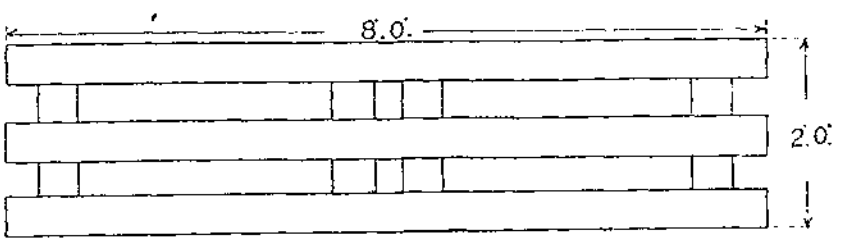
PLAN



FRAME "A"



ELEVATION



FRAME "B"

A FIELD BLONDIN ROPEWAY AS AN AID TO BRIDGING.

By CAPT. (ACTING MAJOR) I. SIMSON, R.E.

IN September and October, 1914, the 8th (Railway) Co., R.E., had to construct two railway bridges in France, and made use of a Field Blondin Ropeway for launching the girders and dropping the various component parts of the bridge into position.

Such a Blondin Ropeway is still of great use for railway construction even when high capacity and long reach cranes are available. It is very quickly erected from material usually available in the field. Its capacity—if constructed of telegraph poles and 3½-in. rope—is probably limited to about two tons, but by lifting only one end of girders, etc., at a time this means that about 4-ton loads can be handled and this is generally sufficient. The "reach" of such a ropeway is practically unlimited, exceeding that of any crane; it spans the whole of a normal gap, and from the moment it is erected it can be employed continuously for clearing away the débris of the old bridge, running out concrete, etc., for foundations, dropping complete trestles (built on shore) into position if not too heavy, launching the girders, etc. It enables work to proceed, if required, on the whole length of a bridge simultaneously, instead of only on one or at most two spans at a time. Its principles of operation may thus prove of service in all types of field engineering, but its use is of course limited in the case of bridges built on curves.

The diagram shows the actual detailed arrangement of the Blondin, as erected in the particular cases referred to. Each pair of sheer legs consisted of two locally acquired telegraph poles 50 ft. to 56 ft. long, butts about 11½ in. diam. and tips 6 in.; the feet of each sheer leg being spaced 13 ft. apart so that a railway truck with material could be run under the legs, and the material picked up direct off the truck by the lifting tackle. The sheers themselves were about 120 ft. apart. The runner, travelling, and lifting tackles, and both back guys consisted of 3½-in. to 4-in. Manilla rope, which was available in coils of 113 fathoms. No blocks with more than 3 sheaves were available at the time. Lashings were of 2-in. rope throughout, while ¾-in. chain was used in addition at each crutch, to couple direct the blocks of the runner tackle and back guys. Side guys of 3½-in. rope were also employed (not shown in diagram).

The arrangement of blocks shown had the following advantages :—

(*a*) Equal strain in all returns of each back guy and "runner" tackle.

(*b*) Easy adjustment for the considerable stretch that took place in all back guys and runner tackle. (The ropes were all new and had never been used previously).

(*c*) By paying out on Q (not under load) the strain on the "runner" tackle was reduced to a minimum for heavy loads ; the "runner" tackle being then at a very steep angle instead of approaching the horizontal, and the blocks of the lifting tackle being chock-a-block when the weight was lifted as high as necessary.

The sheer legs had the great advantage of being self erecting and required no subsidiary derrick poles or tackles to get them up. The legs were placed opposite their footings, both crutches lying away from the gap. One sheers (B) was lashed down to the railway track temporarily ; while the crutch of sheers (A) was raised on to a sleeper crib built up on a railway truck—the crutch thus being 12 ft. or so above rail level—and the feet tied back temporarily to the track. By pulling on the runner tackle in the direction Q1 (from the side "B" of the gap), sheers "A" was pulled up and its back guys made fast when "A" was leaning well forward over the gap.

The free end of the runner tackle Q1 was then run over the second pulley of the double block at the crutch of sheers "B," and, by pulling in the direction Q2, sheers "B" was raised. When also leaning well forward the free end (R1) of the back guy for "B" was made fast, and the free end (Q2) of the runner tackle run through the snatch block (at foot of sheers "B"), in its final direction Q, in which it was made fast. The legs were adjusted for verticality by taking in or paying out on R1 and R2. The runner tackle was adjusted to suit by paying out or taking in Q. The operation of lowering was carried out by practically reversing the above process.

Photograph No. 1 shows the Blondin Ropeway in operation at Pont de Metz (near Amiens), a 53-ft. clear span (elliptical brick arch), destroyed by the enemy, and repaired September—October, 1914. All the timbers in the central trestle and the roadbearers (maximum weight of a single piece about $1\frac{3}{4}$ tons) were dropped into position by the Blondin. *Photograph* No. 2 shows the completed bridge.

Photographs Nos. 3, 4, 5 and 6 show the Blondin at work launching 34-ft. steel girders for the new railway bridge over La Bresle River at Longroy Gamaches (October, 1914). These girders weighed about 3 tons each.

The general procedure for launching the girders was as follows : The truck carrying the girders was run up to the edge of the gap.

A FIELD BLONDIN ROPEWAY AS AN AID TO BRIDGING.

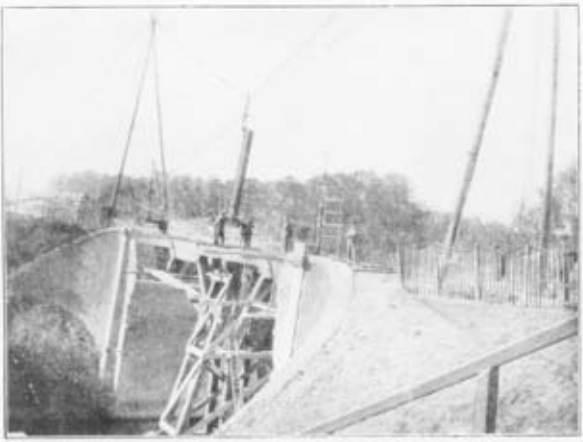


Photo No. 1. Pont de Metz, Amiens.

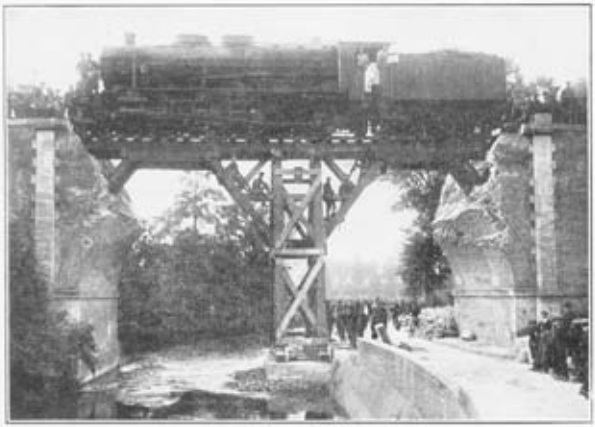


Photo No. 2. Pont de Metz, Amiens.

Reconstructed Bridge, under test for deflection with Nord Railway 2-8-0 locomotive; weight about 125 tons.

Note:—The original bridge was a single span, over both roadway and stream.

A FIELD BLONDIN ROPEWAY AS AN AID TO BRIDGING.

Photo No. 3. La Bresle River, Longroy Gamaches.

