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NOTES

ON

GERMAN SHELLS.

GENERAL STAFF,

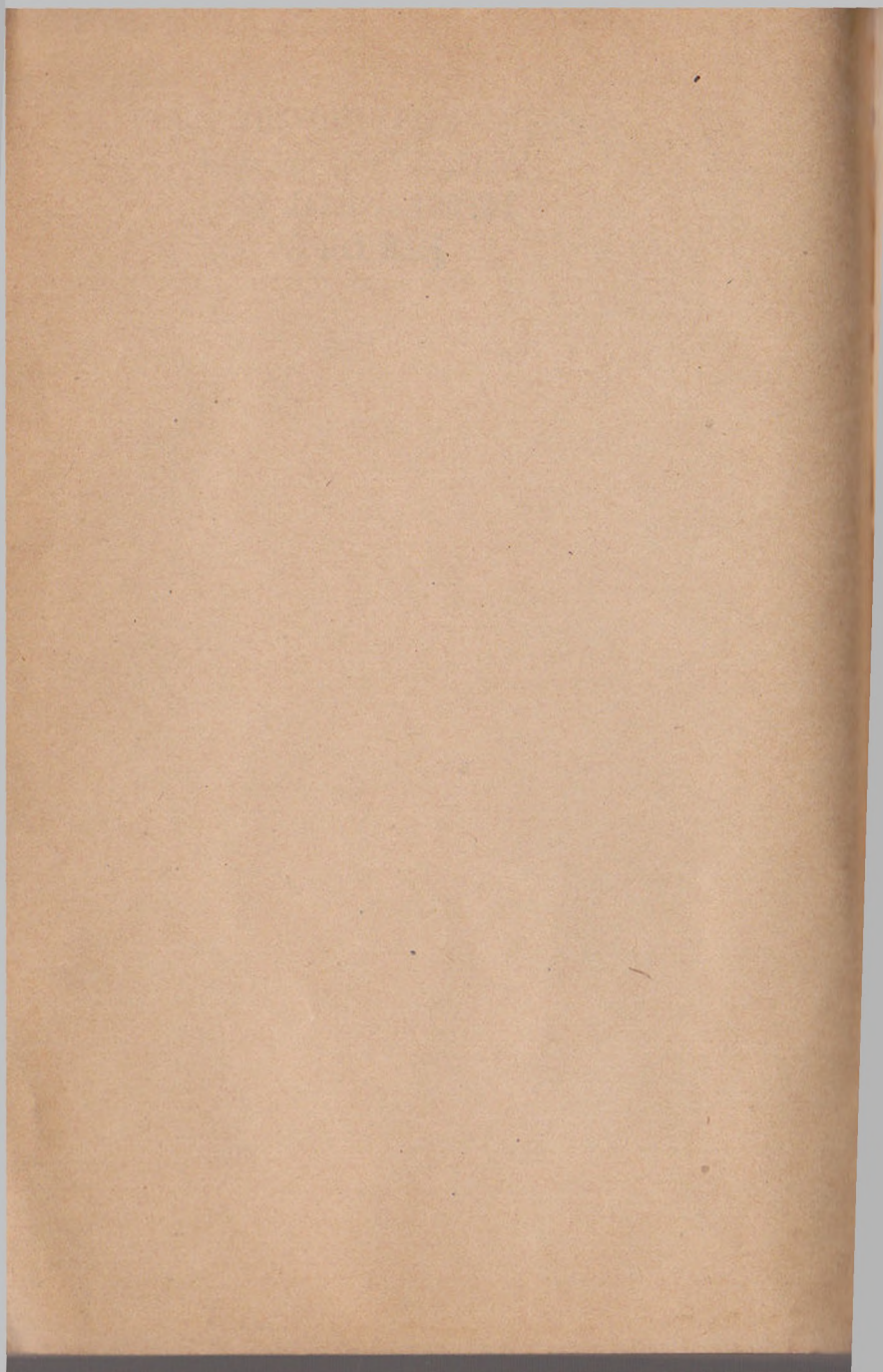
GENERAL HEADQUARTERS,

May, 1916.



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NOTES

ON

GERMAN SHELLS.

GENERAL STAFF,
GENERAL HEADQUARTERS,
May, 1916.

(B 11938) Wt. w. 2262—7438 5500 ~ 6/16 H & S

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PREFACE.

These "Notes" have been compiled from reports and specimens of German shells forwarded by the Armies and from information supplied by the French General Staff and War Ministry.

It will be noticed that detailed information is still wanting as regards several shells of the more recent patterns.* Any information which may be obtained concerning these shells, and variations of any description, should be reported to the General Staff at General Headquarters, making use of the form shown in Appendix XXII.

The information given under the heading of "Employment" for each projectile has been translated literally from German documents issued during the war.

GENERAL STAFF,

GENERAL HEADQUARTERS.

* See pages, 42, 52, 60, 62, 68, 88, 106, 116 and 144.

List of German Shells.

Common and H.E. Shell.							PAGE
3.7 cm. Gr. (and variation)	...	...	...	...	...	...	32
5 cm. Gr....	...	...	...	...	...	...	34
7.7 cm. Gr. 96	...	...	...	...	...	...	36
7.7 cm. Einheits-Geschoss	...	...	...	...	...	...	38
K. Gr. 14	...	...	...	...	...	...	40
K. Gr. 15	...	...	...	...	...	...	42
9 cm. Gr. 82	...	...	...	...	...	...	44
9 cm. Gr. 88 (and variations)	...	...	...	...	...	...	46
F.H. Gesch. 05 (Einheits-Geschoss, and 1898 pattern shell and shrapnel)	...	...	...	...	...	...	48
H. Gr. 14	...	...	...	...	...	...	50
H. Gr. 15...	...	...	...	...	...	...	52
Lange F.H. Gr. (Vers. F.H. Gr.)	...	...	...	...	...	...	54
10 cm. Gr. 96	...	...	...	...	...	...	56
10 cm. Gr.	...	...	...	...	...	...	58
10 cm. Gr. 14	...	...	...	...	...	...	60
10 cm. Gr. 14 A	...	...	...	...	...	...	62
12 cm. Gr. 88 a/A.	...	...	...	...	...	...	64
13 cm. Gr.	...	...	...	...	...	...	66
13 cm. Gr. 14	...	...	...	...	...	...	68
15 cm. Gr. 80	...	...	...	...	...	...	70
15 cm. Gr. 83	...	...	...	...	...	...	72
15 cm. Gr. 88	...	...	...	...	...	...	74
15 cm. Gr. 96	...	...	...	...	...	...	76
15 cm. Gr. 03	...	...	...	...	...	...	78
15 cm. Gr. 04	...	...	...	...	...	...	80
15 cm. Gr. 06	...	...	...	...	...	...	82
15 cm. Gr. 12	...	...	...	...	...	...	84
15 cm. Gr. 12 (gas shell)	...	...	...	...	...	...	86
15 cm. Gr. 14	...	...	...	...	...	...	88
15 cm. Gr. 14 A	...	...	...	...	...	...	90
15 cm. Brand-Gr.	...	...	...	...	...	...	92
21 cm. Gr. 80	...	...	...	...	...	...	94
21 cm. Gr. 83	...	...	...	...	...	...	96

Common and H.E. Shell—*continued.*

	PAGE
21 cm. Gr. 88	98
21 cm. Gr. 96	100
21 cm. Gr. 96 n/A.	102
21 cm. Gr. 06	104
21 cm. Gr. 14	106
21 cm. Gr. 14 A	108
28 cm. Gr. 06	110
28 cm. Gr. (12?)... ..	112
28 cm. Gr. (? pattern)	114
38 cm. Gr.	116
42 cm. Gr.	118

Shrapnel.

7.7 cm. Schr.	126
9 cm. Schr. 82	128
9 cm. Schr. 91 (and variation)	130
10 cm. Schr. 96	132
12 cm. Schr. 80/92	134
13 cm. Schr.	136
15 cm. Schr. 80/92	138
15 cm. Schr. 92 (and 90/92)	140
15 cm. Schr. 03	142
15 cm. Schr. 03 (gr.)	144
15 cm. Schr. 07	146
15 cm. Schr. (? pattern)	148
21 cm. Schr. 89	150
21 cm. Schr. 04	152

Minenwerfer Projectiles.

7.5 cm. l.W.M.	160
7.5 cm. l.W.M. (gas shell)	162
17 cm. m.W.M.	164
17 cm. m.W.M. (gas shell)	166
17 cm. m.W.M. (incendiary shell)	168
25 cm. s.W.M. (long pattern)... ..	170
25 cm. s.W.M. (short pattern)	172

Table of Shells arranged according to Colour and Calibre.

NOTE.—Shells printed in **heavy** type are those in common use.

Colour.*	Shell.	Page.
<i>Calibre—3·7 cm.—1·46 inches.</i>		
Black	3·7 cm. Gr.	32
<i>Calibre—5·3 cm.—2·09 inches.</i>		
Black	5 cm. Gr.	34
<i>Calibre—7·7 cm.—3·03 inches.</i>		
Blue	7·7 cm. Schr.	126
Blue, yellow head ...	7·7 cm. Gr. 96	36
Grey	7·7 cm. Universal shell (chiefly used with anti-aircraft guns) ...	38
Grey, yellow head ...	K. Gr. 15	42
Red	K. Gr. 14	40
Yellow, blue head ...	7·7 cm. Gr. 96 (of less recent date)...	36
<i>Calibre—8·8 cm.—3·46 inches.</i>		
Black, red head ...	9 cm. Gr. 82†	44
Blue	9 cm. Gr. 88 (variation of)† ...	46
	9 cm. Schr. 91	130
Red	9 cm. Gr. 88 (variation of)† ...	46
	9 cm. Schr. 82	128
Yellow, blue head ...	9 cm. Gr. 88	46

* A black or white ring, 3 cm. wide, painted round the head of certain shells merely indicates the quality of the explosive, as does also a white "A" stencilled on the head.

† Now being used on the British front, though not in large numbers.

Colour.*	Shell.	Page.
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Calibre—10.5 cm.—4.13 inches.

Blue	{ 10 cm. Gr. 96 56
	{ 10 cm. Schr. 96 (of less recent date) ... 132
Blue, red ring round centre† ...	10 cm. Schr. 96 132
Blue, yellow head ...	L.F.H. Gr. 54
Grey	{ 10.5 cm. Universal Shell 48
	{ 10 cm. Gr. 14 60
Grey, red head ...	L.F.H. Gr. (of less recent date)† ... 54
Grey, yellow head ...	H. Gr. 15 52
Red	{ H. Gr. 14 50
	{ 10 cm. Gr. 14 A 62
Yellow, blue head ...	10 cm. Gr. 58

Calibre—12.03 cm.—4.73 inches.

Red	12 cm. Schr. 80/92½ 134
Yellow	12 cm. Gr. 88 a/A 64

Calibre—13.5 cm.—5.31 inches.

Blue	13 cm. Gr. (of less recent date) (base fuze) 66
Blue, 2 red rings round centre† ...	13 cm. Gr. (base fuze) 66
Grey	{ 13 cm. Gr. 14 68
	{ 13 cm. Schr. (of less recent date)† ... 136
Grey, 2 red rings round centre† ...	13 cm. Schr. 136

* A black or white ring, 3 cm. wide, painted round the head of certain shells merely indicates the quality of the explosive, as does also a white "A" stencilled on the head.

† Shells of less recent manufacture do not have these red rings.

‡ Now being used on the British front, though not in large numbers.

Colour.*	Shell.	Page.
<i>Calibre—14.97 cm.—5.89 inches.</i>		
Blue	15 cm. Gr. 83	72
	15 cm. Gr. 96	76
	15 cm. Gr. 03	78
	15 cm. Gr. 04	80
	15 cm. Gr. 06 (base fuze)	82
	15 cm. Schr. 92	140
	15 cm. Schr. 90/92	140
	15 cm. Schr. 03 (of less recent date)	142
Blue, red ring round centre.†	15 cm. Schr. (? pattern)	148
	15 cm. Schr. 03	142
Grey	15 cm. Gr. 12	84
	15 cm. Gr. 14 (of less recent date)	88
	15 cm. Schr. 03 (gr.) (of less recent date)	144
Grey, red ring round centre.†	15 cm. Schr. 07	146
	15 cm. Gr. 14	88
Grey, black head and black "T"	15 cm. Schr. 03 (gr.)	144
Grey, yellow head and yellow "K"	15 cm. Gr. 12 (gas shells)	86
Red	15 cm. Gr. 14 A. (of less recent date)	90
	15 cm. Brand. Gr. ‡	92
	15 cm. Schr. 80/92	138
Red, red ring round centre.†	15 cm. Gr. 14 A	90
Red, yellow head ...	15 cm. Gr. 80 (of less recent date)	70
Yellow	15 cm. Gr. 80	70
Yellow, blue head ...	15 cm. Gr. 88	74

Calibre—20.93 cm.—8.24 inches.

Blue	21 cm. Gr. 06 (base fuze)	104
	21 cm. Schr. 04	152
	21 cm. Schr. 89 (with upper driving band)	150
Red	21 cm. Schr. 89 Ec. (with no upper driving band)	150
	21 cm. Gr. 80 (of less recent date)	94
Red, yellow head ...	21 cm. Gr. 80	94
Yellow	21 cm. Gr. 80	94

* A black or white ring, 3 cm. wide, painted round the head of certain shells merely indicates the quality of the explosive, as does also a white "A" stencilled on the head.

† Shells of less recent manufacture do not have these red rings.

‡ Usually marked "Brand-Gr." in black letters.

Colour.*	Shell.	Page.
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Calibre—21.1 cm.—8.3 inches.

Blue ...	{	21 cm. Gr. 83 ...	96
		21 cm. Gr. 96 (base fuze) ...	100
		21 cm. Gr. 96, <i>ung.</i> (base fuze) ...	100
		21 cm. Gr. 96, <i>nicht geänderte</i> ...	100
Grey ...	{	21 cm. Gr. 96 n/A. (base fuze) ...	102
		21 cm. Gr. 14 ...	106
Red ...		21 cm. Gr. 14 A ...	108
Yellow, blue head ...		21 cm. Gr. 88 ...	98

Calibre—28.0 cm. (?)—11.02 inches (?).

Blue ...	28 cm. Gr. 06 (base fuze) ...	110
(Colour ?) ...	28 cm. Gr. (12 ?) ...	112
(Colour ?) ...	28 cm. Gr. (pattern ?) ...	114

Calibre—38 cm. (?)—14.96 inches (?).

(Colour ?) ...	38 cm. Gr. (base fuze) ...	116
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Calibre—42 cm. (?)—16.53 inches (?).

(Colour ?) ...	42 cm. Gr. (base fuze) ...	118
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* A black or white ring, 3 cm. wide, painted round the head of certain shells merely indicates the quality of the explosive, as does also a white "A" stencilled on the head.

Table showing particulars of Rifling of German Guns and Howitzers,
and nature of Shells employed.

Name.	Calibre. cm.	Rifling.					Shell.	Shrapnel.
		Pitch.	Grooves.			Width. mm.		
			Num- ber.	System. P = plain. H = hook.	Depth. mm.			
3·7 cm. Revolver Gun* 3·7 cm. Rev. K.	3·7	6°	12	P	0·4	7·824	3·7 cm. Gr.	
5 cm. Gun on Shielded Mount- ing (or on Case- mate Mounting)* 5 cm. K. (i. P. L.) or 5 cm. K. (i. Kas. L.)	5·3	1° 11' to 5° 56'	24	P	0·4	5·23	5 cm. Gr.	

* These guns also fire case-shot.

Name.	Calibre. cm.	Rifling.					Shell.	Shrapnel.
		Pitch.	Grooves.					
			Num- ber.	System. P = plain. H = hook.	Depth. mm.	Width. mm.		
7.7 cm. Field Gun, '96 n/A. (or on C a s e m a t e Mounting)* <i>F.K. 96 n/A. or 7.7 cm. K. (i. Kas. L.)</i>	7.7	4°-7° 9'	32	P	0.75	5.06	7.7 cm. Gr. 96 7.7 cm. Ein- heits - Ges- choss <i>K. Gr. 14 K. Gr. 15</i>	7.7 cm. Schr.
(10.5 cm.) Light Field Howitzer <i>l. F.H.</i>	10.5	5°-12°	32	P	1.25	6.8	10.5 cm. Ein- heits - Ges- choss 05 <i>H. Gr. 14 H. Gr. 15 L.F.H. Gr.</i>	
9 cm. Gun '73/'88 or '73* <i>9 cm. K. 73/88 or 9 cm. K. 73</i>	8.8	3 10'	24	H	1.25	8.5-8.6	9 cm. Gr. 82 9 cm. Gr. 88	9 cm. Schr. 82 9 cm. Schr. 91

10 cm. Gun '14 ... 10 cm. K. 14	10.5	—	—	—	—	—	10 cm. Gr. 96 10 cm. Gr. 10 cm. Gr. 14 10 cm. Gr. 14 A.	10 cm. Schr. 96
10 cm. Gun '04 ... 10 cm. K. 04	10.5	4°-8°	32	P	1.25	6.8		
10 cm. Gun* ... 10 cm. K.	10.5	4°-8°	32	P	1.25	6.8		
10 cm. Gun on Carriage with Overhead Shield (or in Turret)* 10 cm. K. (i. S.L.) or 10 cm. T.K. or K. 10 cm. T.K.	10.5	4°-7° 10'	32	P	1.25	6.8		
10 cm. Gun, Reinforced, in Turret* 10 cm. T.K. (verst.)	10.5	4°-7° 10'	32	P	1.25	6.8		
12 cm. Heavy Gun s. 12 cm. K.	12.03	4°	30	P	1.3	8.4	12 cm. Gr. 88 a/A.	12 cm. Schr. 80/92

* These guns also fire case-shot.