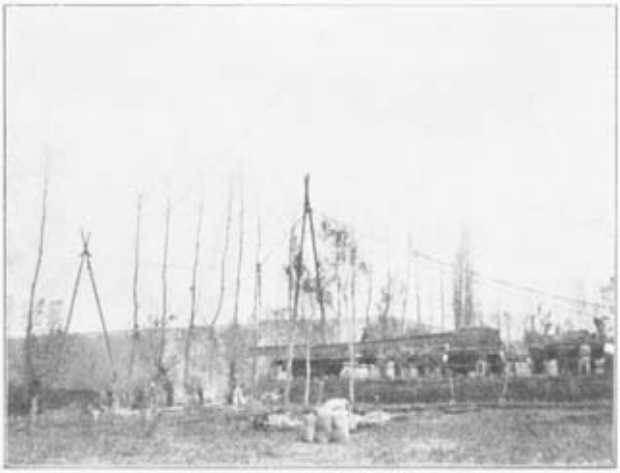


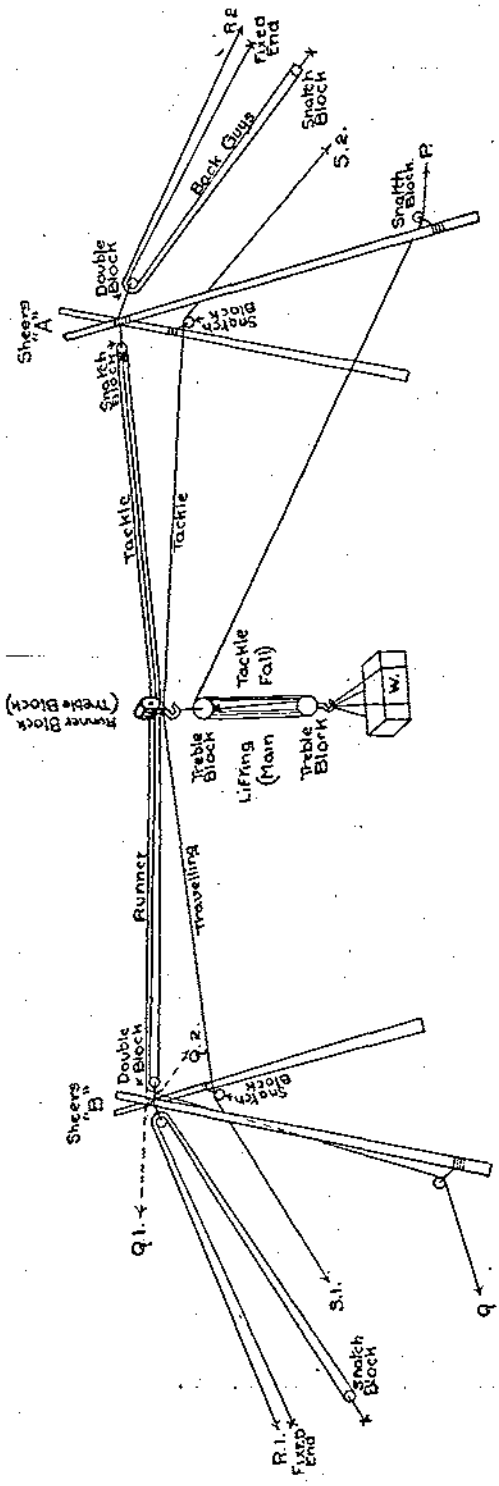
Photo No. 4. La Bresle River.

A FIELD BLONDIN ROPEWAY AS AN AID TO BRIDGING.

Photo No. 5. La Bresle River.

Photo No. 6. La Bresle River.

A FIELD BLONDIN ROPEWAY AS AN AID TO BRIDGING



Field "Blondin" Ropeway
Shewing Arrangement of Tackles.
× Denotes fixed end of rope in any tackle.
+ Denotes free end of a tackle by means of which adjustments could be made.

The front end of the girder was picked up by the tackle, which was then hauled forward on the runner, the back end of the girder being pinched forward on the truck (*Photos* Nos. 3 and 4). The front end was then lowered on to its abutment, the back end resting on the edge of the truck (*Photo* No. 5). Next the back end was picked up by the tackle (*Photo* No. 6), the truck run back out of the way, and the girder dropped into position. It will be noted that at no time during the operation did more than approximately half the weight of the girder come on the gear.

In the construction of this bridge, the four telegraph poles, cordage, etc., were unloaded from railway trucks, lashed and erected, the girders launched, cross-braced, the track laid across the bridge and three small shore spans, and the Blondin dismantled and loaded up again, in 11 hours by 10 sappers, assisted by 30 unskilled refugees.

In conclusion it is pointed out that sheer legs "A"—on the side of the gap to which material can be brought by rail or road—should be situated as near the edge of the gap as possible consistent with picking up the loads directly (off a railway truck or lorry run between the legs); and the running end (P) of the main fall should be run off on this side of the gap. Sheers "B" should be situated as far from the edge of the gap as length of cordage will allow. The object of this is to get the far end of the bridge near the centre of the Blondin span. *All* loads then run *down* the runner tackle, till at the centre of the Blondin span they are at their lowest point. If they have to go further than this, the loads must then be pulled *up* the runner tackle by means of S1. Steel cable for the runner tackle would undoubtedly prove a great improvement for such a Blondin, but was not available at the time.

REINFORCED CONCRETE LORRY TRACK.

By BT. COLONEL H. L. PRITCHARD, C.M.G., D.S.O., R.E.

ANYONE who has been asked to produce a road "forthwith" to carry long convoys of the service 3-ton lorries knows the difficulties of the undertaking.

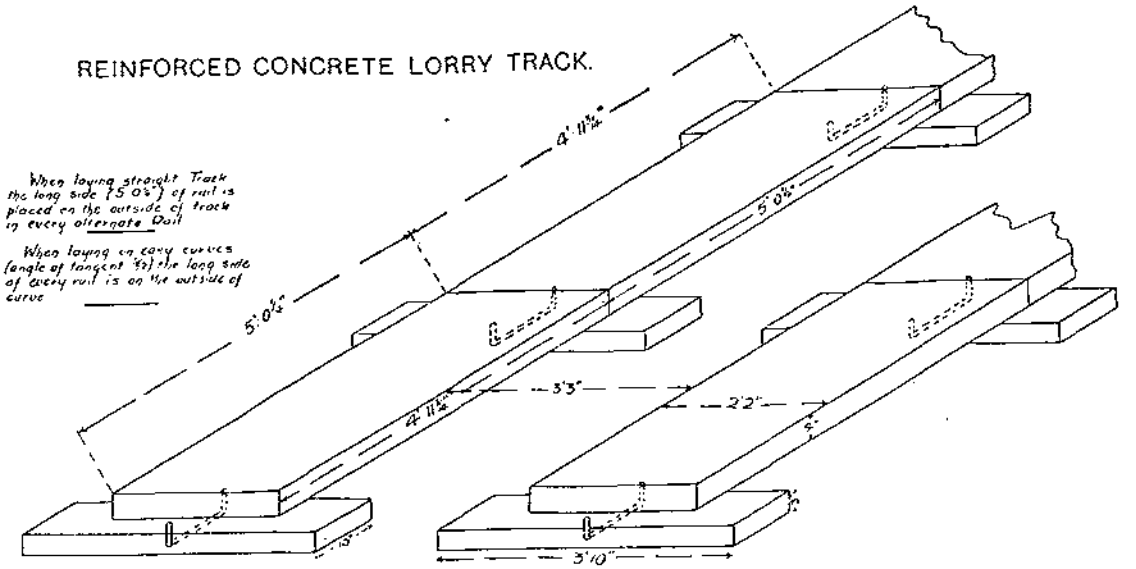
The 3-ton lorry used in our service, weighing as it does seven tons when loaded, of which five tons are on the back axle, acts like a 5-ton pile driver on the road, which must be a first-class one to stand the traffic for long.

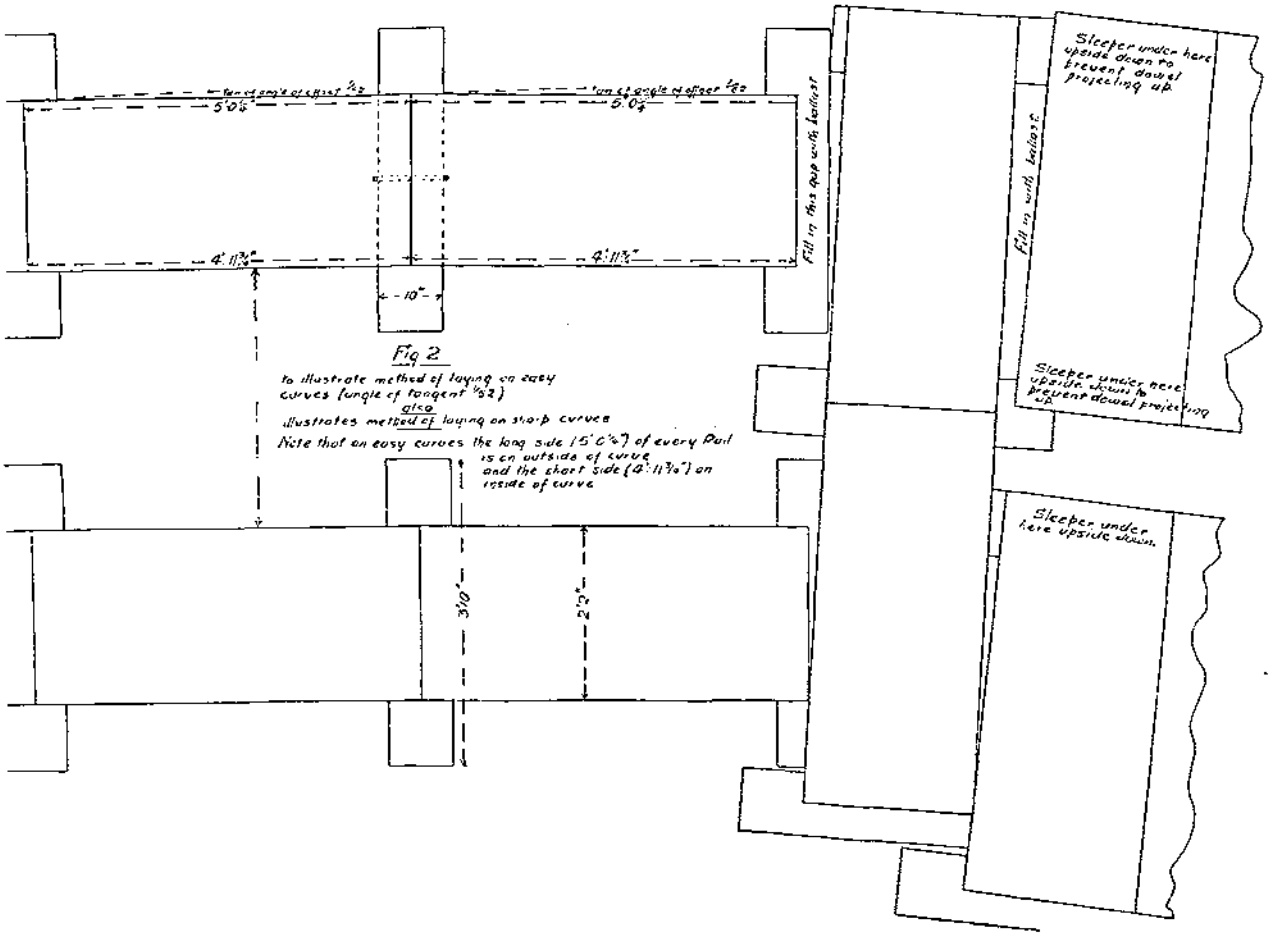
The Italian Army Engineer is more fortunate. His Government use a F.I.A.T. lorry, weighing when loaded about $2\frac{3}{4}$ tons, of which the load is nearly $1\frac{1}{4}$ tons. Driven by Italian drivers at break-neck speed round hairpin bends on the wrong side of precipitous mountain roads, it delivers its load twice without damaging the road, while our lorry pile-drives its way once through to its destination and then struggles to return over the obstacle-course it has created.

Anticipating urgent calls for lorry roads during an advance, and the material for wood "slab" roads not being available where required, experiments were made to secure a stock of reinforced concrete rails and sleepers (see *Plates*). Sufficient experiments were made to convince the writer that these would be invaluable in the emergency contemplated, although for reasons with which this article is not concerned, I cannot produce proofs of its use on any extensive scale.

The main purpose of this reinforced concrete lorry track is to ensure a passage for lorries over those portions of a road which are threatening to become impassable, and to gain time for a more thorough reconstruction of the route that is being used if it is likely to develop into a permanent road. There are many roads which will remain passable for some considerable length of time if one can repair portions, which perhaps aggregate 20% of the whole length, so that a stock of 10 miles of this concrete track might guarantee say 50 miles of road for a considerable period. The track should be ballasted flush with its surface with the best material locally obtainable, but even if this is bad material the concrete track is still of use, as lorry drivers find no difficulty in keeping on it, though it then becomes like a single line of railway as regards

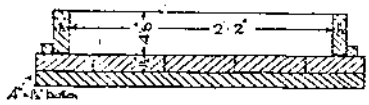
REINFORCED CONCRETE LORRY TRACK.



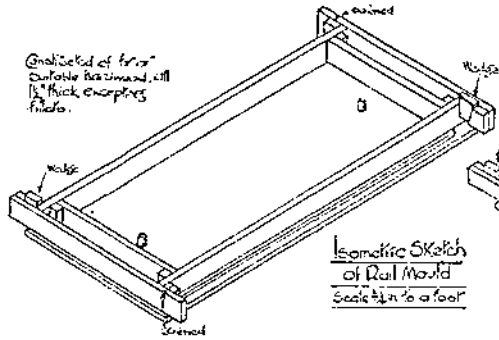


CONCRETE LORRY TRACK. DETAILS OF WOOD MOULDS.

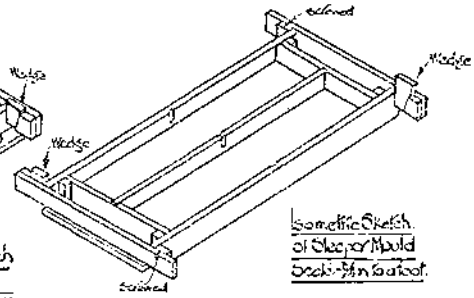
Scale:- 1½ inches to a foot.



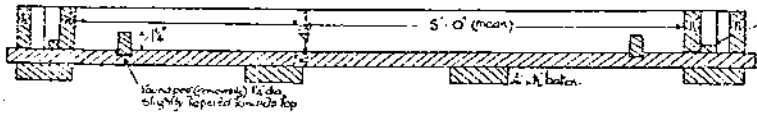
Cross Section thro' Rail Mould.



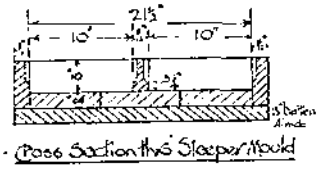
Isometric Sketch of Rail Mould
Scale ½ in to a foot



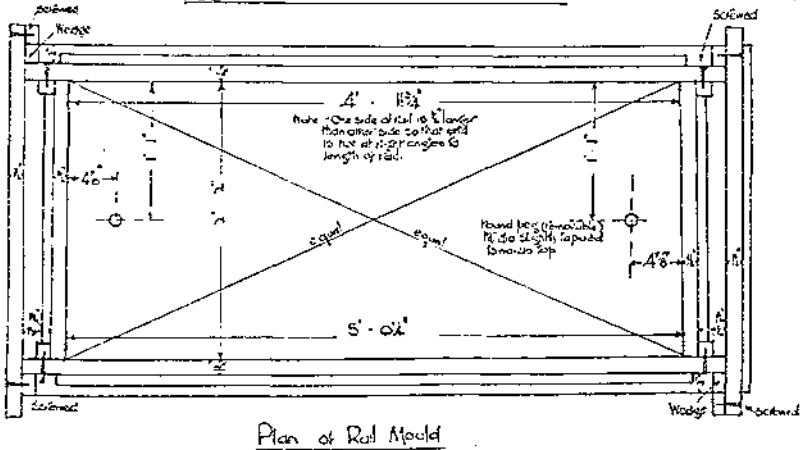
Isometric Sketch of Sleeper Mould
Scale ½ in to a foot



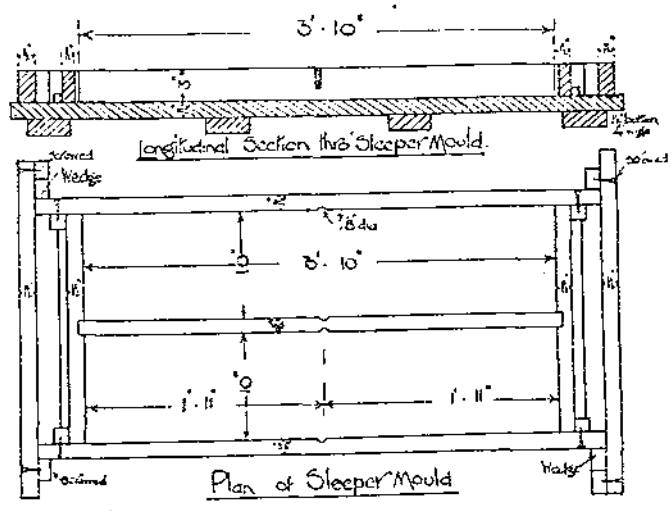
Longitudinal Section thro' Rail Mould



Cross Section thro' Sleeper Mould



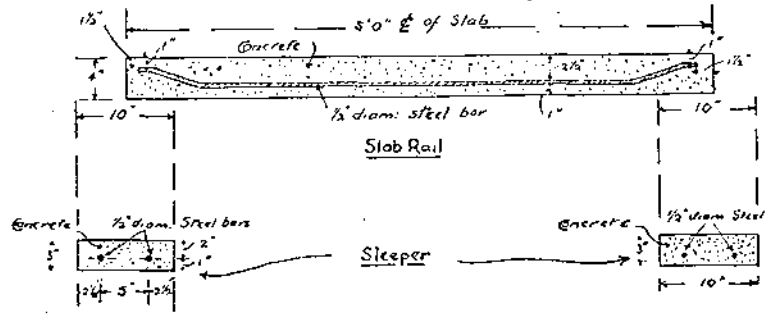
Plan of Rail Mould



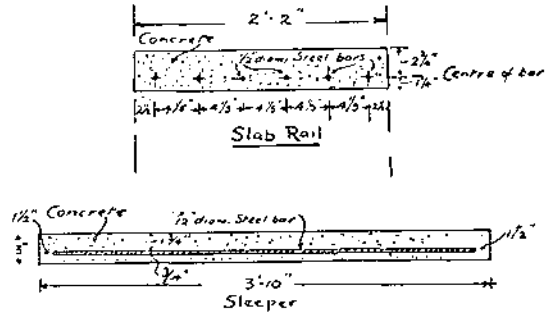
Longitudinal Section thro' Sleeper Mould.

Plan of Sleeper Mould

REINFORCED CONCRETE LORRY TRACK. DETAIL OF REINFORCEMENT



Longitudinal Section



Cross Section

NB If Steel Bars are not available EXPANDED METAL to be used. 3 layers in Slab Rail and 2 in Sleeper. Meshes to be directly above each other and Sheets wired together. Underneath side of sheets to be 1 inch from bottom of concrete.

traffic control. As, however, passing places can be arranged at frequent intervals on the good portions of the road or by laying double track, the traffic control difficulty is not insuperable.

The transport required to bring this track to site, as compared with what is required for soleing and metalling a lorry road, is overwhelmingly in favour of the concrete track. Some of the slabs may crack or even break, but even in this condition they remain serviceable for a very long time. Like the permanent way of a railway they can be taken up from one route and relaid on another.

Examination of the drawings will show that one side of each rail is longer than the other, 4ft. 11¾in. as compared with 5ft. 0¼in. This enables the track to take easy curves to right or left, while for laying straight track, long and short sides of rails are laid alternately outside. To negotiate sharp curves the whole curve can be paved and widened by laying the rails radially at right angles to the direction of the track and filling interstices with road metal, but in this case the sleepers must be laid with the projecting dowel downwards as the recesses in rails to receive dowels do not come in the right place when rails are laid in this way. Lorry parks can be paved quickly with these concrete slabs.