Name.	Calibre. cm.	Rifling.					Shell.	Shrapnel.
		Pitch.	Grooves.					
			Num- ber.	System. P = plain. H = hook.	Depth. mm.	Width. mm.		
13 cm. Gun <i>13 cm. K.</i>	13.5	about 7°	36	P	about 1.3	about 7	13 cm. Gr. 13 cm. Gr. 14	13 cm. Schr.
15 cm. Gun with Chase Rings (or with Chase Rings and Over- head Shield) <i>15 cm. R.K. or 15 cm. R.K. (i. Min. S.L.)</i>	14.97	3° 4'	24	H	1.6	16.3-12.3	15 cm. Gr. 80	15 cm. Schr. 80/92
15 cm. Long Gun with Chase Rings <i>lg. 15 cm. R.K.</i>	14.97	3° 10'	24	H	1.6	17-14.5		
15 cm. Long Gun <i>lg. 15 cm. K.</i>	14.97	3°-7°	36	P	1.5	9.5	15 cm. Gr. 88 15 cm. Gr. 96	15 cm. Schr. 90/92 15 cm. Schr. 92 15 cm. Schr. 07

15 cm. Coast Defence Gun '07 <i>15 cm. K. (i. Kst. L.)</i>	14-97(?)	—	—	—	—	—	15 cm. Gr. 06	15 cm. Schr. 03 15 cm. Schr. 03(gr.)
15 cm. Gun with Overhead Shield <i>15 cm. K. (i. S.L.)</i>	14-97(?)	—	—	—	—	—	15 cm. Gr. 03 15 cm. Gr. 06	15 cm. Schr. 03 15 cm. Schr. 03(gr.)
15 cm. Heavy Field Howitzer '13 <i>s. F.H. 13</i>	14-97	—	—	—	—	—	15 cm. Gr. 83 15 cm. Gr. 88 15 cm. Gr. 96 15 cm. Gr. 04 15 cm. Gr. 12 15 cm. Gr. 14 15 cm. Gr. 14A 15 cm. Brand-Gr.	
15 cm. Heavy Field Howitzer '02 <i>s. F.H. 02</i>	14-97	6°-13°	36	P	1.3	9.5		
15 cm. Heavy Field Howitzer <i>s. F.H.</i>	14-97	4°-12°	36	P	1.3	9.5		
15 cm. Howitzer in Turret <i>15 cm. T.H.</i>	14-97	4°-12°	36	P	1.3	9.5		15 cm. Gr. 88
15 cm. Heavy Coast Defence Howitzer	14-97	—	—	—	—	—		15 cm. Gr. 88

Name.	Calibre. cm.	Rifling.					Shell.	Shrapnel.
		Pitch.	Grooves.					
			Num- ber.	System. P=plain. H=hook.	Depth. mm.	Width. mm.		
21 cm. Jacketed Gun <i>21 cm. Mtl. K.</i>	20.93	2° 10'	30	H	2.6	18.5-14.6	21 cm. Gr. 80	21 cm. Schr. 89
21 cm. Gun with Chase Rings <i>21 cm. R.K.</i>	20.93	2° 10'	30	H	2.6	18.5-14.6	21 cm. Gr. 80 21 cm. Gr. 06	21 cm. Schr. 04
21 cm. Howitzer in Turret <i>21 cm. T.H.</i>	20.93	2°-10°	30	P	2.4	15.5	21 cm. Gr. 80	21 cm. Schr. 89 Ec.
21 cm. Bronze Mortar <i>21 cm. Br. Mrs.</i>	20.93	2°-12°	30	P	2.4	15.5	} 21 cm. Gr. 83 21 cm. Gr. 88 21 cm. Gr. 96	
21 cm. Bronze Mortar, with Overhead Ignition <i>21 cm. Br. Mrs. (M. Ozdg.)</i>	20.93	2°-12°	30	P	2.4	15.5		

21 cm. Bronze Coast Defence Mortar	—	—	—	—	—	—	21 cm. Gr. 06
21 cm. Mortar ... 21 cm. Mrs. (older pattern)	21.1	5° 8' to 11° 50'	64	P	1.5	6.85	21 cm. Gr. 82 21 cm. Gr. 88 21 cm. Gr. 96 21 cm. Gr. 96 n/A. 21 cm. Gr. 14 21 cm. Gr. 14A
Mortar ... Mrs. (latest pattern)	21.1	—	—	—	—	—	
23 cm. Howitzer on Travelling Carriage	28.0 (?)	—	—	—	—	—	
23 cm. Coast De- fence Howitzer 28 cm. Kst. H. (i. Kst. H.L.)	28.0 (?)	—	—	—	—	—	
38 cm. Gun ...	38.0 (?)	—	—	—	—	—	
42 cm. Mortar ...	42.0 (?)	8° 30'	120	—	—	—	42 cm. Gr.

Marks on German Shells.

The majority of German shells are marked on the base with the number of the shell, the manufacturer's mark, and the year of manufacture, and also with various other marks which probably indicate the batch number, or the inspector's number, all these marks being stamped into the metal of the base.

The following are typical examples :—

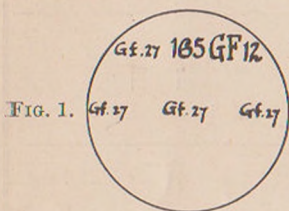


FIG. 1.

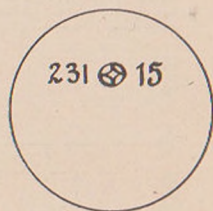


FIG. 2.

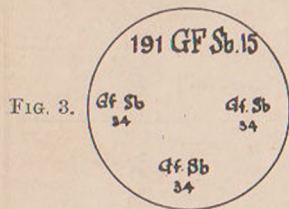


FIG. 3.

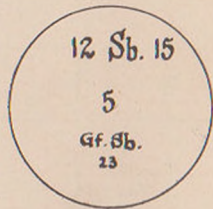


FIG. 4.

In Fig. 1, 165 represents the serial number of the shell (another shell fired on the same day was found bearing identical marks, except that the serial number was 166); GF represents the factory; 12 represents 1912, the year of manufacture; Gf. 27 is probably either a batch number or an inspector's mark.

In Fig. 2, 231 = serial number.

 = factory mark.

15 = year of manufacture.

In Fig. 3, 191 = serial number.
 GF Sb. = factory mark (Geschoss-Fabrik, Strassburg).
 15 = year of manufacture.
 Gf. Sb. = batch number or inspector's mark.
 34

In Fig. 4, 12 = serial number.
 Sb. = factory mark (Strassburg).
 15 = year of manufacture.
 Gf. Sb. = batch number or inspector's mark.
 23

Marks similar to the above are also found stamped on the cylindrical portion of the shell in some instances.

Another mark, which frequently occurs on the cylindrical portions of H.E. shells of recent manufacture, is $\text{Fp. } \frac{60}{40}$ (i.e., *Full-pulver* 60 : 40), indicating that the shell is filled with an explosive mixture containing 40 per cent. of T.N.T.

In addition to the above marks, some German shells are also marked with bands or rings of various coloured paints. The significance of these coloured rings is given under the heading "Distinctive markings," in the description of the shells concerned.

Abbreviations used in connection with German Guns and Ammunition.

Abbreviation.	Signification.	English equivalent.
a/A. ...	alter Art ...	Of old pattern.
Az. ...	Aufschlag-Zünder ...	Percussion fuze.
Bl. ...	Blind ...	Blind.
Bz. ...	Brenn-Zünder ...	Time fuze.
Bd. G. ...	Brand-Geschoss ...	Incendiary shell.
Br. Mrs. ...	Bronze-Mörser ...	Bronze mortar.
Bd. Z. ...	Boden-Zünder ...	Base fuze.
C/92 ...	Construction/92 ...	1892 pattern.
D.Z. ...	} Doppel-Zünder ...	Time and percussion fuze.
Dopp. Z. ...		
Ec. ...	Eisen-Centrifugation ...	With rear driving band only.
f. 10 cm. K. ...	für 10 cm. Kanone ...	For 10 centimetre gun.
Fest. ...	Festung ...	Fortress.
F. Gr. ...	Feld-Granate ...	Field gun H.E. shell.
F.H. ...	Feld-Haubitze ...	Field howitzer.
F.K. ...	Feld-Kanone ...	Field gun.
F. Patr. ...	Feld-Patrone ...	Field gun cartridge (fixed ammunition).
Fp. 02 ...	Füllpulver 02... ...	1902 pattern explosive (T.N.T.).
G. ...	Granate ...	H.E. shell.
Gesch. ...	{ Geschütz ...	Gun.
	{ Geschoss ...	Projectile.
Gr. ...	Granate ...	H.E. shell.
Gr. 88 ...	Granatfüllung 88 ...	1888 pattern explosive (picric acid).
Gel. ...	Geladen ...	Loaded.
Gf. ...	{ Geschütz-Fabrik ...	Gun factory.
	{ Geschoss Fabrik ...	Shell factory.
G-g. ...	Granate-Geschoss ...	H.E. shell.
Gr. Z. ...	Granat-Zünder ...	Fuze for H.E. shell.
H. Gr. ...	Haubitz-Granate ...	Howitzer shell.
H.Z. ...	Haubitz-Zünder ...	Howitzer fuze.
i. Kas. L. ...	in Kasemattenlafette ...	On casemate mounting.
i. Kst. L. ...	in Küstenlafette ...	On coast defence mounting.
i. P.L. ...	in Panzerlafette ...	On shielded mounting.
i. S.L. ...	in Schirmlafette ...	On carriage with overhead shield.
Iz. ...	Innen-Zünder... ...	Internal fuze.

Abbreviation.	Signification.	English equivalent.
K. ...	Kanone ...	Gun.
K. ...	Kürzer ...	Shorter.
K. ...	Kartätsche ...	Case shot.
Kt. ...		
Kart. ...	Kartusche ...	Cartridge.
K. Gr. ...	Kanonen-Granate ...	Gun shell.
Kst. ...	Küste ...	Coast (defence).
Kst. Mrs. ...	Küsten-Mörser ...	Coast defence mortar.
Kst. H. ...	Küsten-Haubitze ...	Coast defence howitzer.
Kst. K. ...	Küsten-Kanone ...	Coast defence gun.
K.Z. ...	Kanonen-Zünder ...	Gun fuze.
Kz. ...	Kopf-Zünder ...	Nose fuze.
Kz. Bd. Z. ...	Kurzer Boden-Zünder ...	Short base fuze.
L. ...	Leicht (e-er) ...	Light.
L. ...	Länger ...	Longer.
Lg. Bd. Z. ...	Langer Boden-Zünder ...	Long base fuze.
Lg. Brlg. ...	lange Brennlänge ...	Long burning (fuze).
Lggr. ...	Langgranate ...	Long shell.
l. W. M. Zdr. ...	leichter Wurf-Mine-Zünder ...	Fuze of light "Minenwerfer."
L/40, &c. ...	Used in the nomenclature of guns to indicate that the length is 40, &c., calibres	
L/3.1, &c. ...	Used in the nomenclature of projectiles to indicate that the length is 3.1, &c., calibres.	
Mdleh. ...	Mundlochbüchse ...	Old pattern type of fuze.
Mdleh. ...	Mundlochfutter ...	Gain.
m. Ozdg. ...	mit Oberzündung ...	With overhead ignition.
Mrs. ...	Mörser ...	Mortar.
Mtl. K. ...	Mantel-Kanone ...	Jacketed gun.
M.V. ...	Mit Verzögerung ...	With delay action.
n/A. ...	neuer Art ...	Of new pattern.
O.V. ...	Ohne Verzögerung ...	Without delay action (direct action).
P. ...	Pulver ...	Powder (usually black powder).
Patr. ...	Patrone ...	Cartridge (fixed ammunition).
Rev. K. ...	Revolver-Kanone ...	Revolver gun.
R. K. ...	Ring-Kanone ...	Gun with chase rings
H. ...	Schwer (e-er) ...	Heavy.
H. ...		
Hsh. ...	Schrapnel ...	Shrapnel.
Hshr. ...		
Hek. ...	Sekunden ...	Seconds.
Hprgr. ...	Spreng-Granate ...	H.E. shell.
T. H. ...	Turm-Haubitze ...	Howitzer in turret.
T. K. ...	Turm-Kanone ...	Gun in turret.

Abbreviation.	Signification.	English equivalent.
U. ...	Unterrichts ...	Instructional.
Üb. ...	Übungs ...	Practice.
Übgr. ...	Übungsgranate ...	Practice shell.
Üb. Ldg. ...	Übungsladung ...	Practice charge.
Umg. ...	Umgeändert or umgearbeitet ...	Converted.
92 umg. ...	1892 umgeändert ...	} 1892 pattern converted.
92 transf. ...	1892 transformiert (?) ...	
Verst. ...	Verstärkt ...	Strengthened.
V.K. ...	Verkürzte Kammerhülse ...	Shortened central tube (of shrapnel. See page 131).
Vrst. ...	} Vorstecker ...	Safety pin (on fuze).
Vst. ...		
Vorst. ...		
Z.... ...	} Zünder ...	Fuze.
Zdr. ...		
Zdg. ...	Zündung ...	Fuze.
Zldlg. ...	} Zündladung ...	Exploder.
Zdlg. ...		
Z.m. W.M. ...	Zünder mittlerer Wurf-Mine	Fuze of medium "Minenwerfer."
Z.s.W.M. ...	Zünder schwerer Wurf-Mine	Fuze of heavy "Minenwerfer."
Z.s.u.m. W.M. ...	Zünder schwerer und mittlerer Wurf-Mine.	Fuze of heavy and medium "Minenwerfer."

Explosives used in German Shells.

In addition to the black powder used in the bursting charges of shrapnel shells, the regulation explosives used by the Germans are *Granatfüllung 88* (*Grf. 88*) or Picric Acid, and *Füllpulver 02* (*Fp. 02*) or Trotyl (T.N.T.)*

Granatfüllung 88, or Picric Acid, is either crystalline or in the form of a fine powder; it is bright yellow in colour, is slightly soluble in water which it colours very strongly; it stains the skin yellow, has an intensely bitter taste, and the fine powder if breathed into the nose, induces sneezing. For the bursting charges of German shells, this explosive has been almost entirely replaced by *Füllpulver 02* (i.e., "Trotyl" or T.N.T.) or a mixture of T.N.T. and other substances, but it is still used for exploders, in the gages of fuzes, &c.

When used for filling shells, it is usually melted (by heat) and poured in; this cast form of Picric Acid is known in England as Lyddite.

The explosive effect is slightly greater than that of an equal weight of compressed wet gun-cotton, and still greater than that of an equal bulk.

Specific gravity.—1.63 grammes per cubic centimetre, as cast into shell, or 1.65 at 10 tons per square inch.

Melting point.—Pure Picric Acid melts at 121.6° C., but the usual form melts at about 120° C.

Colour of smoke produced.—See under "*Füllpulver 02.*"

Remarks.—Picric Acid forms very sensitive compounds with most heavy metals, in particular lead; it must be kept from contact with lead, lead salts, or any material or mixture containing lead or its compounds.

Füllpulver 02, or T.N.T., is crystalline, nearly white in colour (usually a brownish white), almost insoluble in water, but is soluble in hot alcohol or in benzol. T.N.T. is either melted and poured into the shell, in which case it is termed "cast Trotyl," or it is used in the form of powder which is pressed or "stemmed" in.

* This explosive is variously called Tri-nitro-toluol, Tri-nitro-toluene, Trinol, Tritolo, and Tolite.

The explosive effect is slightly less than that of Picric Acid.

Specific gravity.—About 1.55 grammes per cubic centimetre as cast into the shell, or 1.58 at 10 tons per square inch.

Melting point.—Pure T.N.T. melts at 81° C.

Colour of smoke produced.—The smoke produced by the detonation of either Picric Acid or T.N.T. is nearly black; when exploded only, the colour of the smoke produced by T.N.T. is white to blue-grey; by Picric Acid—yellow.

Remarks.—Trotyl (T.N.T.) has none of the disadvantages of Picric Acid, viz., its liability to form very sensitive compounds with lead and most heavy metals.

Other explosives.—Other explosives now being used in German shells are Astralite, Amatol, Di-nitro-benzol, Tri-nitro-anisol, and a mixture of Tri-nitro-anisol and Ammonium Nitrate.

Astralite is yellowish-grey in colour and usually consists of Ammonium Nitrate, Woodmeal, Dinitrotoluene with traces of T.N.T., a small amount of Nitroglycerine and usually some Nitro-cellulose.

Owing to the presence also of traces of Nitrotoluenes and Nitrobenzene, this mixture possesses an almond-like smell, which is frequently mistaken for that of Prussic Acid.

This explosive is more usually employed in trench mortar projectiles, &c., than in shell though some 7.7cm. shell have been found containing it.

Explosive effect.—It is fairly powerful, but not of excessive violence.

Specific gravity.—Varies, owing to the plastic nature of the mixture.

Amatol is crystalline and yellow in colour, and is a mixture of Ammonium Nitrate and T.N.T. in varying proportions, e.g., 70/30 indicates 70 per cent. Ammonium Nitrate and 30 per cent. T.N.T.

Explosive effect.—It is powerful and fairly violent.

Specific gravity.—Varies with proportions of constituents, and also with degree of compression.

Dinitrobenzene (Dinitrobenzol) is a pale yellow crystalline substance, nearly white when pure. The pure substance melts at 89.8° C., but the product generally used melts at about 80° C. It is very slightly soluble in water, more soluble in alcohol and benzene.

Dinitrobenzene is not generally used alone in shell, its explosive properties being poor. It is sometimes used in admixture with Ammonium Nitrate, but this mixture is inferior to Amatol in its explosive effect. The specific gravity of Dinitrobenzene is about the same as that of Trotyl.

Trinitroanisol is a greenish-yellow compound melting at 64° C. when pure. The product used in German bombs is not very pure, and melts at a considerably lower temperature. It is usually cast into the bombs, and forms a soft mass of large crystals with a greasy appearance.

It is readily decomposed by moisture, giving Picric Acid and Methyl Alcohol, so that the same precautions against the presence of lead, &c., have to be taken as in the case of Picric Acid. This explosive does not appear to be used very frequently in German shells or bombs.

Explosive properties.—These are similar to those of Picric Acid, except that Trinitroanisol is somewhat more difficult to detonate.

Nitrolite or Trinitroanisol and Ammonium Nitrate.—This mixture has been found in a Minenwerfer projectile, the proportion being 65 per cent. Trinitroanisol, and 35 per cent. Ammonium Nitrate.

Gas Shells.