Light portable swinging derricks each with a horizontal arm carrying a travelling differential tackle (as supplied with pontoon equipment) were made, suitable for erection either in a lorry or on the ground, for the purpose of loading and unloading the concrete slabs into and out of lorries and on to a railway porter's barrow in which they could be wheeled along the track to the head of it. "Cramps" suspended from the tackle seized the slabs.

The drawings show the slabs reinforced with steel rods, which are probably better reinforcement than expanded metal, but the slabs which were actually tested were reinforced with expanded metal. The drawings shewn in the *Plates* were prepared when it was decided to change to rod reinforcement, but none of the latter type were actually made and tested.

A track of these concrete rails and sleepers was laid across a dry river bed on a road leading into an R.E. dump, into which at least fifteen lorries ran daily for eight months. Some of the slabs remained quite undamaged, others though damaged still served their purpose. With practice and care in manufacture the percentage of slabs failing would be small.

It is suggested that this system meets an emergency that often arises and that it is wise to store some miles of the track ready for the emergency in any area in which operations are proposed, if the country is not served by good lorry roads.

JOTTINGS BY A C.R.E.

ABOUT the middle of August, 1914, recruiting for all branches of the 1st Australian Division started at Sydney. The press of recruits was enormous. Lieut. King had charge. One morning they rushed the front gates and invaded the barracks. King handled the situation neatly, ordered the men to form up smartly and show themselves soldiers. He then marched them out of the barracks by the back gate and closed it behind them. The men saw the joke against them and took it well.

About a fortnight later I was ordered to Melbourne to superintend formation of sapper companies there, and was appointed C.R.E. We expected to get away early in October, and had actually started embarking, when the scare of the *Emden* delayed us. Eventually we sailed from Melbourne on October 16th.

The transports from the Eastern Ports rendezvoused at Freemantle while the New Zealand transports and those from West Australia joined us in the vicinity. We then, with our naval escort, formed a fleet of close on fifty vessels, and our exit from Freemantle Harbour must have been an inspiriting sight. We proceeded in three columns, one mile between columns, with the *Orvieto*, the headquarters ship, leading the centre. Considering that none of these ships had ever been accustomed to keeping stations we maintained our formation very well. A novelty was the large number of horses in some of the ships. Many prophets shook their heads, and prophesied that the tropics would finish most of them, and certainly it was terribly hot on some of the lower horse decks. But we only lost five per cent. of our number, and some of the best equipped ships had no losses at all, though the animals were on board for from two to two-and-a-half months. We were favoured with fine weather once clear of the Bight.

The only excitement of the voyage was the finish of the *Emden* by the *Sydney*. I came on deck early that morning and was surprised to find the *Melbourne* athwart us evidently conversing. Shortly after the *Sydney* went off at speed, and various rumours were rife. The Japanese battleship now got restless, hoisted her ensign fore and aft wherever an ensign could be hoisted, and cleared for action; a most imposing sight she presented. (By this time we knew the *Emden* was the quarry!) A little later she dashed off, belching smoke, but before she got hull down we got the *Sydney*'s signal "*Emden* beached and done for," and back she came. At Colombo two days

later we found the *Sydney* looking a bit battered, and we took on board the Captain and one hundred other ranks taken from the *Emden* and these stayed with us till Egypt.

We arrived in Egypt early in December. The companies were very busy training at Mena, and I had to do C.R.E. of camp, which left me little time to look to the companies. I realized early what an advantage we had over the infantry by having a small nucleus of Regular Officers and N.C.O.'s of the Australian Permanent Engineers, who were invaluable. With the infantry it was, in those early days, sometimes a case of the blind leading the blind. The camp was overcrowded, and the water supply a continual source of worry, but the men worked hard, so hard, in fact, that they were for a while overworked.

We owe a deep debt to the Egyptian State Railways for all they did for us in the way of completing and repairing our equipment. They also made complete pontoon equipments for the three field companies, and generally acted as our Ordnance repair shops. By the end of March we were all eager to get away, and rumour said that we should soon move, though no one could say where. Eventually we heard that we were to make a landing somewhere. We entrained for Alexandria early in April, and found the harbour crammed with ships, after a slight delay, sailing for Mudros. Here we had a further wait to allow the transports to assemble. Our objective then became pretty well known. I formed one of a party of military officers who made a reconnaisance trip of the Gallipoli coast in the *Queen*. When on deck we were disguised in naval overcoats for fear our plans should leak out.

The preparations for the landing were certainly worked out with infinite care. I was warned as C.R.E. that the provision of a pier and the water supply would be my immediate problems. On the afternoon previous to the day fixed we stood out from Mudros, then crammed with a most heterogeneous collection of battleships, transports, cargo boats, etc., and stayed the night in a bay nearer the Turkish shore. The weather held calm and our leading brigade disembarked from the battleships and made the landing at dawn. It was fortunate that the navy landed them about a mile north of the spot selected (Gaba Tepe), which proved a hornets' nest and never passed into our hands.

It was a day of vivid contrasts. Not being detailed to land till 8 a.m., I had time for a bath, a luxurious breakfast, and a smoke on deck before I gathered together my worldly goods, added a bag of biscuits slung round my neck, and, much encumbered, clambered down a rope ladder to the deck of a destroyer, which took us to within a few hundred yards of the shore where we tumbled into cutters and stepped ashore dryshod. All this while promiscuous shelling was going on, but nothing very much. The *Goeben* threw over the first

big one just as we left our transport. Considering the number of ships, and the good observation Abdul had, it was extraordinary how few hits were made. I only saw one, on the waist of a collier, but it did not put her out of action. Nearer the shore a tug was hit and very slowly sank, her smoke stack, alone visible above water, being for weeks a conspicuous warning to navigators

One field company had landed with the advanced brigade and was already at work cutting rough paths through the scrub, and searching for water. In this search we were more successful than we expected, and the local supply for the first few days was a material help. At this time, 9 a.m.; the news was good from all quarters. In the course of the morning my eyes were gladdened by the sight of our barrel pier rafts slowly approaching the shore. Made up complete, they had been carried on a transport and were slung overboard and towed in. By noon they were in position as a pier for landing stores, and another rough pier was made of large stones from the beach, which was used during the afternoon for off-loading tins of water, and for the evacuation of wounded. By mid-day came news that our advance was checked, and as the afternoon wore on there was a feeling that things were not so bright as in the morning. As night fell this feeling increased, and by this time the beach was littered with wounded. Nevertheless by sheer hard work on the part of the A.A.M.C. these had all been evacuated before the next morning. That was an unhappy night. The rattle of musketry was continuous, rising and falling in intensity like the surge of the tide on a beach. However, stores were coming in well, and the New Zealand and Australian Divisions had finished disembarking during the afternoon.

The topography of our immediate hinterland had to be seen to be believed. The plateau immediately formed by the cliffs gave no access to the heights further in, being cut off from them by a deep gully. Our main objective, Sari Bar, was on our left front, but for the time being it was a question of holding what we had. It was most remarkable the next morning how everybody's spirits revived. The gloomy views of the previous evening vanished. The arrangements for landing stores and the further search for water supplies kept me busy. The sappers, in the meantime, were improving paths and roads, and digging an interior line of trenches, in addition to the hundred and one other odd jobs to which he is always heir. Already there were cries for barbed wire, timber of every description, tools, etc., etc., more than our small stocks could supply. My first visit to the front line was on the third or fourth morning. In those early days, the necessity of digging had not yet been fully appreciated by the infantry, and my chief impression of that trip was the enormous difference it made in the morale of the men whether they had got well dug in or not. Where they had fair trenches, they were happy and confident, where they had not, they were unhappy

and apprehensive. I spent most of my time conjugating the verb "to dig," chiefly in the imperative mood. The advantage of clearly written notices was also borne in on me. It is disconcerting when you have spent some moments deciphering a pencil scrawl to find it reads "It is death to linger here," or "A sniper has this spot set;" but these notices only appeared later. Our left at this time consisted mainly of isolated posts, communication between them in daylight was impossible, and we were busy sapping from post to post to make a continuous line. Snipers held the high ground at the head of the main valley, our chief artery, and with them you played the game of "p'raps" as you travelled up and down it, till we had time to build traverses and cut communication trenches. Our front line had deep indentations; it was formed just where our infantry had been stopped on the first morning. This was gradually corrected by sapping. From this sprang our first attempts at mining, and fortunate it was for us that the soil stood without timbering, for the supply of timber would have been out of the question. Attempts to advance our line met with no success and heavy casualties, and a system of trench warfare, with the accompanying trench nuisances, bombs and grenades, gradually developed. The local water supply gave out after the first few days, and had to be brought over on barges and pumped into tanks on the beach, thence carried by man or mule to the consumer. Abdul's shrapnel had overshot the beach for the first day, but thenceforward there were no reasonable grounds for complaint as to the accuracy of his shooting, and the pumping parties had a trying time. Just three weeks after the landing I got a bit, and Gallipoli saw me no more till late in July.

On my return I found the feeling that we were securely "top dog," and that while we could not advance, we were secure from being driven off. By this time the sappers were chiefly employed on underground work, protecting our front line with a system of tunnels. We were lucky indeed to have such large numbers of skilled miners in the infantry, and from the early days we always had the mastery underground. Sent off in August to Egypt to form fresh field companies for the newly forming 2nd Australian Division, I returned in September with two companies formed from volunteers from the infantry, and what tools we could procure in Cairo. My work lay more and more in the tunnels under-ground by which we were trying to make local advances and provide shelters for the men. I remember taking over one set which had simply grown, and was like a rabbit warren. They were most unpopular, and progress through them was a series of gymnastic exercises. Work was concentrated on improvements to exits and entrances, and making the main gallery passable for men walking upright. The improved results in the forward work when resumed were surprising. We sank, against my wishes, one deep shaft which was to come out or fire a large mine some 1,200

yards beyond our front. The men worked steadily and were good miners, but the climate and conditions were telling, and our progress rarely came up to our estimated rate, low as this had been put. I mention this to show that with any amount of good will, you cannot get anywhere near the same amount of work out of men under trying climatic conditions, as in ordinary life, and that estimates based on work done in civil life are most misleading. At this time we were firing a mine or two nearly every day. Abdul retorted in kind, but as his chiefly went up in no man's land, no great harm was done, indeed our casualties from his mines were surprisingly slight considering that in the "Lone Pine" and some other sectors, we were at very close grips, and had broken into some of his tunnels. By this time the beach and its surroundings were hardly recognizable to the early inhabitants. Traverses of provisions and fodder had completely altered its appearance, and saved many lives, while scrub and everything that could light a cook's fire had disappeared from the hills. By now the Suvla push had come and gone, and one had the feeling of rats in a cage. The after-effects of suffocation in a mine caused me to be evacuated early in November, I therefore missed that most extraordinarily brilliant piece of work, the evacuation in December.

CORRESPONDENCE.

SITING OF TRENCHES.

To the Editor, R.E. JOURNAL.

SIR,

With reference to the article by " H.B. " on the " Siting of Trenches " which appeared in the June number of the *R.E. Journal.* I would like to make a few criticisms from a point of view which I venture to think has not yet received the consideration it deserves.

I refer to what was known during the war as " Field Survey Observation." The writer of the article mentions the necessity for obtaining " Artillery Observation " of the ground for at least 400 yards in front of the line of resistance but he says nothing about the equally important necessity for maintaining observation over the enemy's " battery " areas, possibly because it is thought that these can be adequately watched from aeroplanes and balloons.

It is unnecessary to comment on the value and importance of effective " Counter battery " work, but few people, I imagine, outside the comparatively small number of officers who have been concerned during the war with the location of enemy batteries and the direction of " Counter battery " fire, realize how strictly limited are the possibilities of aeroplane observation, or what can be done in the way of properly organized ground observation, for location of hostile guns.

My own experience during the war is that when our own line was favourably situated for this class of work, as for example in the Nieuport Sector in 1917 or the " Lys Salient " formed by the German advance to Merville in 1918, the number of hostile batteries located by ground observation, that is to say by intersection of the flashes of the guns from properly surveyed O.P.'s, was not less than six times the number located by our balloons and planes put together. The locations moreover being far more accurate, and generally also effected far more quickly.

In July and August, 1918, it was my duty to carry out a reconnaissance of the defensive lines which had been prepared by us in front of St. Omer with a view to selecting positions for this kind of observation, and it was perfectly evident from the nature of the positions selected that no attention whatever had been given, in siting the trenches, to this question; with the result that if we had had to occupy this line we should have been virtually compelled to forego a form of observation from which we could have derived the greatest advantage.

I would, therefore, like to state briefly the attributes of a good position from the point of view of the " Flash Spotter " in the hope that any R.E. officer who may be called upon to select a position for a defensive

line in the next war may give his requirements due weight and consideration.

The best sites for flash spotting O.P.'s are those which give a good all round view of the areas likely to be occupied by the enemy's guns, and their positions, with regard to our own front line, should be such that the enemy cannot reach them and disturb the observer with machine guns. That is to say the front line should be sited about 1,500 to 2,000 yards in front of them, not " several hundred " yards as laid down in para. 5 of the article referred to.

Gun flashes can be seen at great distances if the observer's position has sufficient command to make it difficult for the enemy to defilade the flash from him, and with the instruments used the distance from the flash, within limits, has little effect on the accuracy of the location provided the observer can make his observations in comparative security. I have known the position of a gun to be located by intersection of the flash with an error of only 60 yards at a distance of 14 miles.

M. N. MACLEOD, *Lieut.-Colonel, R.E.,*
Cmdg. 4th Field Survey Battalion, R.E.

NOTICES OF MAGAZINES.

PETROLEUM.

THE information given below is drawn from a report on "The energy resources of the United States: a field for reconstruction" by Chester G. Gilbert and Joseph E. Pogue, published quite recently by the Smithsonian Institution of the United States National Museum.

The peculiar value of petroleum is due to the fact that it is the sole source of gasoline (petrol), the dominant motor fuel, provides kerosene, yields lubricating oil, is becoming an essential fuel in districts where coal is scarce and in oil-burning navies, and forms the basis of an oil by-products industry, a branch of chemical manufacture still in its infancy and capable of unlimited possibilities of development. Its peculiar property of being a liquid adds greatly to the facility with which it can be mined and transported. Petroleum, or crude petroleum as the raw or unrefined product is often termed, is an oily liquid varying considerably in appearance according to the locality from which it comes. It is an extremely complex mixture of organic compounds, chiefly hydro-carbons, but substances containing sulphur, oxygen, and nitrogen are also present in small amounts. If crude petroleum is exposed to the air, it gradually thickens until a solid residue is left. The first product given off is natural gas, then liquid components evaporate in the order of their lightness; and the final residue is composed largely of either paraffin wax or asphalt. Though petroleums vary considerably in character, they fall chiefly into two classes, those with a *paraffin base* and those with an *asphaltic base*. The former are richer in gasoline, while the latter are useful commercially in the form of fuel.

Petroleum in commercial quantities is found only at a considerable depth, enclosed within the rocks of the earth's crust. It saturates certain areas of porous rocks, such as beds of sand or sandstone, tending to accumulate where such strata occur beneath denser, impervious layers. Occurring in this way under the pressure that obtains at these depths, carrying immense quantities of gas in solution, and almost invariably associated with water, it is capable of movement, and in general migrates upwards, and becomes impounded into "reservoirs" or "pools" under the domes found on the under side of the impervious strata supervening.

The geology of petroleum is therefore the geology of rock structure, and by skilful mapping of the earth's crust information may be obtained by which the development of petroleum fields may be changed from a gambling venture to an exact science. The chemical composition of the water encountered by the drill also gives some indication of the proximity of oil, and serves as a guide to successful development.

The process of winning the oil consists in puncturing the structural

feature which holds it in restraint, so as to give free scope to a movement upwards to the surface. While petroleum is of very common occurrence in small quantities, areas underlain by commercial quantities are few. Two-thirds of the world's supply are at present found in the United States, while considerable quantities are found in Mexico and Russia, and smaller quantities chiefly in the Dutch East Indies, Roumania, India and Galicia. The Petroleum industry in America is in the hands of two classes of companies only, the producers, of which there are over 1,500 companies, and the companies which handle the oil—carrying out the operations of transportation, refining and distribution—of which there are only a few hundreds.

The oil is obtained from wells drilled to varying depths. The drilling is commonly done by means of a heavy string of tools suspended at the end of a cable and given a churning motion by a walking beam rocked by a steam engine. This method is known as the standard or percussion system of drilling. The steel tools, falling by their own weight, pulverize the solid rock and punch their way to the depth required. To prevent the caving in of the hole, but especially to avoid the inflow of water, the well is lined, or "cased" wholly, or in part, with iron piping, which is inserted in screw-joint sections at intervals during the drilling and forced down to positions needful of such protection. The well does not taper, but, if deep, changes to successively smaller bores at several points, resembling a great telescope.

Another method, known as the rotary system, is also in common use, being adapted to regions where the sides tend to cave badly. In this system the iron casing is tipped with a steel bit and rotated so as to bore its way downward like a great auger.

A successful well eventually penetrates the oil-bearing bed, and the petroleum may spurt forth under the influence of the natural gas held in solution under pressure. These wells are called "gushers" and some pour forth prodigious quantities of oil. Others flow with less violence, and many yield only to pumping, if notable quantities of natural gas are lacking. All wells soon reach a maximum production, after which they soon pass into a period of decline, and eventually become extinct. Wells during decadence may be stimulated by firing charges of nitro-glycerine at their bottoms, and experiments have also been tried in forcing compressed air into some exhausted wells in a group, with a view to driving residual oil into the neighbourhood of other wells from which it can be pumped.

As single wells soon become exhausted, sustained production requires the producing companies not only to draw oil from existing wells, but to persist in drilling an increasing number of new wells, and to select promising fresh sites for future operations.

The expression "wild-cat" operations is used for drilling wells where oil has not been proved to exist. Wild-cat companies are generally small ones which do not afford to spend much money in geological research, but the "wild-catter" has his uses, and gains good positive or negative evidence, for there is a great deal of chance in the industry and without some gambling a large proportion of the oil would never have been found.