Description.—Gas shells fired from German howitzers and Minenwerfer contain a lead receptacle filled with liquid, in the cylindrical portion, and a small bursting charge in the head. Scattered by the force of the explosion, the liquid evaporates. According to the nature of the gas thus formed, the various liquids employed may be classed under one or both of the following headings :—

- (1) *Lachrymatory*, or those which primarily attack the eyes, although, when the vapour is concentrated, the lungs may be affected and vomiting produced.
- (2) *Asphyxiating*, or those which primarily attack the lungs, and also, to a certain extent, the eyes.

Of the liquids employed, benzyl bromide and xylyl bromide (both lachrymatory) evaporate slowly. The gas formed is very heavy and hangs low over the ground, like mist, lodging in woods, hollows, trenches, shelters and cellars. Its irritant effect may sometimes be felt for hours.

Bromethylmethylketone (lachrymatory) is more powerful at first than the above, but the liquid, being more volatile, its gas dissipates more rapidly.

Chlormethylchloroformate (lachrymatory and asphyxiating) is a strong irritant. It is, however, much more volatile and less dense than either of the above, and so dissipates more rapidly.

According to a German document, much moisture in the air favours the employment of gas shells; heavy rain reduces the effect; severe cold precludes their use.

There is a remark in the same document to the effect that the bursts of gas shells are no more difficult to observe than those of ordinary shells, and that the amount of smoke produced by the explosion is identical.

Employment.—The tactical employment of a gas shell depends upon the nature of the gas liberated by its explosion.

In the case of 15 cm. shell :—

T Shell (benzyl bromide and xylyl bromide) are used against a position or an area which it is not desired to occupy, but the use of which is to be denied to the enemy for some time.

K Shell (chlormethylchloroformate) are used when it is intended to drive the enemy quickly from a position, with a view to its occupation.

PARTICULARS OF GAS SHELLS.

Shell.	Liquid employed.		Colouring of shell.	For tails pag
	Nature.	Volume.		
<i>Minenwerfer :</i>		Cub. cent.		
7.5 cm. ...	Chlormethyl- chloroformate (A. & L.)	460	Grey, with 2 white bands.	16
17 cm. ...	Chlormethyl- chloroformate (A. & L.)	7,700	Grey, with 2 yellow bands.	16
17 cm. ...	Bromethyl- methylketone (L.)	?	Grey (yellow head?).	-
<i>Howitzer :</i>				
10.5 cm. (Long Shell)	Benzyl bromide and xylol bromide (L.)	?	?	-
15 cm. (1912 Pat- tern Shell)	Benzyl bromide and xylol bromide (L.)	2,350	Grey, with black head, and black T below head.	8
15 cm. (1912 Pat- tern Shell)	Chlormethyl- chloroformate (A. & L.)	2,350	Grey, with yellow head and yellow (black?) K below head.*	8

(A.) = Asphyxiating.

(L.) = Lachrymatory.

* K2 is marked in black lettering on the lead container of one variety of this shell.

Incendiary Shells.

The shells used by the Germans for incendiary purposes are the incendiary shells proper, viz., the 15-cm. *Brand-Granate*, the 15-cm. *Gr. 14 A* with celluloid filling, the 13-cm. *Gr.* with thermite filling, and the *Mittlere Wurf-Mine* with sodium and thermite filling, and various shrapnel shell which produce incendiary effect, e.g., 15-cm. *Schr. 03 (gr.)* (see page 144), 13-cm. *Schr.* (see page 136), and 10-cm. *Schr. 96* (see page 132).

The last two shells have moderate incendiary effect when fired as percussion shrapnel, but their action is not certain. The German instructions lay down that, under favourable conditions, common shell and shrapnel of other patterns may produce incendiary effect, either by the flame from the fuze or the flash of the burst, but this effect cannot be relied on.

The inflammable material employed in the 15-cm. *Brand-Granate* consists of a celluloid-camphor composition and yellow phosphorus (see page 92), and a similar filling is sometimes employed in the 15-cm. *Gr. 14 A* (see page 90).

In the case of the 13-cm. *Gr.* and the *Mittlere Wurf-Mine*, thermite is employed (see pages 66 and 168). An analysis of the thermite composition in the latter shell gave the following results:—

	per cent.
Magnetic oxide of iron	23.9
Aluminium... ..	11.2
Manganese dioxide	34.4
Lead sulphide	21.0
Silicon	4.2
Sulphur in combination, probably with iron.	5.6
Total... ..	100.3

This thermite composition is employed to melt and ignite metallic sodium.

Shells used with Captured Guns.

The Germans are manufacturing shells specially designed for use with captured guns. The majority of these shells appear to be painted yellow in the case of the 15 cm. guns, and sometimes have one or more black bands painted round the nose or centre of cylindrical portion.

The charge is usually T.N.T., and is contained in a cardboard case bearing a label, of which the following is a typical example :—

Sprengladung f. franz. 155 mm. K.
Fp. 02 Schlebusch 1915. Lief. 86
Hanau 1915. L. 4.

i.e., Charge for French 155 mm. Gun. Charge consists of *Fp. 02* (*i.e.*, T.N.T.) manufactured at Schlebusch in 1915, Batch No. 86. Charge made up at Hanau in 1915, Batch No. 4.

Naval Shells.

Details of German naval shells cannot be given in these "Notes," but a few general remarks will not be out of place, as there are many naval and coast defence guns, etc., along the coast of Belgium, some of which may be employed against the British front.

The following table contains certain particulars of the nature and marking of naval projectiles :—

Nature.	German Name.	Colour.*	Used with
Steel shot ...	<i>Stahlvollgeschoss</i>	Light-blue ...	Practically all guns of 15 cm. and upwards.
Armour-piercing shell.	<i>Ps-Granate</i> ...	Blue, with yellow head.	All modern guns of 15 cm. and upwards.
Substitute A.P. shell†	<i>Ersatz Ps-Granate</i>	Yellow‡ ...	28 cm. and 30·5 cm. guns.
H.E. Shell ...	<i>Spreng-granate</i> ...	Yellow ...	All guns of 8·8 cm. and upwards, except 24 cm.
Practice H.E. and common shell (cast iron)	<i>Granate</i> ...	Red§ ...	All guns of 8·8 cm. and upwards.
Shrapnel ...	<i>Stahlschrapnel</i> ...	Blue ...	Practically all 10·5 cm., 15 cm., and 17 cm. guns.

* In addition to the distinctive colours given in this column, every German naval shell has a black lacquer ring round the shoulder, and every "filled" naval shell has the nose painted black.

† The heads of these shells are cast in one piece and have practically the same contour and give the same ballistics as the capped armour-piercing shell; the capacity for the bursting charge is also the same as that of the A.P. shell, but for practice purposes they are used with a small blowing charge only. They have a groove round the head, about midway between point and shoulder, corresponding to the lower extremity of the cap of the A.P. shell.

‡ A black ring above the upper driving band denotes that the shell is filled with an H.E. practice bursting charge.

§ A yellow ring below the shoulder denotes that the shell is filled with an H.E. practice bursting charge.

Of the above, the H.E. shells are those most likely to be encountered. The total weights of these shells and of their bursting charges are, as a rule, smaller than those of the corresponding shells used in the German Army, and the naval shells have a greater range.

The fuzes employed differ from those of the Army shells, and comprise nose, base, and internal fuzes.

Certain 15 cm. H.E. shells which are occasionally fired against the British front are filled with T.N.T., which is contained in a cardboard case bearing a label of which the following is a typical example:—

Einteilige Sprengladung für 15 cm. Sp. Gr.
L/3·1 (Kz.)
2·940 kg. Fp. c/02 Rdf. Lief. 112/14
gefertigt Reinsdorf 1915 II Lief.

i.e., Single charge for 15 cm. H.E. shell, length of which is 3·1 calibres (nose fuze): 2·940 kg. of *Füllpulver 02* (*i.e.*, T.N.T.) manufactured at Reinsdorf in 1914, Batch No. 112: made up at Reinsdorf in 1915, Batch No. II.

These shells are painted yellow, with a black ring round shoulder, and have special percussion nose fuzes of a simple type (direct action only) which are marked "Sp. gr."

It seems probable that these are fired from a naval 15 cm. L/40 Q.F. gun, or possibly the older pattern 15 cm. L/35 Q.F. gun.

3·7 cm. Revolver Gun Common Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
3·7 cm. Gr. (fixed ammunition)	3·7 cm. Revolver Gun. (Rifling, 12 grooves)	3·7 cm. Gr. Z.	yards. —	yards. 3,280

Material—Cast iron.

Weight—

Shell complete, 0·46 kg. (1·01 lb.).

Bursting charge, 0·023 kg. (0·05 lb.). Black powder.

Employment—*Principal object* : bombardment of trenches.

Sufficient effect at living targets. This shell replaces case shot at ranges exceeding 330 yards. It requires 60 rounds to destroy temporary cover,* such as hastily piled sandbags.

Remarks—This shell has apparently been replaced by a new pattern steel H.E. shell (a drawing of which is shown opposite) which has been used on the British front.

The steel shell has a screwed-in base, the walls are 5 mm. thick, and there is only one driving band.

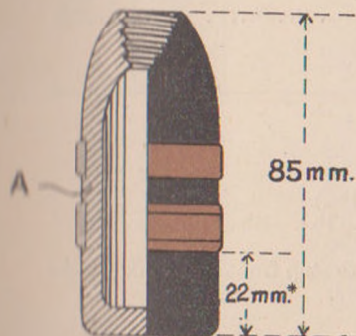
For range table, see Appendix I.

* The amount of this cover is not stated.

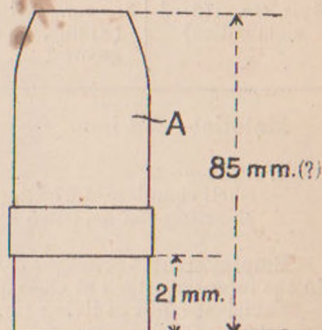
3.7 cm. Gr.

Calibre, 3.7 cm. (1.46").

OLD PATTERN.

SCALE - $\frac{1}{2}$.

NEW PATTERN (STEEL).

SCALE - $\frac{1}{2}$.

Thickness of walls—

At A, 5 mm.*

Thickness of base—8 mm.*

Width of driving bands—

Upper band, 9 mm.,* lower, 12 mm.*

Distinctive markings—

* These measurements are only approximate, as they have been taken from small-scale drawings, and have not been verified by actual measurement of the shell itself. Throughout this book measurements marked with an asterisk are merely approximate for the reason just given.

(n 11938)

C

5 cm. Gun Common Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
5 cm. Gr. (fixed ammunition)	5 cm. Gun. (Rifling, grooves) 24	5 cm. Gr. Z...	yards. —	yards. 3,280

Material—Cast iron.

Weight—

Shell complete, 1·67 kg. (3·68 lbs.).

Bursting charge, 0·085 kg. (0·19 lb.). Black powder.

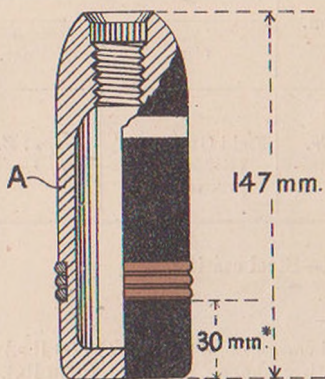
Employment—*Principal object*: to stop front and flank attacks in the infantry attack at close quarters.

Sufficient effect at living targets.

Remarks—

5 cm. Gr.

Calibre, 5.3 cm. (2.09")

SCALE - $\frac{1}{3}$.

Thickness of walls—

At A, 6 mm.*

Thickness of base—12 mm.*

Width of driving band—13 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1896 Pattern Field Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>F. Gr. Patr.</i> (fixed ammunition)	Field Gun 96 n/A. (Rifling, 32 grooves)	<i>Dopp. Z. 96</i> <i>n/A</i>	yards. 5,850*	yards. 9,186

Material—Steel casting.

Weight—

Shell complete, 6·825 kg. (15·06 lbs.)

Bursting charge, 0·165 kg. (0·36 lb.). *Grf. 88* (picric acid, stemmed in).

Employment—*With percussion fuze*: destruction of targets capable of offering resistance (shielded batteries in the open at close ranges), against troops in tall timbered woods, as well as living targets beyond the maximum range with time fuze.

With time fuze: against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), and aeroplanes, especially at long ranges.

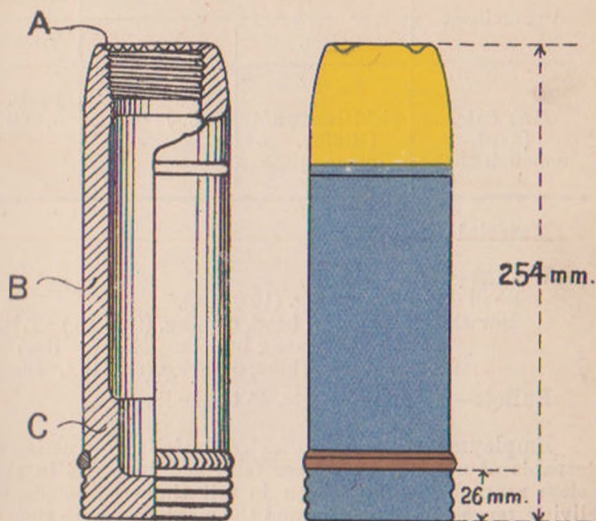
Remarks—Specimens of this shell have been found containing 40 g. of red phosphorus.

For range table, see Appendix II.

* With a certain proportion of fuzes up to 7,820 yards.

7.7 cm. Gr. 96.

Calibre, 7.7 cm. (3.03").

SCALE - $\frac{1}{4}$.

Thickness of walls—

- At A, 8.5 mm.
- At B, 14.5* mm.
- At C, 18 mm.

Thickness of base—19† mm.

Width of driving band—8 mm.

Distinctive markings—

- Shells of less recent manufacture are coloured yellow with blue head.

* 10 mm. in shells of less recent manufacture.

† 22 mm. in shells of less recent manufacture.

Field Gun Universal Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>F.K. Patr.</i> (fixed ammunition)	Field Gun 96 n/A. (Rifling, 32 grooves)	<i>K.Z. 11*</i> ...	yards. 5,468†	yards. 9,186

Material—Cast steel.

Weight—

Shell complete, 6·8 kg. (15·0 lbs.).

Bursting charge—In head, 0·16 kg. (0·35 lb.) T.N.T.

Among bullets, kg. (lbs.) T.N.T.

At base, 0·075 kg. (0·16 lb.). Black powder.

Bullets—300 10 g. bullets, 45 to the lb.

Employment—*As percussion H.E. shell*: destruction of targets capable of offering resistance (shielded batteries in the open at close ranges), against troops in tall timbered woods, as well as living targets at ranges beyond the maximum with time fuze.

As time shrapnel: against all living targets, except when these are close behind or under cover (*e.g.*, behind shields, at the bottom of trenches, or in shelters), or in tall timbered woods.

As time H.E. shell: against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), and aeroplanes, especially at long ranges.

Remarks—This “Universal” shell may be described as a shrapnel with a high-explosive burster in the head and high-explosive among the bullets. The shell can be used in three ways, *viz.*, as percussion H.E. shell, time shrapnel or time H.E. shell.

When used as time or percussion H.E. shell, the high-explosive in the head and among the bullets, detonates, giving the effect of a powerful high-explosive shell.

When used as time shrapnel in air, the head flies forward forming a high-explosive shell on its own account, the remainder of the shell acting as shrapnel.

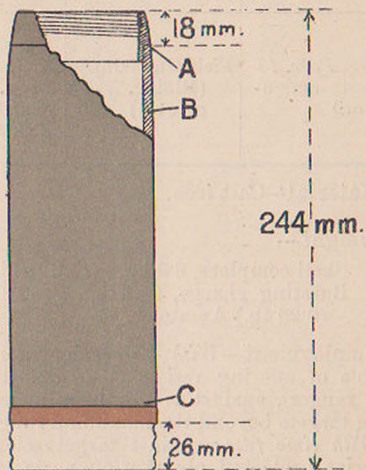
For range table, *see* Appendix II.

* Dopp. Z. 96 n/A can also be used with this shell.

† With a certain proportion of fuzes up to 7,655 yards. *K.Z. 11* fuzes have recently been found graduated up to 7,200 m. (7,874 yards).

(7.7 cm.) Einheits-Geschoss.

Calibre, 7.7 cm. (3.03").

SCALE— $\frac{1}{4}$.

Thickness of walls—

At A, 6 mm.

At B, 4.75 mm.

At C, 10 mm.

Thickness of base—9 mm.

Width of driving band—9 mm.

Distinctive markings—

Remarks—The internal arrangement of this shell is very similar to that of the Light Field Howitzer Universal Shell (see page 49).

In some specimens of this shell which were fired from anti-aircraft guns, there is an aluminium box, 20 mm. deep, containing 40 10-g. bullets embedded in a mixture of red phosphorus and paraffin wax; the top of this box is 136 mm. below the top of the shell. The bullets above this box are embedded in T.N.T., those below it (80 in number) in resin.

1914 Pattern Field Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>F. Gr. Patr. 14</i> (fixed ammu- nition)	Field Gun 96n/A. (Rifling, 32 grooves)	<i>K.Z. 14</i> ...	yards.	yards.
		<i>Dopp. Z. 96</i>	—	9,186
		<i>n/A</i>	5,850*	9,186
		<i>K.Z. 11</i> ...	5,468†	9,186

Material—Cast iron.

Weight—

Shell complete, 6·8 kg.‡ (15·0 lbs.‡).

Bursting charge, 0·26 kg. (0·57 lb.) Astralite, or 0·13 kg. (0·29 lb.) Amatol.§

Employment—*With percussion fuze*: destruction of targets capable of offering resistance (shielded batteries in the open at close ranges), against troops in tall timbered woods, as well as living targets beyond the maximum range with time fuze.

With time fuze: against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), and aeroplanes, especially at long ranges.

Remarks—This shell was introduced in the autumn of 1914. Its simple design enabled it to be manufactured comparatively quickly in large quantities by private firms which were not equipped specially for the production of shells. The shell did not prove satisfactory, and many complaints were received from the troops regarding its defects; as a result of this, the 1915 pattern cast steel shell was introduced (*see* page 42).