Turning now to the companies which handle the oil after it has been raised to the surface, the first operation carried out by them is *transportation*. This is almost entirely done by means of pipe lines, the principal systems of which, in America, are calculated to aggregate 28,995 miles. The pipes vary in diameter from 2 to 12 inches, but 6 to 10 inches represent the common sizes. The piping is made of iron plate and is ordinarily placed below the surface of the ground. At intervals of 15 to 30 miles, according to the viscosity of the oil, are pumping stations, where powerful pumps seize the spent oil and force it forward. In the case of heavy viscous oils, it becomes necessary to heat the product at each pumping station. Unlike a railroad, the pipe-lines, in general, follow a direct course, uphill and down. A coasting service of tank steamers also plays a part in the transportation of the raw material.

Crude petroleum is used as fuel and for roads, but most of the oil is manufactured into a series of products which have wider usefulness and higher value. This *refining* is an ingenious mechanical device whereby the raw material, through the agency of physics and chemistry is fitted to the needs of society. As these needs are ever increasing in size and diversity, refining practice is in continuous flux, adapting a constant substance to a shifting and widening demand.

At present petroleum yields, when completely refined, four main products—gasoline, kerosene, fuel oil and lubricating oil—and a large number of by-products, of which benzine, vaseline, paraffin, road-oil, asphalt and petroleum coke are well-known examples. Most of these products can be broken up into other subjects, numbering some hundreds of substances of commercial value, and leaving scope for the further discovery of many more.

While refinery practice is highly technical and varies according to the chemical nature of the oil and the local demand for products, we may ignore details and note that there are three main types of refineries. Firstly, the "skimming" or "topping" plant, in which the light oils are removed from the rest of the products, which are sold in the semi-crude condition for fuel purposes. Secondly, the "straight-run" plant, which produces all the four main products and some by-products, the process separating the crude oil into its natural components with the minimum of chemical change. The third type is of recent birth, employing the so-called "cracking" process, which yields the full set of products, but a greater percentage of gasoline than the crude oil gives upon ordinary distillation. This is accomplished at the expense of the heavier component oils, whose molecules are broken or "cracked" into lighter molecules, which constitute a corresponding amount of additional gasoline. All types of refineries employ the principle of distillation in their operations. The petroleum is heated in stills, and the products vaporize, pass off, and are condensed in fractions, representing roughly the materials in demand. These products are then purified by chemical treatment, or transformed by chemical means into a series of secondary products.

The requirements of *distribution* are considered in the siting of the refineries. Distribution is not carried out by means of pipes, but use is made of railways and canals for inland traffic and of tank steamers for

service overseas. Storage tanks are provided at distributing centres, and supply tank wagons radiate to comply with local needs. The system is highly organized and the results are evident in the wide-spread use of all petroleum products, but especially of kerosene, which penetrates into the most out-of-the-way regions of the globe.

A few words about the natural gas may be of interest. The gas produced is of two types, according to whether it carries a conspicuous burden of gasoline vapour or not. The first type flows from an oil-productive stratum and is called " wet " or " casing-head " gas. The second is " dry " gas and comes from portions of porous rock formations practically free of oil.

About one-third of the natural gas produced in the United States is used for domestic purposes—lighting, cooking and heating—while the rest is burned in industrial plants under steam boilers, and especially in metallurgical operations, glass and pottery furnaces and cement kilns, where intense heat is required. The drilling of gas wells is not essentially different from that of oil wells; but gas, unlike oil, cannot be stored in the field and hence is piped directly to centres of consumption. The gas emerges from new wells under high pressure, but as this declines rapidly, the gas field is equipped with compressors which serve to increase the speed and volume of the gas under distribution. In general the pressure of casing-head gas is much lower than that of dry gas.

The waste of natural gas in the past was very great, and it used to be looked upon and treated as a waste product, but now it is known to be necessary to the proper recovery of the oil, and in oil borings the gas-bearing beds encountered are sealed off by means of mud-laden fluid, and the gas is saved for the protection of the oil beds and for subsequent recovery of the natural gas. The gas flowing from the oil-productive stratum along with the oil, particularly in the gusher and youthful period of production, is the casing-head gas from which, since 1910, a growing production of gasoline has been won. New processes are also being developed for the production of gasoline from dry gas also.

PROFESSIONAL MEMOIRS, CORPS OF ENGINEERS, UNITED STATES ARMY AND ENGINEER DEPARTMENT AT LARGE.

March—April, 1919.

The Development of Anti-Aircraft Searchlights.—By Lieut.-Col. James B. Cress, Engineers, U.S. Army.—Prior to the date on which the United States entered the war various types of mobile searchlights for the purpose of battlefield illumination had been tested. These included a horse-drawn 36-in. set, and a 36-in. light on a Strauss extension tower, mounted on one F.W.D. truck, with a motor generator on a second truck. This latter type had also been supplied to the Russian Government. More recently a large order had been given for 24-in. searchlight sets, similar to those manufactured for the German Government. These

were horse-drawn, and consisted of limber and carriage, the former carrying the motor, while the latter was fitted with an extension mast supporting the high intensity light.

In the autumn of 1917 information was received that field searchlights were no longer used on the battlefield, but that enemy bombing operations were becoming so extensive that some form of anti-aircraft searchlight defence was essential. After various improvizations had been adopted, the question of a suitable design was taken up seriously in America, and an experimental detachment was formed who drew upon the large manufacturers of electrical equipment, numerous scientific bodies, and noted scientists, for advice in improving the searchlight and its power unit. Meanwhile experiments were made in reducing the weight of the equipment, which resulted in a carriage made up of a steel frame supported on standard Ford axles and wheels, and the reduction of weight to 1,600 lbs. in the case of a 36-in. light, and to 1,800 lbs. for a 60-in. light.

In the spring of 1918, it was suggested to abandon the front glass, which was found to absorb about 25 per cent. of the light. This resulted in the first Dishpan searchlight, composed essentially of the mirror, the mirror support, and the mechanism. With its carriage, the latest 60-in. light of this type weighs about 900 lbs. and gives a more powerful and effective light than an enclosed searchlight, using the same mechanism, current and mirror. Compared with the 60-in. sea-coast searchlight in use before the war, it costs about one-fourth as much, weighs about one-eighth, and is more powerful.

Another important development was the adoption of a metal mirror. At the outbreak of war, only one firm in the United States manufactured glass mirrors, and their output was limited to approximately one mirror per week. It was also almost impossible to obtain optical glass. Before the war closed three firms could produce glass mirrors, but, more important still, a type of metal mirror had been developed which could be turned out in unlimited quantities, and at a cost of about one-third that of the glass mirror. The final design of the metal mirrors has yet to be determined, but it is certain that they can be effectively used in the place of glass mirrors, and that they have many advantages over them. They will not shatter when hit, they are cheaper and more easily procurable, and, more interesting still, they permit of a higher development of the searchlight than had been previously considered possible. Because the glass mirror absorbs about eight per cent. of all the incident light and because of the poor conductivity of glass, mirrors made from it become hot, and, in practice, have usually cracked when used with arcs carrying more than 200 amperes. The metal mirror, however, runs cold with these powerful arcs. This quality, when considered with the efficiency of the metal mirror, which the latest tests have shown to be from 95 to 99 per cent. of that of the best glass mirrors, is alone almost enough to warrant its adoption to replace the glass mirror.

The development in America of the manufacture of carbons for high intensity lights—that is, for lights which use an incandescent carbon

gas as their illuminating source—has also been successful, the locally-made carbons are cheaper than those previously considered standard, and give three times as much light.

The development of mechanism has made it possible to use a much higher current density, which produces a more intense light, with either a longer range or a greater field. The medium intensity light—that one in which incandescent carbon forms the source of light—as well as the high intensity, have been carefully investigated, and both medium and high intensity lights taking as much as 500 amperes have given satisfactory tests. Whether the blue light produced by the high intensity arc, or the yellow light produced by the medium intensity arc, is better for picking up aeroplanes, will soon be carefully studied.

The article is illustrated with reproductions of photographs of various types of equipment. Other articles included in this number deal with:—(i.) Technical engineering details of the Hindenburg line in the sector of attack of the II. Army Corps; (ii.) a technical description of the British Light Railways in France; and (iii.) The Coblentz Pontoon Bridge.

REVUE MILITAIRE SUISSE.

No. 6.—June, 1919.

THE GERMAN AND FRENCH CAVALRIES IN THE GREAT WAR.

The article on the above subject by Colonel Poudret, begun in the number of the *Revue* for March last, is continued in the number under notice. Attention is called by Colonel Poudret to the fact that not only had the French cavalry to be reorganized and completely re-armed, whilst a fierce war was actually in progress, but its training had to be carried out on entirely new lines. The French Regulations of 1916, it is pointed out, contained a chapter on "Methods of Training," whilst in the Regulations of 1918 the subject was amplified and completed in matters of details. An extract is given from the latter Regulations wherein it is laid down that: "It is an imperative duty for every one to be continually increasing his own personal efficiency and that of his subordinates by training. For the Chief who "understands his business" does not call upon his men to exert themselves uselessly; he does not tire them out prematurely and in the battle does not risk their lives unnecessarily."

"The absence of knowledge is fatal. It makes a Chief irresolute and timorous, causing the men to lose their confidence in their leaders."

During the war the training of the large cavalry formations was periodically carried out with each formation complete in all details, *i.e.*, its staff, its artillery and its cyclists.

Even when cavalry units were taking their turn of duty in sectors of defence they were required to continue, as far as was possible, their training. Such training was based not only on the Regulations of 1918, but also on instructions contained in pamphlets and manuals issued

both previously to and since the outbreak of war. During such training, suitable schemes were set, in which the Special Idea often represented a situation of a kind in which a large cavalry formation would have been called upon to play a rôle had such a situation come into existence during the campaign. In other cases *études de combat* were carried out during which complete sets of orders were issued to every unit exactly as would have been the case in an actual engagement.

Individual training was carried out in the platoon and *group training* in the demi-squadron, squadron, demi-regiment, regiment and brigade, whilst *mounted training* was carried out in connection with manœuvres. Such manœuvres involved the execution of some scheme representing operations in which, according to the Regulations, large cavalry formations and divisional cavalry would be called upon to play an important part. During such exercises movements in extended order were practised, with a view to illustrate a rapid advance of cavalry under artillery fire over rough ground.

The labour devoted to this training was not spent entirely in vain, although in view of the precipitancy with which the Germans accepted the Armistice terms, the cavalry was deprived of the opportunity of reaping the full advantage therefrom that it had counted upon. The part played by the cavalry during the critical days of the spring of 1918 is touched upon. As is well known now, the Germans spent the whole period from November, 1917, to March, 1918, in ceaselessly transporting troops from the Russian to the Western Front. No secret of war was so well kept as the German design to break through the Allied front during their last great offensive. Forty German divisions were collected on a front of 50 miles, between the Scarpe and the Oise, with the object of separating the British from their Allies and of thus opening the road to Paris.

The German "push" began on the 21st March, and with the first fierce onslaught the British 3rd and 5th Armies were driven from their first positions and in some cases from the second also. Lassigny, Roye and Noyon fell and a gap was created between the British and French Armies. The French G.H.Q. at once made use of the reserves, and amongst the first of the troops to be moved forward was the 1st French Cavalry Division (General de Rascas); it advanced on Noyon and heroically came into action against the Germans who out-numbered them in the proportion of 10 to 1. The 9th Cuirassiers were decimated in the obstinate fighting on the borders of the Bois de Frières.

The Germans occupied Noyon on the 25th March. The 1st French Cavalry Division then proceeded in haste to Roye to join General Robillot, who was at the time commanding the 2nd French Cavalry Corps, as well as the 22nd and 62nd Infantry Divisions—these troops were responsible for the defence of the Roye sector.—(*To be Continued*).

Machine Guns in Action.

The article on the above subject by Captain Bridel is concluded in the number of the *Revue* under notice: questions affecting the employment of machine-guns in the offensive and in the defensive battle are examined. The Commander-in-Chief of the Swiss Army, it is pointed

out, issued an instruction in July, 1917, containing the following statement: "The preparation of troops for battle has one sole end in view, the preparation for the attack; the attack in a war of movements or the *combat de rencontre*, the counter-attack in the defensive battle and the assualt in trench warfare are but variants of the attack."

The question of the part that machine-guns should play in the offensive battle is discussed. The conclusion is arrived at that where the *terrain* and circumstances permit, machine-guns should come into action on the same line as the infantry or only slightly in rear of this line. The advantage of having machine-guns on the same line as the infantry is that the latter derive a certain measure of confidence by being so closely supported, and there is also the further gain that the positions of the machine-guns are under such circumstances, less easily located by the enemy. It is recommended that the machine-guns should come into action on that part of the front which affords most cover and where they can be pushed forward by short advances into positions whence they can bring oblique and flanking fire to bear on the enemy.

The Western Powers organized their machine-guns in "forward" groups and in "rearward" groups; the former term was applied to those machine-guns which came into action in conquered ground and were employed defensively, whilst the latter term was applied to the machine-guns employed in positions behind the fighting line to support infantry during and after an assault. The Germans had a similar organization, but used the terms "light machine-guns" and "heavy machine-guns" respectively for the two groups.

Towards the middle of 1918, each section of infantry in the German Army had two groups of light machine-guns allotted to it: these two groups were intended to afford each other mutual support. On being taken forward from the trenches these machine-guns were entrenched in "offensive nests": the duty was imposed upon them to co-operate closely with the infantry when it advanced, and to assist it by keeping down the fire of the enemy's infantry and machine-guns. As soon as the first wave of attack of their own infantry reached the enemy's position and occupied it, these machine-guns were pushed forward in order to help clear the enemy's trenches, and to cover the reorganization of their own assaulting columns.

The two important matters which commanders of machine-guns have continually to attend to in the attack are the making good of casualties in their gun teams, and the maintaining of a sufficient supply of ammunition.

The Great War has shown the very valuable rôle which machine-guns can play in the defensive battle. The Swiss Regulations lay down the rule that machine-guns shall be entrenched approximately at intervals of 30 paces, and that their positions shall be masked as completely as possible.

All the belligerents, it is pointed out, attached considerable importance to distributing their machine-guns in deep echelons; the reason being that the enemy's infantry and also his artillery barrage advanced in parallel lines, and in consequence, by the distribution in depth there was not the same risk incurred of losing all the machine-guns in a single

assault as would have been the case had they been all placed in the front line. Further, it also became customary during the war to entrench machine-guns singly instead of in pairs, as had been the practice in peace exercises before the war

When employed on the defensive, machine-guns are organized in two categories also, namely, the " forward " group and the " rearward " group. The former groups act under the orders of their own commanders in direct support of the infantry, whilst the latter groups conform to the orders of the superior commander and are employed to put up a barrage and also to direct their fire on moving targets indicated to them.

As a rule, machine-guns should be placed in support trenches, as they are less liable to be taken by surprise there. It is recommended that these guns should be placed chequer-wise in a defensive position—the chequer should be of considerable depth. It is suggested that a suitable basis for calculating the number of guns for a sector of defence would be as follows :—" forward " group, an average of one machine-gun per 100 yards of front per line of defence ; "rearward " group, an average of one machine-gun per 30 yards of front per line of defence.

When an alarm is given the " rearward " groups should at once put up a barrage. If the enemy has already come within their limit of range, it is the duty of these groups to prevent reinforcements and ammunition coming forward. Machine-guns, it is recommended, should never attempt to fire on air-craft flying at an altitude greater than 3,000 feet—machine-guns require special mountings to enable them effectively to come into action against air-craft.

Notes have been issued in Switzerland giving detailed information concerning the factors which influence the fire of machine-guns against air-craft. It is recognized that ordinary range-finders cannot be satisfactorily used when flying air-craft constitute the target : attention is called to the *télémètre avec correcteur de hausse*, introduced into the French Army to overcome difficulties of ranging in such cases. Reference is also made in the original article to the tables prepared for the use of the British Army, and intended to serve a similar purpose.

The lesson that Captain Bridel wishes inculcated above all others is that soldiers should be taught not merely to fight, but to fight with intelligence, with all their strength and to the last ounce of it.

The Necessity for Specialization in the Army.

Lieutenant James Quinclet, the author of the original article, calls attention to an address recently given at the Military Club of Geneva by Colonel Vuilleumier, the G.S.O.,*I.* of the Swiss 1st Division : the subject of the address related to the means and methods to be employed to bring about a democratisation of the Swiss Army.

Lieutenant Quinclet tells us that the experiences of many officers during the period of the mobilization of the Swiss Army, 1914—1918, were such as to discourage, to disillusion and even to disgust them.

Colonel Vuilleumier covered, it would seem, a great deal of ground in his address ; Lieutenant Quinclet, however, deals with one only of the matters touched upon, namely, " Specialization according to

functions." The fallacy that those in a higher grade of the army must always be superior in every respect, morally and materially, and in all things, to those inferior in rank to them, has, it is pointed out, widespread currency in Switzerland. For example, according to the accepted theory, the company commander should be the "best shot," the best scout, the best horseman, the best instructor etc., in his company. The prevalence of this idea, it is said has proved extremely prejudicial in matters affecting the training of the units of the Swiss Army; since those occupying subordinate positions, who have been imbued to some extent with the doctrine which placed the chief on a pedestal of superiority, knowing that their work might be corrected or subjected to criticism—unjustly according to their views—have failed to take a proper interest in their work. The result of this has been to create in the ranks that mischievous feeling which sometimes is referred to as being "fed up."

The proper cure for this state of affairs, it is urged, is a "specialization according to functions": that is to say, the separation of the function of "command" from that of "instruction." In accordance with this scheme "command" would be vested in a superior whose responsibility would consist in ordering, disposing, and sanctioning; on the other hand, such superior would not himself impart instruction—except where he was peculiarly qualified to do so—but this duty would be carried out under his directions by a subordinate selected by him on account of such subordinate's special fitness and qualifications to undertake the particular task assigned to him. For instance, the duty of explaining the details of a machine-gun would be assigned to a subaltern perfectly familiar with the mechanism, and in the event of no officer being present possessing sufficient knowledge of the subject, a qualified N.C.O. would be detailed for the purpose. Similarly, equitation would be taught either by an officer who had the qualifications of a riding-master, or by a N.C.O. so qualified, etc., etc.

"Specialization according to functions" arranged on an intelligent basis and carefully controlled by the C.O. would, it is suggested, considerably stimulate the subordinate ranks. To meet the contingency of casualties in the ranks of the instructors it would alone be necessary, it is pointed out, to provide a suitable number of under-studies for each branch of instruction requiring attention.