For range table, *see* Appendix II.

* With a certain proportion of fuzes up to 7,820 yards.

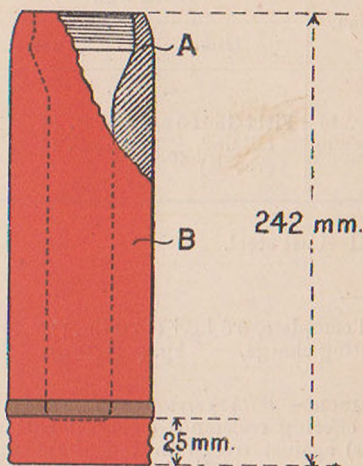
† With a certain proportion of fuzes up to 7,655 yards. *K.Z. 11* fuzes have recently been found graduated up to 7,200 m. (7,874 yards).

‡ The weight varies considerably according to the material of which the fuze is constructed.

§ Shells have been found stamped "Fp. 60/40" indicating Amatol containing 40 per cent. of T.N.T.

K. Gr. 14.

Calibre, 7.7 cm. (3.03").

SCALE— $\frac{1}{4}$.**Thickness of walls—**

At A, 10 mm.

At B, 21 mm.

Thickness of base—24 mm.**Width of driving band—9 mm.**

Distinctive markings—Shells which have a white ring, 3 cm. wide, painted round the head, are filled with a superior explosive: a similar black ring indicates that the shell is filled with the same explosive as that employed in the regulation pattern ammunition, viz., *Fp. 02* or T.N.T.

A large "A" stencilled in white on the head indicates the employment of a propelling charge which produces a lower initial velocity, and is particularly sensitive to heat.

1915 Pattern Field Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>F. Gr. Patr. 15</i> (fixed ammunition)	Field Gun 96 n/A. (Rifling, 32 grooves)	<i>K. Z. 14</i> ...	yards.	yards.
		<i>K. Z. 11</i> ...	— 5,468*	9,186 9,186

Material—Cast steel.

Weight—

Shell complete, 6·8 kg.† (15·0 lbs. †).

Bursting charge, kg. (lbs.).

Employment—*With percussion fuze*: destruction of targets capable of offering resistance (shielded batteries in the open at close ranges) against troops in tall timbered woods, as well as living targets beyond the maximum range with time fuze.

With time fuze: against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), and aeroplanes, especially at long ranges.

Remarks—This shell was introduced in 1915 to replace the 1914 pattern shell which proved defective in many respects.

For range table, *see* Appendix II.

* With a certain proportion of fuzes up to 7,655 yards. *K.Z. 11* fuzes have recently been found graduated up to 7,200 m. (7,874 yards).

† The weight varies considerably according to the material of which the fuze is constructed.

K. Gr. 15.

Calibre, 7.7 cm. (3.03").

Thickness of walls—

At A. mm.

At B. mm.

Thickness of base— mm.**Width of driving band— mm.****Distinctive markings—**Painted grey, with yellow head.

Shells which have a white ring, 3 cm. wide, painted round the head, are filled with a superior explosive: a similar black ring indicates that the shell is filled with the same explosive as that employed in the regulation pattern ammunition, viz., *Fp. 02*, or T.N.T.

1882 Pattern 9 cm. Field Gun Segment Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
9 cm. Gr. 82 ...	9 cm. Field Gun 73/88 (Rifling, 24 grooves)	Gr. Z. 82 ...	yards. —	yards. 7,109

Material—Cast iron.

Weight—

Shell complete, 7.0 kg. (15.43 lbs.).

Bursting charge, 0.22 kg. (0.48 lb.). Black powder.

Employment—

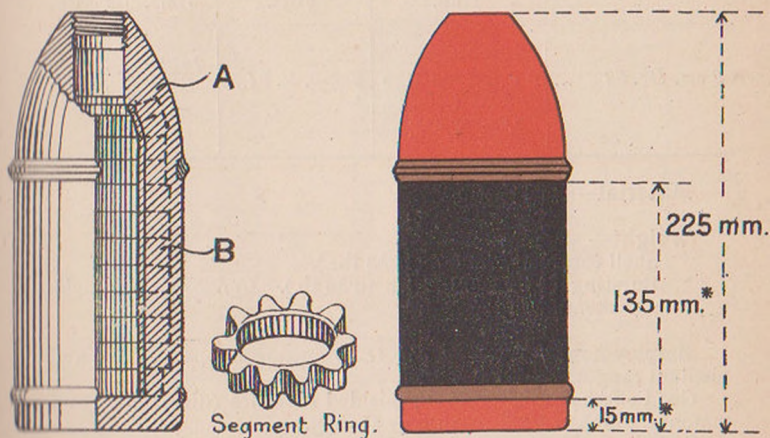
Remarks—This is an old-fashioned segment shell.

The 9 cm. Field Gun was replaced by the Field Gun 96 n/A., but the gun is being used in the present trench warfare, and this segment shell has been found occasionally.

For range table, see Appendix III.

9 cm. Gr. 82.

Calibre, 8.8 cm. (3.46")

SCALE - $\frac{1}{4}$.

Thickness of walls—

At A, 24 mm.*

At B, 6 to 21 mm.

Thickness of segment rings—14 mm.

Thickness of base—17.5 mm.*

Width of driving bands—Upper band, 10 mm.,* lower, 8 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1888 Pattern 9 cm. Field Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
9 cm. Gr. 88 ...	9 cm. Field Gun 73/88 (Rifling, 24 grooves)	Dopp. Z. 91 ...	yards. 4,921	yards. 7,109

Material—Steel casting.

Weight—

Shell complete, 7.5 kg. (16.53 lbs.).

Bursting charge, 0.165 kg. (0.36 lb.). Grf. 88 (picric acid, stemmed in).

Employment—*Principal object*: to engage troops at short and medium ranges.

Good effect against *matériel*, shielded batteries (direct hits) and masonry which is weak or already shaken.

Sufficient effect at living targets, even in high woods or buildings.

Remarks—A variation of this shell was reported on the British front in February, 1916, painted blue, with *Kz. Gr. Z. 14* fuze, and walls 12 mm. thick. The base of the shell was seated out like the bottom of a wine bottle.

Another variation of this shell has been reported, on both the French and British fronts, which differs in the following respects:—

Colour—Red.

Fuze—*H.Z. 14* or *K.Z. 14*.

Material—Cast iron.

Weight—

Shell complete, 7.39 kg. (16.3 lbs.).

Bursting charge, 0.21 kg. (0.46 lb.). *Fp. 60/40* (amatol).

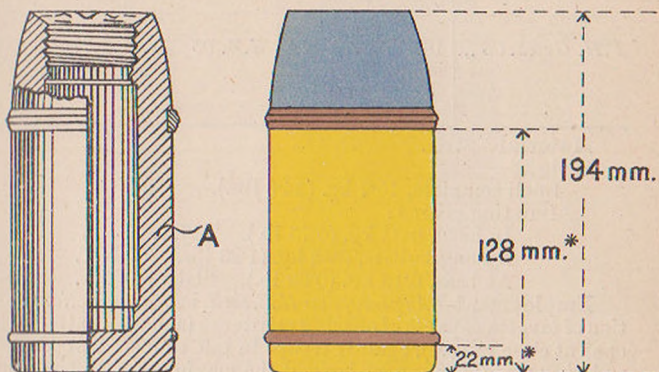
Thickness of walls—20 mm.

Driving band—Lower band, 15 mm. above base.

A third variation, somewhat similar to the last, is painted black and has an *H.Z. 14 Vst.* fuze.

For range table, see Appendix III.

9 cm. Gr. 88.
Calibre, 8.8 cm. (3.46").



SCALE— $\frac{1}{4}$.

Thickness of walls—

At A, 18 mm.*

Thickness of base—22 mm.*

Width of driving bands—Upper band, 11 mm.,* lower, 6 mm.*

Distinctive markings—Variations of this shell are reported as being coloured blue, red and black respectively, see "Remarks" on page opposite.

* Measurement approximate only, see footnote on page 33.

1905 Pattern Light Field Howitzer Universal Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>F.H. Gesch. 05 ...</i>	10.5 cm. Light Field Howitzer, 98/09 (Rifling, 32 grooves)	<i>H.Z. 05 ...</i>	yards. 5,796*	yards. 6,890

Material—Steel.

Weight—

Shell complete, 15.7 kg. (34.6 lbs.).

Bursting charge:

In head, 0.34 kg. (0.75 lb.). T.N.T.

Among bullets, 0.56 kg. (1.23 lbs.). T.N.T.

At base, 0.15 kg. (0.33 lb.). Black powder.

Employment—*As percussion H.E. shell, with direct action:* destruction of targets capable of offering resistance (shielded batteries in the open at close ranges), against troops in tall timbered woods, as well as living targets at ranges beyond the maximum with time fuze.

As percussion H.E. shell, with delay action: against living targets under overhead cover of a nature likely to be encountered in field warfare. Demolition of solid masonry. Against targets in the interior of houses.

As time shrapnel: against all living targets, except when these are close behind or under cover (e.g., behind shields, at the bottom of trenches, or in shelters), or in tall timbered woods.

As time H.E. shell: against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), aeroplanes, especially at long ranges.

The effect is considerably greater than that of the Field Gun Universal Shell, both in depth and laterally.

Remarks—This "Universal" shell may be described as a shrapnel with high-explosive burster ($\frac{3}{4}$ lb.) in the head and high-explosive ($1\frac{1}{4}$ lbs.) among the bullets (400 10g. bullets, 45 to the lb.). The shell can be used in four ways, viz., as percussion H.E. shell with or without delay action, time shrapnel or time H.E. shell.

When used as time or percussion H.E. shell, the high-explosive in the head and among the bullets detonates, giving the effect of a powerful high-explosive shell.

When used as time shrapnel in air, the head flies forward, forming a high-explosive shell on its own account, the remainder of the shell acting as shrapnel.

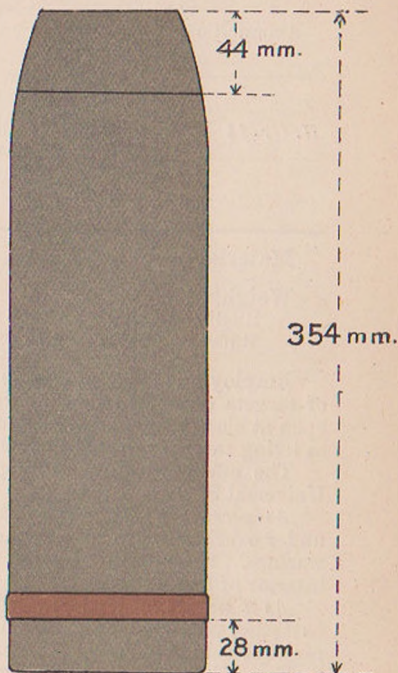
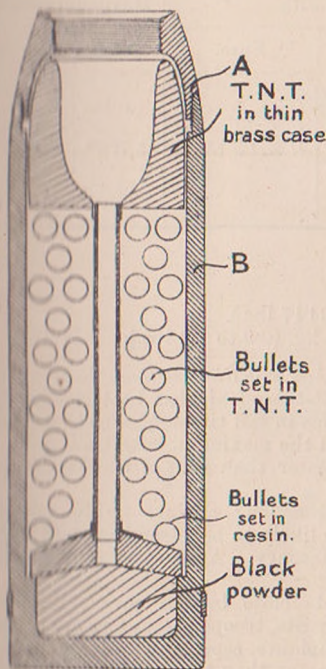
This shell was designed to replace the 1898 pattern shell and 1898 pattern shrapnel, both of which are probably obsolete.

For range table, see Appendix IV.

* With a certain proportion of fuzes up to 6,890 yards.

F.H. Geschoss, 05. (Einheits-geschoss).

Calibre, 10.5 cm. (4.13").



Thickness of walls—

At A, 7 mm.

At B, 9 mm.

SCALE - $\frac{1}{4}$.

Thickness of base—17 mm.

Width of driving band—13.5 mm.

Distinctive markings—

NOTE.—In some specimens the shell, for a depth of $2\frac{1}{4}$ inches below the brass case, contains no bullets, this space being filled with amatol.

1914 Pattern Light Field Howitzer H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>H. Gr. 14</i> ...	10.5 cm. Light Field Howitzer 98/09 (Rifling, 32 grooves)	<i>H.Z. 14</i> ... <i>H.Z. 05 Gr.</i> ...	yards. — 5,796*	yards. 6,890 6,890

Material—Cast iron.

Weight—

Shell complete, 15.5 kg.† (34.17 lbs.).

Bursting charge, 0.4 to 0.6 kg. (0.9 to 1.3 lbs.). T.N.T.‡

Employment—*As percussion shell with direct action*: destruction of targets capable of offering resistance (shielded batteries in the open at close ranges), against troops in tall timbered woods, as well as living targets at ranges beyond the maximum with time fuze.

The effect is considerably greater than that of the Field Gun Universal Shell.

As percussion shell with delay action: against living targets under overhead cover of a nature likely to be encountered in field warfare. Demolition of solid masonry. Against targets in the interior of houses.

As time shell: against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), aeroplanes, especially at long ranges.

The effect is considerably greater than that of the Field Gun Universal Shell, both in depth and laterally.

Remarks—This shell was introduced in the autumn of 1914. Its simple design enabled it to be manufactured comparatively quickly in large quantities by private firms which were not equipped specially for the production of shells. The shell did not prove satisfactory and many complaints were received from the troops regarding its defects: as a result of this, the 1915 pattern cast steel shell was introduced (*see* page 52).

For range table, *see* Appendix IV.

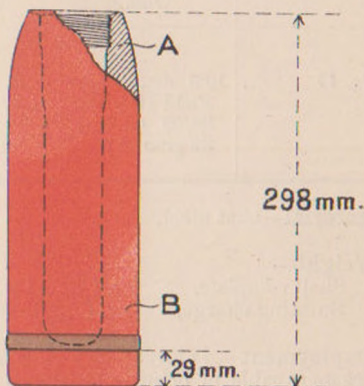
* With a certain proportion of fuzes up to 6,890 yards.

† The weight varies considerably.

‡ Other explosives are also used, *e.g.*, amatol.

H. Gr. 14.

Calibre, 10.5 cm. (4.13").

SCALE - $\frac{1}{6}$.

Thickness of walls—

At A, 21 mm.

At B, 29 mm.

Thickness of base—33 mm.

Width of driving band—12 mm.

Distinctive markings—Shells which have a white ring, 3 cm. wide, painted round the head are filled with a superior explosive; a similar black ring indicates that the shell is filled with the same explosive as that employed in the regulation pattern ammunition, viz., *Fp. 02* or T.N.T.

1915 Pattern Light Field Howitzer H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>H. Gr. 15</i> ...	10.5 cm. Light Field Howitzer 98/09 (Rifling, 32 grooves)	<i>H.Z. 14</i> ... <i>H.Z. 05 Gr.</i> ...	yards. — 5,796*	yards. 6,890 6,890

Material—Cast steel.

Weight—

Shell complete, kg. (lbs.).
Bursting charge, kg. (lbs.).

Employment—*As percussion shell with direct action*: destruction of targets capable of offering resistance (shielded batteries in the open at close ranges), against troops in tall timbered woods, as well as living targets at ranges beyond the maximum with time fuze.

As percussion shell with delay action: against living targets under overhead cover of a nature likely to be encountered in field warfare. Demolition of solid masonry. Against targets in the interior of houses.

As time shell: against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), aeroplanes at long ranges.

The effect is greater than that of the 1914 pattern shell.

Remarks—This shell was introduced in 1915 to replace the 1914 pattern shell, which proved defective in many respects.

For range table, see Appendix IV.

* With a certain proportion of fuzes up to 6,890 yards.

H. Gr. 15.

Calibre, 10.5 cm. (4.13").

Thickness of walls—

At A, mm.

At B, mm.

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—Painted grey, with yellow head.

Shells which have a white ring, 3 cm. wide, painted round the head are filled with a superior explosive; a similar black ring indicates that the shell is filled with the same explosive as that employed in the regulation pattern ammunition, viz., *Ep. 02* or T.N.T.

Experimental or Long Pattern Light Field Howitzer H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Long F.H. Gr.</i> <i>formerly Ver-</i> <i>suchs-F.H. Gr.</i>	10.5 cm. Light Field Howitzer 98/09 (Rifling, 32 grooves)	<i>H.Z. 05. Gr.*</i>	yards. 5,796†	yards. 6,890

Material—Steel.

Weight—

Shell complete, 15.6 kg. (34.4 lbs.).

Bursting charge, 1.8 kg. (4.0 lbs.). Amatol or cast T.N.T.

Employment—*As percussion shell with direct action* : destruction of targets capable of offering resistance (shielded batteries in the open at close ranges), against troops in tall timbered woods, as well as living targets at ranges beyond the maximum with time fuze.

As percussion shell with delay action : against living targets under overhead cover of a nature likely to be encountered in field warfare. Demolition of solid masonry. Against targets in the interior of houses.

As time shell : against targets close behind cover (shielded batteries, protected observation posts, troops sitting in trenches, reserves behind houses, &c.), and aeroplanes, especially at long ranges. It is effective against living targets in the open.

The effect is greater than that of the Light Field Howitzer Universal Shell.

Remarks—This shell was introduced in 1915 after satisfactory reports had been received from the front as to its action. Its name was then changed from "Experimental" to "Long Shell." The shell is also used as a gas shell, *see* page 27.

For range table, *see* Appendix IV.

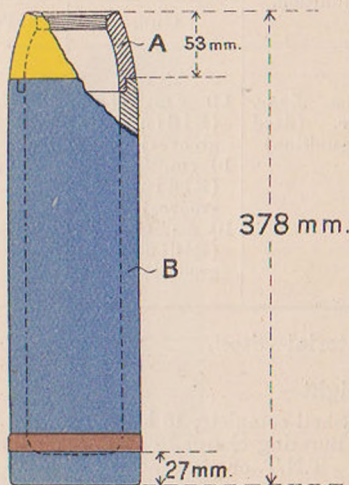
* When used with this shell, the extreme top of the fuze is painted red.

† With a certain proportion of fuzes up to 6,890 yards.

Lange F.H. Gr.
formerly

Vers. F.H. Gr.

Calibre, 10.5 cm. (4.13").



SCALE - $\frac{1}{6}$.

Thickness of walls—

At A, 12 mm.

At B, 15 mm.

Thickness of base—25 mm. (21 mm. in some specimens).

Width of driving band—14 mm.

Distinctive markings—Shells of less recent manufacture are painted field-grey with red head.

Shells which have a black ring painted round the head are filled with the same explosive as that employed in the regulation pattern ammunition, viz., *Fp. 02* or T.N.T.

The yellow paint shown above sometimes extends to about 2 inches below the junction of the head and body of the shell.

1896 Pattern 10 cm. Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
10 cm. <i>Lggr. Patr.</i> (fixed ammunition)	10 cm. Gun (Rifling, 32 grooves)	<i>Gr. Z. 04</i> ...	yards. —	yards. 11,264
	10 cm. Gun 04 (Rifling, 32 grooves)	„	—	11,264
	10 cm. Gun 14 (Rifling, grooves)	„	—	11,264

Material—Steel.

Weight—

Shell complete, 18 kg. (39.68 lbs.).

Bursting charge, 2.2 kg. (4.85 lbs.), *Fp. 02*, or *Grf. 88* (cast T.N.T. or picric acid).

Employment—*Principal object*: to engage living targets, to sweep lines of communication of all kinds, to bombard localities.

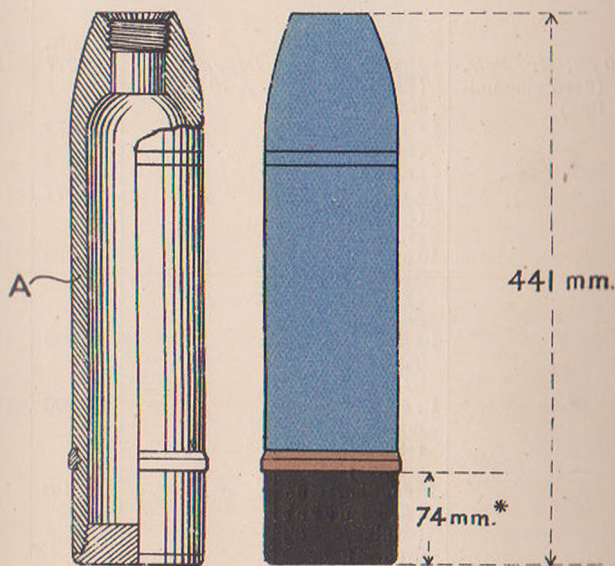
With direct action: good effect against *matériel*, against light overhead cover when the angle of descent is sufficient, against earthworks and buildings.

Sufficient effect at living targets when the ground is hard (this effect is reduced when the surface of impact is soft); against targets in high woods and localities; against field wire entanglements with wooden posts.

With delay action: has good effect against living targets, even on soft ground, when the projectiles burst in the air after having ricocheted.

Remarks—For range table, *see* Appendix V.

10 cm. Gr. 96.
Calibre, 10.5 cm. (4.13").



SCALE $-\frac{1}{6}$.

Thickness of walls—

At A, 12 mm.*

Thickness of base—30 mm.*

Width of driving band—15 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

10 cm. Gun H. E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
10 cm. Gr. Patr. (fixed ammunition)	10 cm. Gun 32 (Rifling, 32 grooves)	<i>Dopp. Z. 92 f. 10 cm. K.</i>	yards. 9,077	yards. 11,264
	10 cm. Gun 04 (Rifling, 32 grooves)	"	9,077	11,264
	10 cm. Gun 14 (Rifling, 32 grooves)	"	9,077	11,264
	10 cm. Gun with Overhead Shield (Rifling, 32 grooves)	"	9,296	11,811
	10 cm. Gun in Turret (Rifling, 32 grooves)	"	9,296	11,811
	10 cm. Gun, Re- inforced in Tur- ret (Rifling, 32 grooves)	"	9,296	11,811
	10 cm. Short Gun in Turret (Rifling, 32 grooves)	"	8,640	10,608

Material—Steel casting.

Weight—

Shell complete, 17.8 kg. (39.24 lbs.).

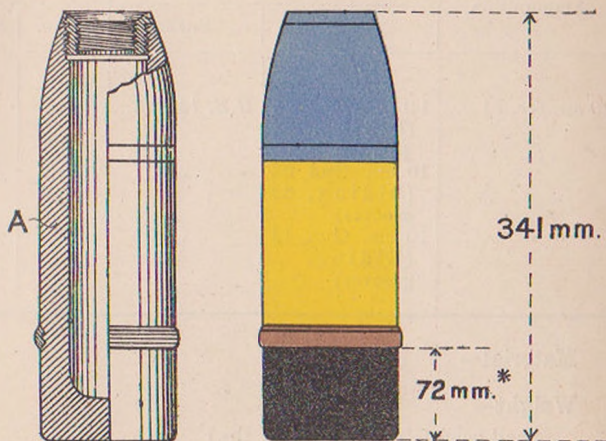
Bursting charge, 0.67 kg. (1.48 lbs.). *Grf. 88* (picric acid, stemmed in).

Employment—*Principal object*: to engage living targets, to sweep lines of communication of every kind, to bombard localities and captive balloons. When the gun is on a pivot mounting it is suitable for engaging aerial targets of all kinds.

The 10 cm. Gr. is less effective than the 10 cm. Gr. 96.

Remarks—For range tables, see Appendix V.

10 cm. Gr.
Calibre, 10.5 cm. (4.13").



SCALE— $\frac{1}{6}$.

Thickness of walls—

At A., 22 mm.*

Thickness of base—32 mm.*

Width of driving band—15 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1914 Pattern 10 cm. Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
10 cm. Gr. 14 ...	10 cm. Gun (Rifling, 32 grooves)	H.Z. 14 Vst....	yards. —	yards. 11,264
	10 cm. Gun 04 (Rifling, 32 grooves)	„	—	11,264
	10 cm. Gun 14 (Rifling, grooves)	„	—	11,264

Material—

Weight—

Shell complete, kg. (lbs.)

Bursting charge, 0.9 kg. (1.98 lb.)

Employment—*Principal object*: to engage living targets, to sweep lines of communication of all kinds, to bombard localities.

Good effect against *matériel*, against light overhead cover when the angle of descent is sufficient, against earthworks and buildings.

Sufficient effect at living targets when the ground is hard (this effect is reduced when the surface of impact is soft); against targets in high woods and localities; against field wire entanglements with wooden posts.

The effect is slightly less than that of the 1896 pattern 10 cm. H.E. Shell.

Remarks—For range table, see Appendix V.

10 cm. Gr. 14.

Calibre, 10.5 cm. (4.13").

Thickness of walls—

At A, mm.

At B, mm.

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—Painted grey.

1914 A Pattern 10 cm. Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
10 cm. Gr. 14 A...	10 cm. Gun (Rifling, 32 grooves)	H.Z. 14 Vst....	yards. —	yards. 11,264
	10 cm. Gun 04 (Rifling, 32 grooves)	„	—	11,264
	10 cm. Gun 14 (Rifling, grooves)	„	—	11,264

Material—

Weight—

Shell complete, kg. (lbs.).
Bursting charge, 0.7 kg. (1.54 lbs.).

Employment—*Principal object*: to engage living targets, to sweep lines of communication of all kinds, to bombard localities.

Good effect against *matériel*, against light overhead cover when the angle of descent is sufficient, against earthworks and buildings.

Sufficient effect at living targets when the ground is hard (this effect is reduced when the surface of impact is soft); against targets in high woods and localities; against field wire entanglements with wooden posts.

The effect is slightly less than that of the 1896 pattern 10 cm. H.E. Shell.

Remarks—For range table, see Appendix V.

10 cm. Gr. 14 A.

Calibre, 10.5 cm. (4.13").

Thickness of walls—

At A, mm.

At B, mm.

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—Painted red.

1888 a/A. Pattern 12 cm. Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
12 cm. Gr. 88 a/A.	12 cm. Heavy Gun (Rifling, 30 grooves)	Dopp. Z. 88 ...	yards. —*	yards. 7,984

Material—Cylindrical portion, charcoal pig iron ; nose, mild steel.

Weight—

Shell complete, 16·5 kg. (36·38 lbs.).

Bursting charge, 0·74 kg. (1·63 lbs.). Grf. 88 (picric acid, stemmed in).

Employment—*Principal object*: to engage living targets of all kinds, sweep communications of all kinds, and bombard localities.

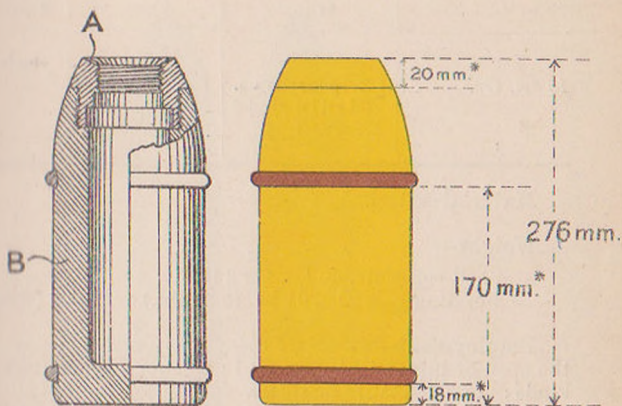
Sufficient effect at living targets, even in high woods, localities and buildings.

Slight effect against *matériel*, wire entanglements with wooden posts, light blinded cover and earthworks.

Remarks—For range table, see Appendix VI.

* *Dopp. Z. 88* is only used as a percussion fuze.

12 cm. Gr. 88 a/A.
Calibre, 12.03 cm. (4.73").



SCALE— $\frac{1}{6}$.

Thickness of walls—

At A, 15 mm.*

At B, 27 mm.*

Thickness of base—30 mm.*

Width of driving bands—12 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

13 cm. Gun H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
13 cm. Gr. ...	13 cm. Gun (Rifling, 36 grooves)	Lg. Bd. Z. 10*	yards. —	yards. 15,748

Material—Steel.

Weight—

Shell complete, 40 kg. (88·2 lbs.).

Bursting charge, 4·01 kg. (8·84 lbs.). *Fp.* 02 (cast T.N.T.)

Employment—*Principal object*: to engage living targets in the open or insufficiently covered; to sweep communications of all kinds; to bombard localities, fortresses, buildings, detrainning platforms, and parks; to destroy masonry, penetrate concrete escarp walls and earthworks.

With direct action: good effect against living targets, even in high woods and localities, against *matériel*, earthworks, strong vertical masonry, and light concrete works.

Slight effect against blinded cover.

With delay action: good effect, especially with double delay action against strong masonry, concrete escarp walls and earthworks. A single round will penetrate a concrete vertical wall 6½ feet thick.

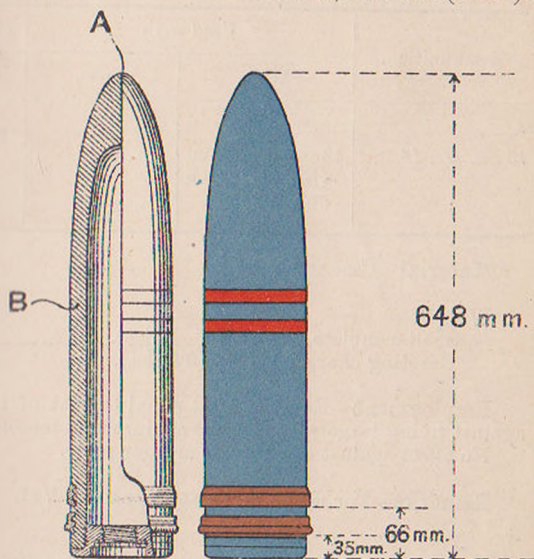
Remarks—This shell is also employed as an incendiary shell, being then filled with thermite (*see* page 28).

For range table, *see* Appendix VII.

* Has superseded *Bd. Z. 06*.

13 cm. Gr.

Calibre, 13.5 cm. (5.31").

SCALE $-\frac{1}{10}$.

Thickness of walls—

At A, 95 mm.

At B, 18 mm.

Thickness of base—42 mm.

Width of driving bands—Upper band, 24 mm., lower, 22 mm.

Distinctive markings—Shells of less recent manufacture do not have red rings round the cylindrical portion.

1914 Pattern 13 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
13 cm. Gr. 14 ...	13 cm. Gun (Rifling, grooves) 36	Gr. Z. 14 ...	yards. —	yards. 15,311

Material—Cast steel.

Weight—

Shell complete, kg. (lbs.).

Bursting charge, 1.6 kg. (3.5 lbs.).

Employment—Effect at least equal to that of the 13 cm. shell against living targets. Effective against thin masonry.

No effect against concrete or armour plate.

Remarks—For range table, see Appendix VII.

13 cm. Gr. 14.
Calibre, 13.5 cm. (5.31").

Thickness of walls—

At top, 13.5 mm. (?)

At centre, 26 mm. (?)

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—Painted grey.

1880 Pattern 15 cm. Common Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 80 ...	15 cm. Gun (<i>Ringkanone</i>) (Rifling, 24 grooves)	Gr. Z. 82 ...	yards. —	yards. 8,312
	15 cm. Gun (<i>Lange Ring- kanone</i>) (Rif- ling, 24 grooves)	„ ...	—	7,929

Material—Cast iron.

Weight—

Shell complete, 27.5 kg. (60.6 lbs.).

Bursting charge, 1.9 kg. (4.2 lbs.). Black powder.

Employment—*Principal object*: to engage targets in the open or insufficiently covered, to sweep communications of all kinds and to bombard localities.

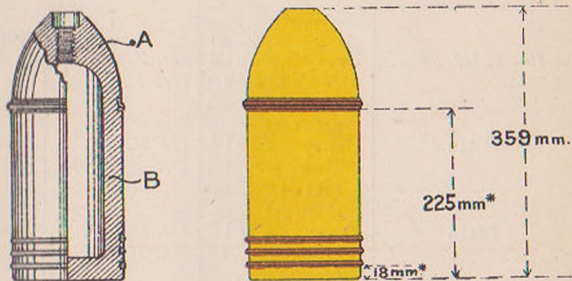
Sufficient effect against living targets even in high woods or localities and against light overhead cover if the angle of descent is sufficient; against weak or shaky masonry and *matériel*.

Slight effect against field wire entanglements with wooden posts.

Remarks—For range table of *Ringkanone*, see Appendix VIII.

15 cm. Gr. 80.

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—

At A, 48 mm.*

At B, 25 mm.*

Thickness of base—30 mm.*

Width of driving bands—Upper band, 17 mm.,* three lower bands, 5 mm.*

Distinctive markings—Shells of less recent manufacture are painted red with yellow head.

* Measurement approximate only, see footnote on page 33.

1883 Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 83 ...	Heavy Field Howitzer (Rifling, 36 grooves)	Gr. Z. 04 ... Gr. Z. 96/04	yards. —	yards. 6,616
Ditto	Heavy Field Howitzer 02 (Rifling, 36 grooves)	Gr. Z. 04 ... Gr. Z. 96/04	—	8,147
Ditto	Heavy Field Howitzer 13 (Rifling, grooves)	Gr. Z. 04 ... Gr. Z. 96/04	—	8,093

Material—Steel.

Weight—

Shell complete, 39 kg. (86 lbs.).

Bursting charge, 5.89 kg. (13 lbs.). Grf. 88 (cast picric acid).

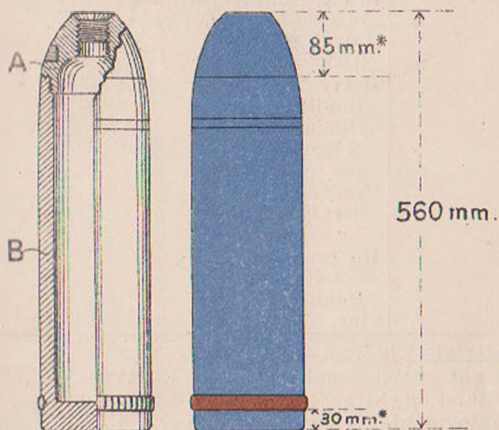
Employment—*Principal object*: to engage living targets behind or under cover; batteries, especially shielded batteries, and *matériel*; destruction of fieldworks or semi-permanent earthworks not protected with concrete; stout masonry and light splinter-proof armour plates.

The characteristics of this shell are generally similar to those of the 1896 Pattern 15 cm. Shell (*see* p. 76). The burster being smaller (13 lbs. against 16 lbs.), the effect is less.

Remarks—For range tables of Heavy Field Howitzers 13 and 02, *see* Appendices X and XI.

15 cm. Gr. 83.

Calibre, 14.97 cm. (5.89").

SCALE - $\frac{1}{10}$.

Thickness of walls—

At A, 23 mm.*

At B, 17 mm.*

Thickness of base—40 mm.*

Width of driving band—18 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1888 Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 88 ...	15 cm. Long Gun	<i>Dopp. Z. 92 ...</i>	yards.	yards.
	15 cm. Howitzer in Turret	<i>Gr. Z. 82</i>	—	10,936
	Heavy Field Howitzer	(<i>Kp.</i>)*	—	7,874
	Heavy Field Howitzer 02	"	—	6,616
	(Rifling of each of the above, 36 grooves)	"	—	8,147
	Heavy Field Howitzer 13 (Rifling, grooves)	"	—	8,093
	15 cm. Heavy Coast Defence Howitzer (Rifling, grooves)	"	—	6,616

Material—Pig iron.

Weight—Shell complete, 42·3 kg. (93·25 lbs.)

Bursting charge, 1·5 kg. (3·3 lbs.). *Gr. 88* (cast picric acid).

Employment—*Principal object* (with 15 cm. Long Gun): to engage living targets in the open or insufficiently covered, and targets behind cover; to sweep communications of all kinds; to bombard localities, detrain platforms, and parks.

Good effect against living targets, even in high woods and localities, against light overhead cover, if the angle of descent is sufficient, and against weak or shaken masonry.

Sufficient effect against *matériel*.

Principal object (with Heavy Field Howitzers): to engage living targets behind or under cover; batteries, especially shielded batteries, and *matériel*; destruction of fieldworks or semi-permanent earthworks not protected with concrete; stout masonry and light splinter-proof armour plates.