NOTES AND NEWS.

Switzerland.—The Federal Council has announced its intention to promote a popular discussion on the question whether Switzerland should join the League of Nations as one of its members or not. In this connection attention is called in the Notes to M. Paul Crokaert's work *L'immortelle mêlée* (Perrin et Cie, Paris), dealing with the military situation in Belgium in 1914. The danger of a "guaranteed" neutrality and those of a "perpetual" neutrality are also briefly discussed.

The appointment of Colonel Sondregger to the position of Chief of the Swiss General Staff seems to have given general satisfaction in military circles.

The death of Colonel George Favey, which took place at Lausanne,

on May 26th last, is announced; he it was who first organized the Lines of Communication services in Switzerland.

United States of America.—A special correspondent contributes notes dealing with the demobilization of the American Army; the future of the National Guard; the proposal to hold a review in New York in connection with peace celebrations—the proposal is not viewed with favour on account of the probable expense, viz., £180,000; questions relating to uniform and the distinctive badges to be worn thereon; the mutiny of a company of an American line regiment near Archangel on March 30th last; and the proposed reorganization of the American Army to meet the new peace conditions.

INFORMATION.

Switzerland.—A short note is published under the heading "Military Education"; therein the necessity for the adoption of every means to foster and secure good feeling between all ranks of the army is urged.

The Herzog Trust.—The objects of this trust, founded particularly for the benefit of artillery officers, are set out in the original note.

BIBLIOGRAPHY.

A notice on General Berthaut's work *L' "Erreur" de* 1914 (published by G. van Oest et Cie, Paris and Brussels, at 4 fr. 40 c.) appears under the above heading.

Information relating to other works of military interest published recently on the Continent is also contained in this part of the number of the *Revue* under notice.

W. A. J. O'MEARA.

RIVISTA DI ARTIGLIÉRIA E GENIO.

February, 1919.

THE BOMBARDMENTS OF PARIS AND OF DUNKIRK.

The first bombardment of Paris by German aeroplanes of the Taube type took place on the 30th August, 1914, five bombs being discharged, and was renewed with a few bombs on successive days up to the 1st September. Other bombardments took place on the 27th September, 8th, 11th and 12th October of the same year, and the 11th and 22nd of May, 1915. These were the only bombardments by aeroplanes of the Taube type, which discharged, altogether, 58 bombs in 10 visits, killing 11 persons and wounding 50. The projectiles were of four types:—cylindrical-conical incendiary bombs weighing 4-5 kg.; spherical explosive bombs of the same weight; pear-shaped with shrapnel weighing 3 kg. containing 150—175 bullets of 12 g.; and of the same form but larger of 15 kg. and 30 kg. There were no fires. The first attack by dirigibles of the Zeppelin type on Paris and its suburbs took place on the 21st

March, 1915, six bombs being discharged. These caused slight damage, viz., two or three small fires which were easily overcome, and wounded a dozen persons. The second and last visit of these dirigibles occurred on the 29th January, 1916; 17 bombs fell which killed 20 persons and wounded 28. The projectiles were more powerful than those dropped from the Taubes, and were exclusively of two types:—spherical explosive bombs weighing 60 to 130 kg. charged with powerful explosive (tolite or trinitro-anisol); and incendiary bombs of 8 to 10 kg.; these last had very little effect. Large fires were only caused by explosive bombs under favourable conditions.

For about two years Paris was not bombarded, but on the 31st January, 1918, there commenced attacks by powerful bombing aeroplanes of the Gotha and other types. The first attack caused the greatest damage owing to the discharge of 269 projectiles on the city and suburbs. There were many victims.

The projectiles discharged from these aeroplanes were described in the *Rivista**; a few data are given below:—

	Number of bombs.	Number that failed to explode.
Spherical bombs of 300 kg. ...	5	3
,, ,, 100 ,, ...	57	19
,, ,, 50 ,, ...	232	26
,, ,, 10 ,, ...	279	25
Incendiary ,, 10 ,, ...	7	4
,, ,, 5 ,, ...	64	23
Not identified	20	—

On the 28th March, 1918, the bombardment of Paris by guns of long range commenced, 18 projectiles falling in the city that day; and the bombardment continued on successive days with few intervals up to the 27th April. After a month of tranquility it recommenced on the 27th May and continued with very irregular intervals up to the 10th June, and again from the 15th July to the 9th August, which was the last day of action of these guns. Altogether 303 shots were fired, resulting in 256 persons being killed and 620 wounded; the material damage was relatively less serious than that caused by the aerial bombs. It is confirmed that the calibre was 21 cm. and that all the projectiles burst without exception and that they were provided with two fuses. Experts have absolutely excluded the hypothesis that the internal charge was formed of two separate liquids, which united during the flight so as to cause an extra-powerful explosion. It is interesting to compare the effects of the two kinds of bombardment; the aeroplanes and the dirigibles dropped 303 shells, causing the death of 256 people and wounding 620. The casualties almost exactly balance, but the author states that the moral effect of the fire from the gun was much greater, because the projectiles arrived at all hours without it being possible to give the alarm or to take shelter in any way. The material losses caused by the guns were far greater than those caused by the aerial bombs.

* *Rivista*, 1918. Vol. iii., p. 80.

The bombardments of Dunkirk at intervals between the 28th October, 1914 and the 11th November, 1918, are shown in the following list :—

Actions of	Bombardments.	Projectiles.	Killed.	Wounded.
Aeroplanes ...	177	5092	424	888
Dirigibles ...	1	11	3	9
Guns, land	32	411	114	185
„ naval	4	2000	7	32

The shells of 380 mm. which fell on Dunkirk were fired from a gun at Lemegembroom at 38 km. distance and were more effective than those of 210 mm. with which Paris was bombarded.

New Determinations of the Velocity of Sound.

In the *Comptes Rendus des Séances de l'Academie des Sciences* is produced a report by Ernesto Esclangon on a new determination of the velocity of sound—which is believed to be verified by several trials made in France during the course of the war—and on various problems for the determination of distance, and identification of the enemy's artillery positions, etc.

An exact knowledge as far as possible of the velocity of sound is of special importance in its application to the identification of artillery positions by means of sound. The precise determination of the velocity presents difficulties essentially derived from the imperfect knowledge of wind phenomena, since the influence of temperature is less and is easier to determine exactly. The influence of the wind is always badly determined owing to its continuous variation. The intensity of the wind is manifested in squalls and under-currents. Moreover, the measurements of the force of the wind depend upon the instruments used :– an anemometer, by the medium velocity of the fluid molecules that surround it a sound-balloon, on the other hand, by the medium velocity of molecules following its movement. In the propagation of sound there occurs a special integration, corresponding to the medium velocity of the several molecules met with successively by the sound wave, similar to the integration presented by the action of the wind on projectiles. If the wind is regular and constant these data would be identical ; buf they vary owing to squalls ; and with very strong wind, the differences attain a value of several metres. When experiments in the velocity of sound are made at short distances, (some hundreds of metres for instance), all measurements correspond with the wind according to the phases and importance of the squalls, elements difficult of ascertaining. Further, in the immediate vicinity of the ground, the velocity of the wind produces a variation of barometric pressure, very rapid, irregular, and indeterminable, which provokes refractions and deviations of the sonorous rays. At great distances, (15, 20, 25 km. for example) the sonorous rays may be raised in the strata of the air by continuous refraction to a height the physical state of which is unknown. In calm weather it is observed that near the ground there happen other small irregular movements of the air, besides local variations of temperature, which cause great variations in the results, as has been

repeatedly shewn by experiments in the camp of Gâvre. The measurements obtained from the sound of cannon shots give systematically numbers lower than those obtained by other methods. During the year 1917 to 1918 the author undertook at Gâvre the determination of the velocity of sound, working in the open under all conditions of weather, with strong winds, and a variable temperature, and with cannon of all calibres. The sound waves were collected in electric-acoustic receivers placed one at 1,400 m. from the battery and another at 1,400 m. beyond on the same alignment; the position of the two stations was fixed with the greatest exactness; the time was measured with an approximation of about $\frac{1}{500}$ of a second, and the wind pressure was determined by means of sound balloons. The observations made from June, 1917, to March, 1918, were taken from a series of experiments of 30 cannon shots each and were divided in two groups, the first with strong and irregular winds, with velocity up to 18 m., the other, with wind apparently regular, with velocity to 10 m. The results of the first group showed very sensitive differences up to 3 m., with an average of 1 m. These differences are indications of systematic errors due to the influence of the wind. With regard to the second group the average difference obtained in 100 observations for the sound velocity—corrected for the influence of wind, temperature, and humidity—was 2 m.

In conclusion the author obtains for the sound velocity, as deduced from the second group of the series, with 15 deg. of temperature and dry air, the value of 339·9 m. It may be noted that the velocity of sound according to the observations of Regnault made exclusively in calm air was shown to be 339·7 m. In the experiments made by Esclangon, (the calibres of the guns being from 14 cm. to 52 cm.), the velocity of sound does not appear to have been affected at a distance of 1,400 m. Finally the experiments seem to show that the velocity of sound is greater when the wind blows in a direction from which the sound is propagated but not in a contrary case. The difference, very slight with moderate winds, increases rapidly in the case of strong winds, this phenomenon being attributed to the oscillatory form of the wind (squalls).

E. T. THACKERAY.

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