With direct action: sufficient effect against living targets in the open or covered, even in high woods and localities; against *matériel*, especially shielded guns, trenches, and field casemates covered with a layer of earth up to 20" thick; against field wire entanglements with wooden posts, and thin masonry.

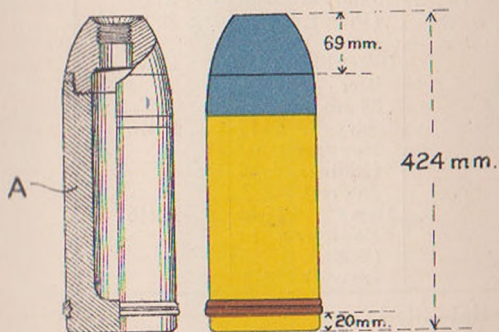
With delay action: sufficient effect at field casemates covered with 20" to 40" of earth, if the supporting posts are not too stout.

On account of its small burster, this shell is considerably inferior to 15 cm. *Gr. 12*, 15 cm. *Gr. 04*, 15 cm. *Gr. 96* and 15 cm. *Gr. 83* against targets offering resistance; but the effect on living targets is better than that of 15 cm. *Gr. 96* and 15 cm. *Gr. 83*.

* *Dopp. Z. 92* was formerly used with this shell, but it has been superseded by *Gr. Z. 82 (Kp.)* when used with howitzers.

15 cm. Gr. 88.

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 38 mm.

Thickness of base—42 mm.

Width of driving band—20 mm.

Distinctive markings—

Remarks—For range tables, *see* Appendices IX, X, XI and XII.

1896 Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 96 ...	15 cm. Long Gun (Rifling, 36 grooves)	Gr. Z. 04 Gr. Z. 96/04	yards. —	yards. 10,936
	Heavy Field How- itzer (Rifling, 36 grooves)	Ditto	—	6,616
	Heavy Field Howitzer 02 (Rifling, 36 grooves)	Ditto	—	8,147
	Heavy Field Howitzer 13 (Rifling, grooves)	Ditto	—	8,093

Material—Steel.

Weight—

Shell complete, 39.5 kg. (87.1 lbs.).

Bursting charge, 7.3 kg. (16.1 lbs.), Grf. 88 (cast picric acid).

Employment—*Principal object* (with 15 cm. Long Gun): to engage living targets behind cover in the open or insufficiently covered; to sweep communications of all kinds; to bombard localities, detrain platforms, and parks.

With direct action: good effect against *matériel*, especially shielded guns; against field wire entanglements with wooden posts, stout field casemates (if the angle of descent is sufficient) and strong buildings.

Sufficient effect against living targets.

With delay action: good effect against stout field casemates when the angle of descent is sufficient, and against strong buildings.

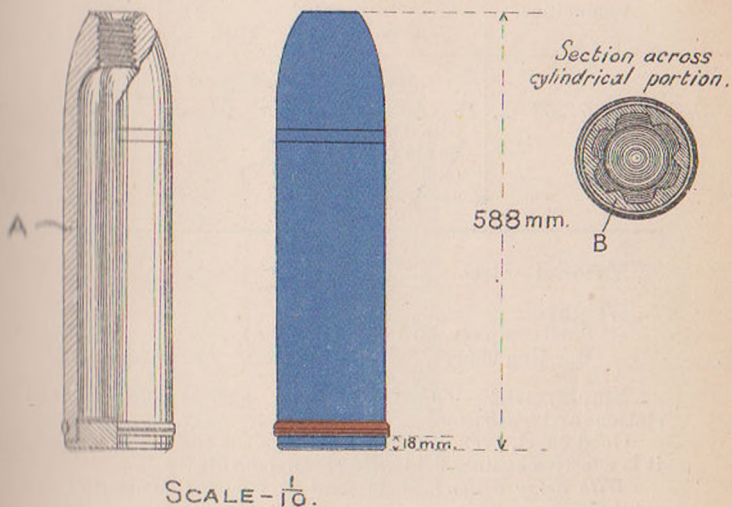
Principal object (with Heavy Field Howitzers): to engage living targets behind or under cover; batteries, especially shielded batteries, and *matériel*; destruction of fieldworks or semi-permanent earthworks not protected with concrete, stout masonry and light splinter-proof armour plates.

Its effect is generally similar to that of the 1912 Pattern 15 cm. Shell (see p. 84). Against targets offering resistance, especially casemates, its effect is good on account of its large bursting charge compared with the 1912 or 1904 Pattern Shells. Against living targets and *matériel* its effect is decidedly inferior to that of the 1904 Pattern Shell, and it is still less effective than the 1912 Pattern Shell.

Remarks—For range tables, see Appendices IX, X and XI.

15 cm. Gr. 96.

Calibre, 14.97 cm. (5.89").



Thickness of walls—

At A, 12 mm.

At B, 17.5 mm. (see "Section" above).

Thickness of base—40 mm.

Width of driving band—15 mm.

Distinctive markings—

1903 Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 03 ...	15 cm. Gun with Overhead Shield (i.S.L.) (Rifling, grooves)	Gr. Z. 04 ...	yards. —	yards. 17,060

Material—Steel.

Weight—

Shell complete, 50.5 kg. (111.3 lbs.).

Bursting charge, 3.27 kg. (7.2 lbs.). *Fp. 02* (cast T.N.T.).

Employment—*With direct action*: against localities, railway stations and *matériel*.

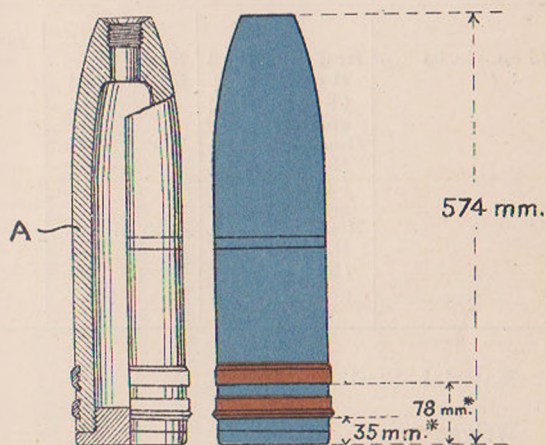
Good effect, even at long ranges, against the above targets, and it is effective against field wire entanglements.

With delay action: it is used in bombardments and against stout masonry.

Remarks—

15 cm. Gr. 03.

Calibre 14.97 cm. (5.89")

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 25 mm.*

Thickness of base—50 mm.*

Width of driving bands—25 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1904 Pattern 15 cm. H. E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 04 ...	Heavy Field Howitzer (Rifling, 36 grooves)	Gr. Z. 04 ... Gr. Z. 96/04	yards. —	yards. 6,616
	Heavy Field Howitzer 02 (Rifling, 36 grooves)	Ditto ...	—	8,147
	Heavy Field Howitzer 13 (Rifling, grooves)	Ditto ...	—	9,296

Material—Steel.

Weight—

Shell complete, 40·5 kg. (89·3 lbs.).

Bursting charge, 4·73 kg. (10·4 lbs.). *Fp. 02* (cast T.N.T.).*

Employment—*Principal object*: to engage living targets behind or under cover; batteries, especially shielded batteries, and *matériel*; destruction of fieldworks or semi-permanent earthworks not protected with concrete, stout masonry and light splinter-proof armour shields.

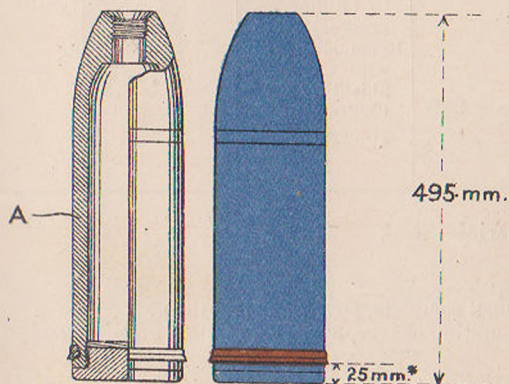
The effect is similar to that of 15 cm. Gr. 12, but is slightly less.

Remarks—For range tables, see Appendices X and XI.

* Shells of less recent manufacture are charged with *Grf. 88* (picric acid).

15 cm. Gr. 04.

Calibre 14.97 cm. (5.89").

SCALE - $\frac{1}{10}$.

Thickness of walls—At A., 20 mm.*

Thickness of base—42 mm.*

Width of driving band—16 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1906 Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 06 ...	15 cm. Coast Defence Gun 07 (Rifling, grooves)	Lg. Bd. Z. 10*	yards. —	yards. 8,530
	15 cm. Gun with Overhead Shield (i.s.l.) (Rifling, grooves)	" "	—	17,060

Material—Steel.

Weight—

Shell complete, 50.5 kg. (111.3 lbs.).

Bursting charge, 3.26 kg. (7.2 lbs.). *Fp. 02* (cast T.N.T.).

Employment—*Principal object* (with the 15 cm. Coast Defence Gun): to engage living targets and thinly armoured vessels, defence of channels, and counter-attacks against torpedo boats at long ranges.

Good effect against living targets and *matériel* when not protected, and against torpedo boats; also against unarmoured or lightly armoured superstructures and armour of small cruisers (up to 2.4 inches thick).

With the 15 cm. Gun with Overhead Shield, this shell is fired *with direct action* against localities, railway stations and *matériel*.

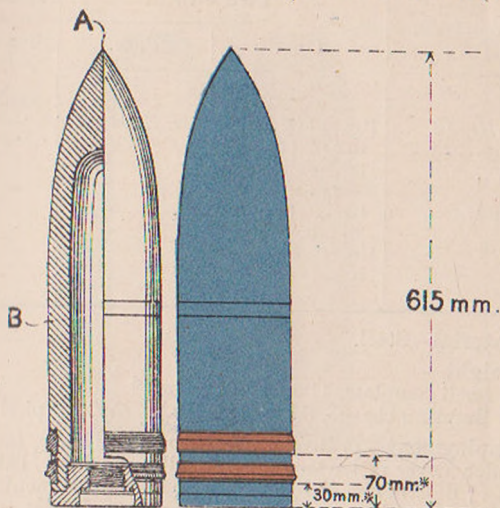
Good effect even at long ranges against the above targets; it is effective against field wire entanglements.

With delay action: it is used in bombardments and against stout masonry.

Remarks—

* Has superseded *Bd. Z. 06*.

15 cm. Gr. 06.
Calibre 14.97 cm. (5.89").



SCALE - $\frac{1}{10}$.

Thickness of walls—

At A, 130 mm.*

At B, 28 mm.*

Thickness of base—53 mm.*

Width of driving bands—25 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

(B 11938)

1912 Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 12 ...	Heavy Field Howitzer (Rifling, 36 grooves)	Gr. Z. 04 ...	yards. —	yards. 6,616
	Heavy Field Howitzer 02 (Rifling, 36 grooves)	„ ...	—	8,147
	Heavy Field Howitzer 13 (Rifling, grooves)	„ ...	—	9,296

Material—Steel.

Weight—

Shell complete, 41.5 kg. (91.5 lbs.).*

Bursting charge, 6 kg. (13.2 lbs.). Grf. 88 (picric acid).†

Employment—*Principal object*: to engage living targets behind or under cover; batteries, especially shielded batteries, and *matériel*; destruction of fieldworks or semi-permanent earthworks not protected with concrete, stout masonry and light splinter-proof armour shields.

With direct action: good effect at living targets behind or under cover, even in high woods and localities; against *matériel*, especially shielded guns; against field fortifications with blinded cover, covered with not more than 20 inches of earth; against wire entanglements of all kinds, solid masonry, walls up to 3 feet 3 inches thick faced with concrete, and light splinter-proof armour.

Sufficient effect against raised observing posts; against field casemates without concrete, covered with a layer of earth up to 20 inches thick.

Slight effect on layers of concrete 20 inches thick and over.

No effect on armour stouter than splinter-proof shields.

With delay action: good effect against the stoutest overhead cover in field defences covered with a layer of earth up to 6½ feet thick, with intermediate layers of other material.

Sufficient effect against field casemates without concrete, covered with a layer of earth up to 6½ feet thick. Effective against cellars.

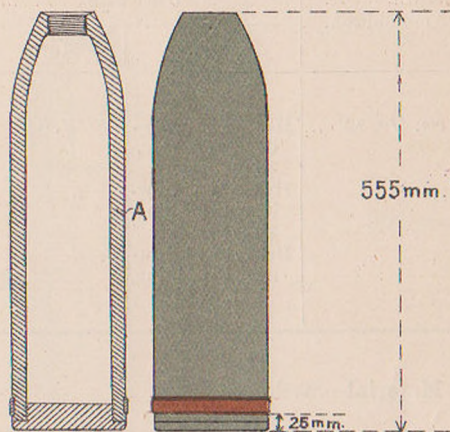
Inappreciable effect against concrete.

Remarks—For range tables, see Appendices X and XI.

* Weight approximate only.

† Contained in a cardboard case bearing the following inscription, "Grf. 88, Hanau 1915. Sprengladung für 15 cm. Gr. 12."

15 cm. Gr. 12.
Calibre, 14.97 cm. (5.89").



SCALE $-\frac{1}{10}$.

Thickness of walls—At A, 19 mm.

Thickness of base—34 mm.

Width of driving band—15 mm.

Distinctive markings—The head painted black with a black T below it, or the head painted yellow with a yellow K below it, indicates that the projectile is a gas shell (*see* page 87).

1912 Pattern 15 cm. Gas Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 12 ...	Heavy Field Howitzer (Rifling, 36 grooves)	Gr. Z. 04 ...	yards. —	yards. 6,616(?)*
	Heavy Field Howitzer 02 (Rifling, 36 grooves)	„ ...	—	8,147(?)*
	Heavy Field Howitzer 13 (Rifling, grooves)	„ ...	—	9,295(?)*

Material—Steel.

Weight—

Shell complete, 43.3 kg. (95.5 lbs.).

Bursting charge, 1.5 kg. (3.3 lbs.), cast, T.N.T.

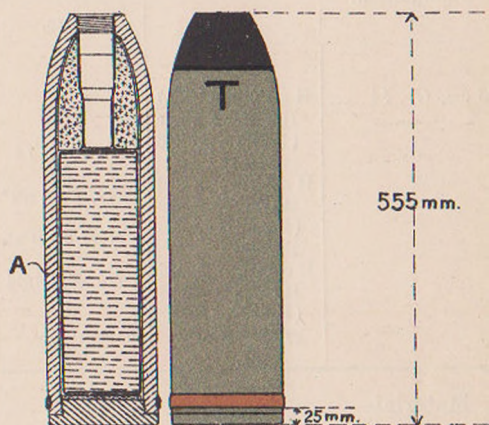
Employment—See page 26.

Remarks—The lead receptacle contains 3 kg. (6.6 lbs.) or 2.35 litres (4.1 pints) of liquid (see page 27). Between the receptacle and the base of the shell is a felt wad. The space between the walls of the shell and the receptacle is filled with paraffin wax.

* Owing to the gas shell being 1.8 kg. (4.0 lbs.) heavier than the ordinary shell, the maximum ranges are slightly less than those shown above.

15 cm. Gas Shell.

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 19 mm.

Thickness of base—34 mm.

Width of driving band—15 mm.

Distinctive markings—

The shell illustrated is a T-shell, K-shell have a yellow head with a yellow "K" below the head (*see* pages 26 and 85). The black marking is only shown approximately.

1914 Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 14 ...	Heavy Field Howitzer (Rifling, 36 grooves)	Gr. Z. 14	—	yards. 6,616
	Heavy Field Howitzer 02 (Rifling, 36 grooves)	or Gr. Zdg. 88*	—	8,147
	Heavy Field Howitzer 13 (Rifling, grooves)	or H. Z. 14. Vst.	—	8,147
		or Gr. Z. 96/04	—	

Material—**Weight—**

Shell complete, kg. (lbs.).

Bursting charge, 2.5 kg. (5.5 lbs.).

Employment—Effective against living targets in the open or under cover, even in high woods and localities, against *matériel*, shielded batteries, overhead cover in field defences, wire entanglements and light masonry.

The radius of action of each projectile is less than that of the 1912 Pattern 15 cm. Shell (*see* page 84). Against overhead cover the 1914 Pattern 15 cm. Shell is more effective than the 1914 A pattern (*see* page 90).

Remarks—The range tables of the 1888 Pattern 15 cm. Shell (*see* Appendices X and XI) should be employed.

* That is, Gr. Z. 82 (Kp.) fuze combined with *Mdlchf.* 88 and *Zdlg.* 82.

15 cm. Gr. 14.

Calibre, 14.97 cm. (5.89").

Thickness of walls—

At A, mm.

At B, mm.

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—Painted grey.

A black or white band round the head of a shell indicates that the shell is filled with explosive of a superior quality.

A red ring also indicates that the shell contains a particular explosive.

1914 A Pattern 15 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Gr. 14 A...	Heavy Field Howitzer (Rifling, 36 grooves)	Gr. Z. 14	—	yards. 6,616
	Heavy Field Howitzer 02 (Rifling, 36 grooves)	or Gr. Zdg. 88*	—	8,147
	Heavy Field Howitzer 13 (Rifling, 36 grooves)	or H.Z. 14 Vst.	—	8,147
		or Gr. Z. 96/04	—	

Material—Cast iron.

Weight—

Shell complete, 42 kg. (92·6 lbs.).

Bursting charge, 1·4 kg. (3·1 lbs.). Amatol, 70/30 (1 kg.) and cast T.N.T. (0·4 kg.).

Employment—Effective against living targets in the open or under cover, even in high woods and localities, against *matériel*, shielded batteries, overhead cover in field defences, wire entanglements and light masonry.

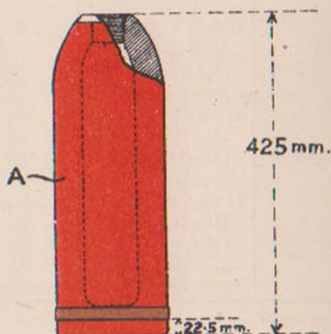
The radius of action of each projectile is less than that of the 1912 Pattern 15 cm. Shell (*see* page 84). Against overhead cover the 1914 A Pattern 15 cm. Shell is less effective than the 1914 pattern (*see* page 88).

Remarks—This shell is also employed as an incendiary shell, the inflammable material being similar to that contained in the *Brand-Granate* (*see* page 92). The 12 incendiary cylinders are 75 to 80 mm. long and are packed in black powder, of which there is a layer in the head connected by a central column of powder with another layer in the base.

The range tables of the 1888 Pattern 15 cm. Shell (*see* Appendices X and XI) should be employed.

* That is, Gr. Z. 82 (Kp.) fuze combined with *Mdlchf.* 88 and *Zdlg.* 82.

15 cm. Gr. 14 A.
Calibre, 14.97 cm. (5.89").



SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 38 mm.

Thickness of base—40 mm.

Width of driving band—15 mm.

Distinctive markings—A black or white band round the head of the shell indicates that the shell is filled with explosive of a superior quality.

A red ring also indicates that the shell contains a particular explosive.

15 cm. Incendiary Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Brand-Gr.</i> ...	Heavy Field Howitzer. (Rifling, 36 grooves).	<i>Gr. Z. 82</i> ...	yards. —	yards. 6,616
	Heavy Field Howitzer 02. (Rifling, 36 grooves).	„ ...	—	7,109
	Heavy Field Howitzer 13. (Rifling, grooves).	„ ...	—	8,749

Material—Cast iron.

Weight—

Shell complete, 27.5 kg. (60.6 lbs.)

Bursting charge, kg. (lbs.)

Employment—Very good incendiary effect, but no effect is produced by the splinters.

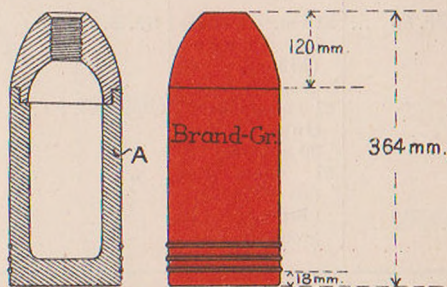
Remarks—At the top of the cylindrical portion is a thin metal disc, which is kept in place by the head of the shell being screwed down. Through the centre of this disc runs a brass tube, 32.5 mm. in diameter, containing black powder and reaching nearly to the base of the shell.

Round this tube are packed 12 incendiary cylinders in two layers, and kept in place by being embedded in paraffin wax. These cylinders are 95 mm. long and 30 mm. in diameter, and consist of a thin outer shell of celluloid, inside which is a solid cylinder of a highly inflammable celluloid—camphor composition. Round each cylinder are wound eight turns of cotton yarn, the space between the cylinders being filled with yellow phosphorus to a height of 40 mm. from the bottom, and thence to the top with paraffin wax.

A special range table is necessary.

(15 cm.) Brand-Gr.

Calibre 14.97 cm. (5.89").

SCALE - $\frac{1}{10}$.

Thickness of walls—At A, 25 mm.

Thickness of base—36 mm.

Width of driving bands—5 mm. (11 mm. apart).

Distinctive markings—"Brand-Gr." in black letters on cylindrical portion.

1880 Pattern 21 cm. Common Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 80 ...	21 cm. Howitzer in turret (Rifling, 30 grooves)	Gr. Z. 82 (Kp.)	yards. —	yards. 8,749
	21 cm. Jacketed Gun (Rifling, 30 grooves)	Dopp. Z. 92 ...	—	—
	21 cm. Gun (Ringkanone) (Rifling, 30 grooves)	„ „ ...	—	9,952

Material—Cast iron.

Weight—

Shell complete, 78 kg. (172 lbs.).

Bursting charge, 4.45 kg. (9.8 lbs.). Black powder.

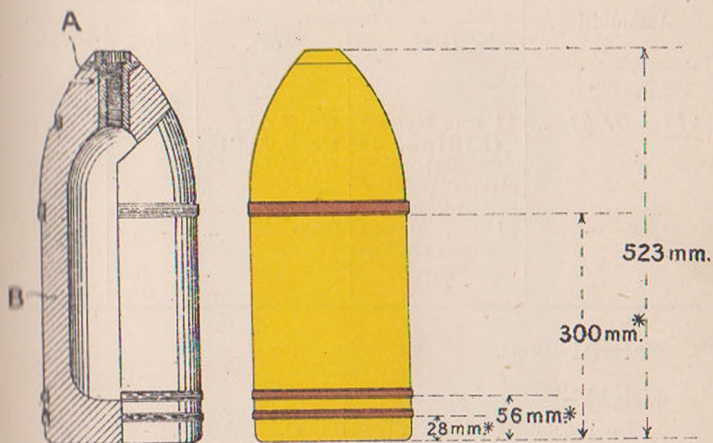
Employment—*Principal object*: the destruction of field casemates and firing against living targets and *matériel*.

Its effect is sufficient against such targets, and against field wire entanglements.

Remarks—For range table, *see* Appendix XVII.

21 cm. Gr. 80.

Calibre, 20.93 cm. (8.24").

SCALE— $\frac{1}{10}$.

Thickness of walls—

At A, 23 mm.*

At B, 37 mm.*

Thickness of base—56 mm.*

Width of driving bands—Upper band, 21 mm.*; 2 lower bands, 10 mm.*

Distinctive markings—Shells of less recent manufacture are painted red with yellow head.

* Measurement approximate only, see footnote on page 33.

1883 Pattern 21 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 83 ...	21 cm. Mortar* (Rifling, 64 grooves)	Gr. Z. 04. ...	yards. —	yards. 7,327
		Gr. Z. 96/04		
	Mortar* (Rifling, grooves)	Gr. Z. 96		
		Ditto ...	—	9,733
	21 cm. Bronze Mortar (Rifling, 30 grooves)	Ditto ...	—	7,000(?)

Material—Steel.

Weight—

Shell complete, 119 kg. (262·3 lbs.).

Bursting charge, 17·39 kg. (38·3 lbs.). Gr. 83 (cast picric acid).

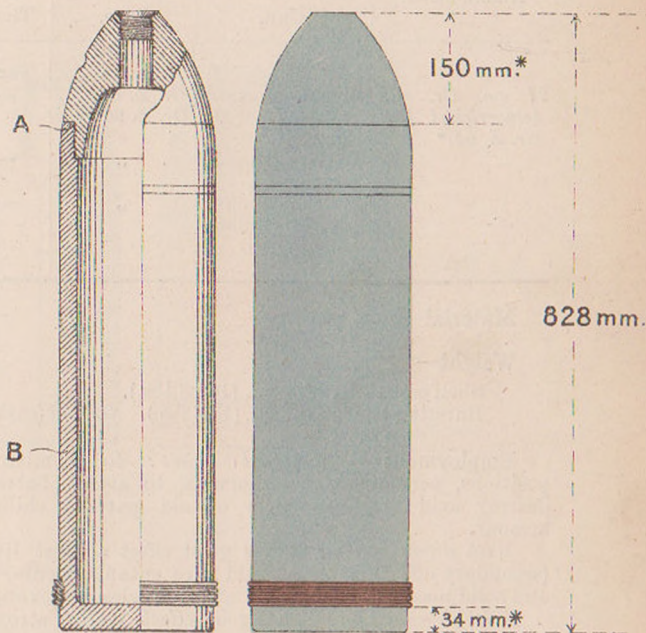
Employment—

Remarks—For range tables, see Appendices XIII and XV.

* 21 cm. is the older pattern mortar: the latest pattern, introduced in 1910, is called Mortar (*Mörser*) without specifying the calibre.

21 cm. Gr. 83.

Calibre, 21.1 cm. (8.3').



Thickness of walls—

SCALE — $\frac{1}{10}$.

At A, 17 mm.*

At B, 22 mm.*

Thickness of base—34 mm.*

Width of driving band—32 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1888 Pattern 21 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 88 (eingerichtet für Gr. Z. 04)*	21 cm. Mortar† (Rifling, 64 grooves)	Gr. Z. 04 ... Gr. Z. 96/04	yards. —	yards. 8,968
	Mortar† (Rifling, grooves)	„	—	9,952
	21 cm. Bronze Mortar (Rifling, 30 grooves)	„	—	8,530

Material—Steel casting.

Weight—

Shell complete, 83·3 kg. (183·6 lbs.).

Bursting charge, 5·7 kg. (12·6 lbs.). Grf. 88 (cast picric acid).

Employment — *Principal object*: to bombard infantry positions, permanent or otherwise, to attack batteries and to destroy field overhead cover or old pattern chilled cast-iron armour.

With direct action: it has good effect against living targets (secondary effect), *matériel*, field wire entanglements, bomb proofs and solid masonry, when fired at low angles of elevation.

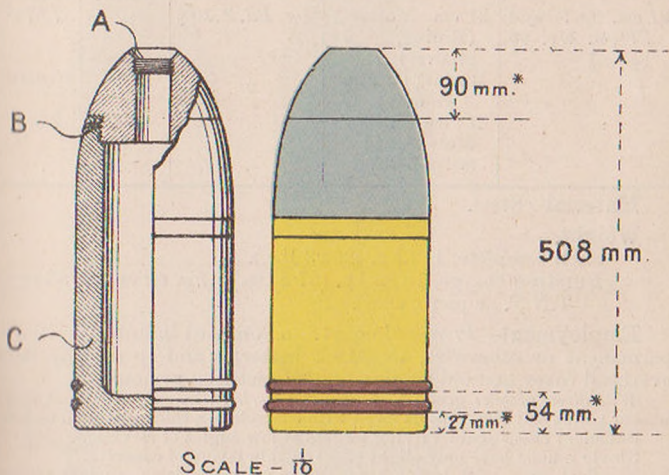
With delay action: it has good effect against strong field casemates, with high angle fire.

Remarks—For range tables, see Appendices XIV and XVI.

* A variation of this shell, called 21 cm. Gr. 88 (eingerichtet für Gel. Mdchb.) is slightly longer (513 mm.) and takes the Gr. Z. 84 fuze.

† See footnote on page 96.

21 cm. Gr. 88.
Calibre, 21.1 cm. (8.3").



Thickness of walls—

At A, 15 mm.*

At B, 20 mm.*

At C, 37 mm.*

Thickness of base—44 mm.*

Width of driving bands—Upper band, 12 mm.* ; lower, 10 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1896 Pattern 21 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 96 and 21 cm. Gr. 96 (umg.)	21 cm. Mortar ‡ (Rifling, 64 grooves) Mortar‡ (Rifling, grooves) 21 cm. Bronze Mortar (Rifling, 30 grooves)	Lg. Bd. Z. 10 § " "	yards. — —	yards. 7,874* 10,280† 7,000

Material—Steel.

Weight—

Shell complete, 119 kg. (262.3 lbs.).

Bursting charge, 16.93 kg. (37.3 lbs.). *Fp.* 02 or *Gr.* 88 (cast T.N.T. or picric acid).

Employment—*Principal object*: to bombard infantry positions, permanent or otherwise, to attack batteries and to destroy field overhead cover and old pattern chilled cast-iron armour.

With direct action: good effect against *matériel*, wire entanglements, light armour plates and escarp walls faced with concrete to a thickness of 40 inches. Sufficient effect against living targets at low angles of elevation.

Single rounds have only slight effect on thin layers of concrete.

No effect, even with lavish expenditure of ammunition, against strong concrete protection of permanent works.

With delay action: good effect against field casemates without concrete protection, at foundation walls and permanent constructions of non-reinforced concrete.

Sufficient effect against new casemates from which the centering has only just been removed: a single round will penetrate if the concrete is not more than 24 inches thick, 2 hits side by side will probably penetrate concrete 40 inches thick. Sufficient effect also against permanent infantry positions.

No appreciable effect against permanent concrete structures, well set.

No effect against armour plates.

Remarks—There are four patterns of this 21 cm. Gr. 96. The original pattern, 21 cm. Gr. 96 (*nicht geänderte*), had a fuze-hole socket in the head to take *Gr. Z. 04*. This pattern was converted into 21 cm. Gr. 96 (*umg.*) by screwing a hardened steel point into the fuze-hole socket in the head and fitting the base to take a base fuze (*Bd. Z. 06*). The third pattern, 21 cm. Gr. 96, is as shown in the plate opposite, and a fourth pattern, 21 cm. Gr. 96 *n/A*, was introduced in 1915, see page 102.

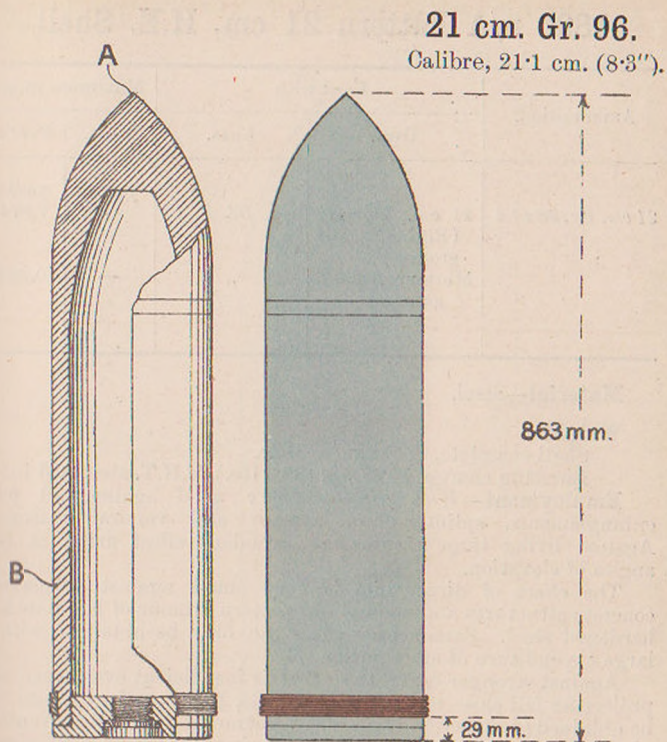
For range tables, see Appendices XIII and XV.

* The range table (see Appendix XIII) gives 8,421 yards as the maximum range, but a recent German document gives it as 7,874 yards, implying that the full charge is no longer used.

† See footnote ‡ to Appendix XV.

‡ See footnote on page 96.

§ Has superseded *Bd. Z. 06*.



SCALE— $\frac{1}{10}$.

Thickness of walls—

At A, 136 mm.

At B, 23 mm.

Thickness of base—55 mm.*

Width of driving band—25 mm.

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1896 n/A Pattern 21 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 96 n/A	21 cm. Mortar† (Rifling, 64 grooves)	Kz. Bd. Z. 10	yards. —	yards. 7,874
	Mortar† (Rifling, grooves)	„	—	10,280*

Material—Steel.

Weight—

Shell complete, kg. (lbs.).

Bursting charge, 17.47 kg. (38.5 lbs.). T.N.T. stemmed in.

Employment—*With direct action*: good against all wire entanglements, splinter-proof armour and vertical masonry. Against living targets sufficient secondary effect firing at low angles of elevation.

The effect of direct hits is very small against permanent concrete structures and against old pattern armour of laminated or hardened steel. Satisfactory effect can only be obtained with a large expenditure of ammunition.

Against stronger cover the effect is insufficient even when the projectiles fall close to armoured turrets, but secondary effects can be obtained (destruction of means of communication and prevention of observation; destructive effect against the personnel by means of the flames which enter the loopholes).

With delay action: good against all field and improvised cover which is not provided with concrete. Sufficient against concrete roofs and improvised cover when high angle fire is employed, and against permanent infantry positions in the works and their intervals.

Small effect against very thick concrete structures, off which the projectile ricochets, even when fired at maximum angles of elevation.

No effect against armour.

Very suitable for bombardments.

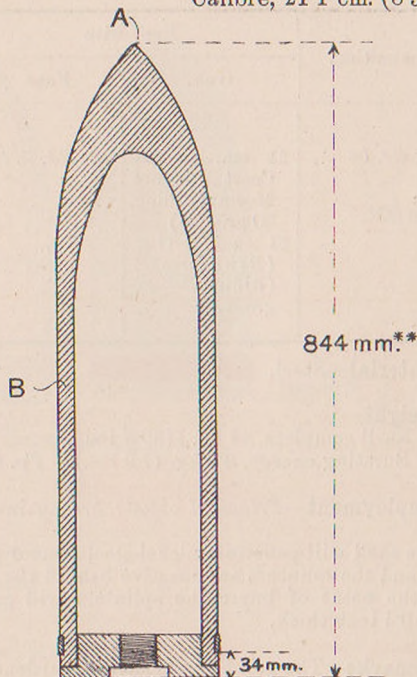
Remarks—For range tables, see Appendices XIII and XV.

* See footnote ‡ to Appendix XV.

† See footnote on p. 96.

21 cm. Gr. 96 n/A.

Calibre, 21.1 cm. (8.3").

SCALE - $\frac{1}{10}$.

Thickness of walls—

At A, 146 mm.

At B, 22 mm.

Thickness of base—55 mm.

Width of driving band—24 mm.

Distinctive markings—Painted grey.

** This dimension is not quite accurate, as the shell from which the measurements were taken was not complete.

1906 Pattern 21 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 06 ...	21 cm. Bronze Coast Defence Mortar (Rifling, 30 grooves)	Lg. Bd. Z. 10*	yards. —	yards. 8,530
	21 cm. Gun (<i>Ringkanone</i>) (Rifling, 30 grooves)	„	—	10,718

Material—Steel.

Weight—

Shell complete, 82 kg. (180·8 lbs.).

Bursting charge, 3·2 kg. (7·0 lbs.). *Fp. 02* (cast T.N.T.).

Employment—*Principal object*: fire against thinly armoured ships.

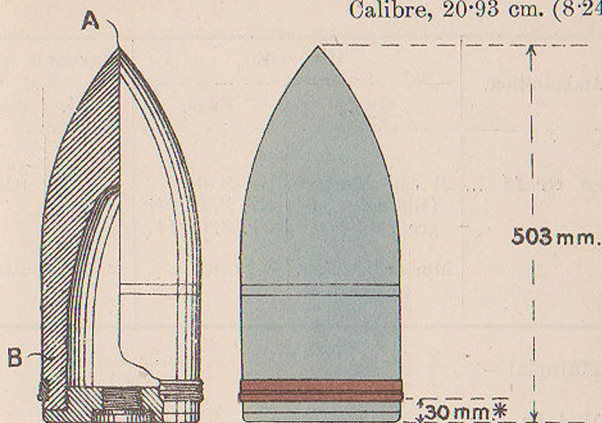
The shell will penetrate nickel-steel armour plates up to 2 inches thick, and the splinters are effective behind the plate. At $5\frac{1}{2}$ yards from the point of burst the splinters will penetrate hard steel plates 0·4 inch thick.

Remarks—The point of the shell is hardened.

* Has superseded *Bd. Z. 06*.

21 cm. Gr. 06.

Calibre, 20.93 cm. (8.24").

SCALE— $\frac{1}{10}$.

Thickness of walls—

At A, 185 mm.*

At B, 35 mm.*

Thickness of base—45 mm.*

Width of driving band—28 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1914 Pattern 21 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 14 ...	21 cm. Mortar* (Rifling, 64 grooves)	Gr. Z. 04 Gr. Z. 96/14† Gr. Z. 04/14	yards. —	yards. 8,968
	Mortar*(Rifling, grooves)	Ditto	—	9,952

Material—**Weight—**

Shell complete, kg. (lbs.).

Bursting charge, 8 kg. (17·6 lbs.).

Employment—*With direct action* (at low angles of elevation): it has good effect against living targets (secondary effect), *matériel*, field wire entanglements, light cover and stout masonry.

With delay action (at high angles of elevation): it has good effect against stout overhead cover in field defences, cellars, &c.

Remarks—The range table for the 1888 Pattern 21 cm. Shell (see Appendices XIV and XVI) should be used.

* See footnote on p. 96.

† There is some doubt as to the existence of this fuze which has possibly been confused with Gr. Z. 96/04.

21 cm. Gr. 14.
Calibre, 21.1 cm. (8.3").

Thickness of walls—

At A, mm.

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—Painted grey.

1914 A Pattern 21 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Gr. 14 A	21 cm. Mortar* (Rifling, 64 grooves)	Gr. Z. 04 Gr. Z. 96/14† Gr. Z. 04/14 Ditto	yards. —	yards. 8,968
	Mortar* (Rifling, grooves)		—	9,952

Material—**Weight—**

Shell complete, 83 kg. (183 lbs.).

Bursting charge, 6.3 kg. (13.9 lbs.).

Employment—*With direct action* (at low angles of elevation): it has good effect against living targets (secondary effect), *matériel*, field wire entanglements, light cover and stout masonry.

With delay action (at high angles of elevation): it has good effect against stout overhead cover in field defences, cellars, &c.

The effect is inferior to that of the 1914 Pattern Shell.

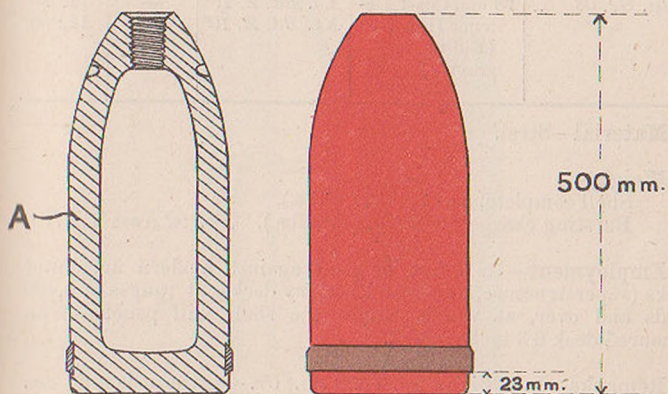
Remarks—The range table for the 1888 Pattern Shell (*see* Appendices XIV and XVI) should be used.

* See footnote on p. 96.

† There is some doubt as to the existence of this fuze which has possibly been confused with Gr. Z. 96/04.

21 cm. Gr. 14 A.

Calibre, 21.1 cm. (8.3").



SCALE— $\frac{1}{10}$.

Thickness of walls—

At A, 40 mm.

Thickness of base—47 mm.

Width of driving band—25 mm.

Distinctive markings—

1906 Pattern 28 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
28 cm. Gr. 06 ...	28 cm. Coast Defence Howitzer (Rifling, grooves)	<i>Lg. Bd. Z. 10*</i> <i>Kz. Bd. Z. 10*</i>	yards. — —	yards. 12,030 12,030

Material—Steel.

Weight—

Shell complete, 350 kg. (771·6 lbs.).

Bursting charge, 10·01 kg. (22·0 lbs.). *Fp. 02* (cast T.N.T.).

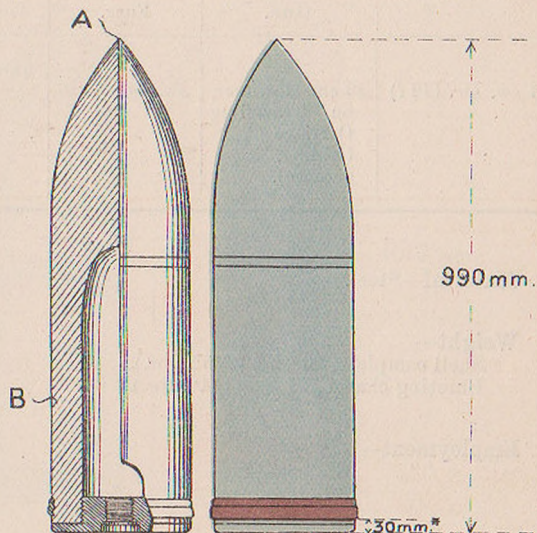
Employment—Its effect is good against modern armoured decks (superstructure, upper and battery decks) at ranges of 4,400 yards and over, at which ranges the shell will penetrate an armoured deck 6·3 inches thick.

Remarks—In addition to the 28 cm. Gr. 06, there is a 28 cm. *Lggr.* (28 cm. *Lang-granate*) or double shell, of which the following details are available : It has a maximum range of 10,608 yards, and should be employed at ranges below 4,375 yards in preference to 28 cm. Gr. 06. It has a considerably larger bursting charge than 28 cm. Gr. 06.

* Shells manufactured prior to 1911 are fitted with *Lg. Bd. Z. 10*, those of later date with *Kz. Bd. Z. 10*. These fuzes have superseded *Bd. Z. 06*.

28 cm. Gr. 06.

Calibre, 28 cm. (11.02") (?)

SCALE - $\frac{1}{15}$.

Thickness of walls—

At A, 420 mm.*

At B, 63 mm.*

Thickness of base—70 mm.*

Width of driving band—41 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

1912 (?) Pattern 28 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
28 cm. Gr. (12 ?)	28 cm. Howitzer, on Travelling Carriage (Rifling, grooves).	Kz. Bd. Z. 10	yards. —	yards. 12,030

Material—Steel.

Weight—

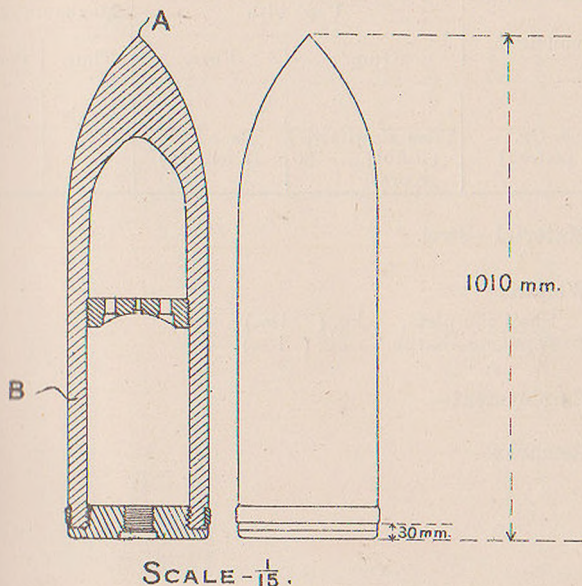
Shell complete, 338 kg. (745·2 lbs.).

Bursting charge, 52 kg. (114·6 lbs.).

Employment—

Remarks—

28 cm. Gr. (12?).
Calibre, 28 cm. (11.02") (?).



Thickness of walls—

At A, 200 mm.*

At B, 35 mm.

Thickness of base—65 mm.

Width of driving band—33 mm.

Distinctive markings—

* Approximate measurement.

? Pattern 28 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
28 cm. Gr. (? pattern)	28 cm. Howitzer(?) (Rifling, 80 grooves)	Base fuze (? pattern)	yards. (?)	yards. (?)

Material—Steel.

Weight—

Shell complete, kg. (lbs.)

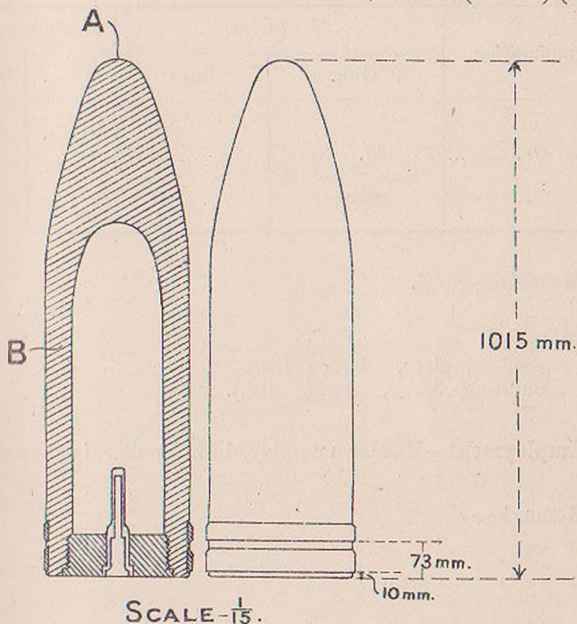
Bursting charge, kg. (lbs.)

Employment—

Remarks—

28 cm. Gr. (? pattern).

Calibre, 28 cm. (11.02") (?).

SCALE— $\frac{1}{15}$.

Thickness of walls—

At A, 315 mm.

At B, 50 mm.

Thickness of base—85 mm.

Width of driving bands—Upper band, 35 mm., lower, 45 mm.

Distinctive markings—

38 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
38 cm. Gr. ...	38 cm. Naval Gun (Rifling, grooves)		yards.	yards.

Material—Steel.

Weight—

Shell complete, kg. (lbs.).
Bursting charge, kg. (lbs.).

Employment—Has been employed for bombarding towns.

Remarks—

38 cm. Gr.

Calibre, 38 cm. (14.96") (?).

Thickness of walls—

At A, mm.

At B, mm.

Thickness of base—110 mm.

Width of driving band— mm.

Distinctive markings—

42 cm. H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
42 cm. Gr. ..	42 cm. Mortar (Rifling, 120 grooves)	Special.	yards. —	yards. (?)*

Material—Steel.

Weight—

Shell complete, 931 kg. (2,052 lbs.).

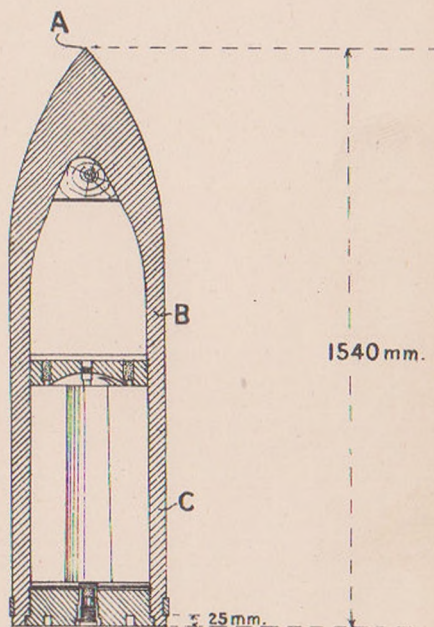
Bursting charge, 106 kg. (234 lbs.). *Fp. 02* (cast T.N.T.).

Employment—Principally employed against permanent fortifications, but is also used for bombarding towns and against field fortifications.

Remarks—

* Reported to be about 14,000 yards.

42 cm. Gr.
Calibre, 42 cm. (16.54").



SCALE - $\frac{1}{20}$.

Thickness of walls—

At A, 295 mm.

At B, 52 mm.

At C, 46 mm.

Thickness of base—95 mm.

Width of driving band—50 mm.

Distinctive markings—

1896 Pattern 7.7 cm. Field Gun Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>F. Schr. Patr.</i> (fixed ammunition)	Field Gun 96 n/A. (Rifling, 32 grooves)	<i>Dopp. Z. 96</i> <i>n/A.</i>	yards. 5,850*	yards. 9,186

Material—Steel.

Weight—

Shell complete, 6.825 kg. (15.04 lbs.).

Bursting charge, 0.093 kg. (0.2 lb.). Black powder.

Bullets—300 10-g. bullets, 45 to the lb.

Employment—*As time shrapnel*: against all living targets, except when these are close behind or under cover (*e.g.*, behind shields, at the bottom of trenches or in shelters) or in tall timbered woods.

As percussion shrapnel: destruction of vertical targets capable of offering resistance.

Its incendiary effect is better than that of the field gun "Universal" or 1896 pattern shells.

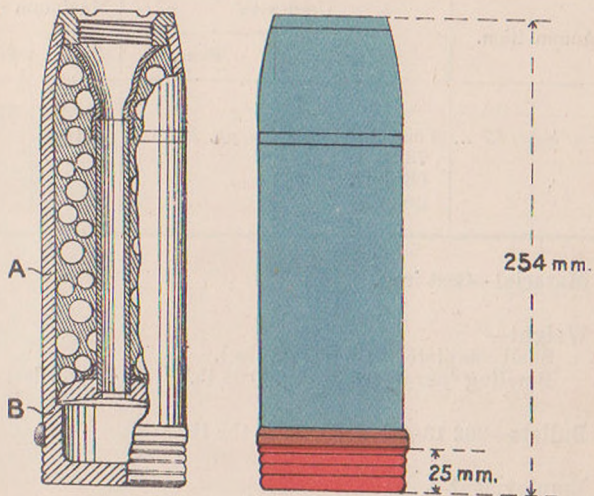
Remarks—The space between the bullets is filled up near the base of the shell with molten resin, in the central part with black powder, and in the upper part with a mixture of resin and paraffin wax.

For range table, see Appendix II.

* With a certain proportion of fuzes up to 7,820 yards.

7.7 cm. Schr.

Calibre, 7.7 cm. (3.03").

SCALE— $\frac{1}{4}$.

Thickness of walls—

At A, 5 mm.

At B, 11 mm.

Thickness of base—9 mm.

Width of driving band—7.5 mm.

Distinctive markings—

1882 Pattern 9 cm. Field Gun Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
9 cm. <i>Schr.</i> 82 ...	9 cm. Field Gun 73/88 (Rifling, 24 grooves)	<i>Dopp. Z.</i> 86 ...	yards. 3,445	yards. —

Material—Cast iron.

Weight—

Shell complete, 8.1 kg. (17.8 lbs.).

Bursting charge, 0.0225 kg. (0.05 lb.). Black powder.

Bullets—262 13-g. bullets, 35 to the lb.

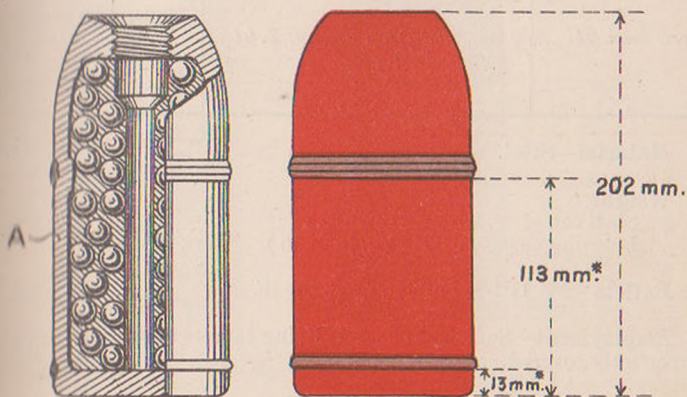
Employment—

Remarks—An obsolete shrapnel.

For range table, see Appendix III.

9 cm. Schr. 82.

Calibre, 8.8 cm. (3.46").

SCALE - $\frac{1}{4}$.

Thickness of walls—At A, 8 mm.*

Thickness of base—13 mm.*

Width of driving bands—Upper band 11 mm.,* lower 5 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33
(B 11938)

1891 Pattern 9 cm. Field Gun Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
9 cm. Schr. 91 ...	9 cm. Field Gun 73/88 (Rifling, 24 grooves).	Dopp. Z. 91 ...	yards. 4,921	yards. 7,109

Material—Steel.

Weight—

Shell complete, 7.5 kg. (16.5 lbs.).

Bursting charge, 0.0045 kg. (0.01 lb.). Black powder.

Bullets—285 11.1-g. bullets, 41 to the lb.

Employment—Sufficient effect at living targets in the open or imperfectly covered.

Remarks—A variation of this shell has been found on the British front which differs in the following particulars:—

Head—Screwed in, exterior height of this portion being 19 mm.

Base—Solid, 20 mm. thick.

Walls—7.5 mm. thick, stepped to 12.5 mm. thick at a height of 45 mm. above the base.

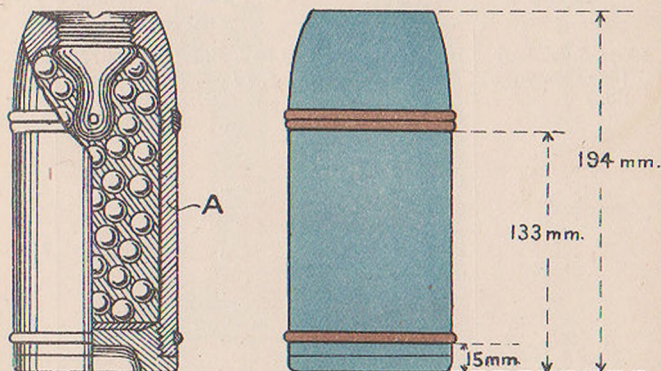
Width of driving bands—Upper band 11 mm., lower 8 mm.

Fuze—Dopp. Z. 92 f. 10 cm. K.

For range table, see Appendix III.

9 cm. Schr. 91.

Calibre, 8.8 cm. (3.46").

SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 7 mm.

Thickness of base—9 mm.

Width of driving bands—Upper band, 10.5 mm., lower, 4 mm.

Distinctive markings—V.K. stamped on nose of shell indicates the more recent type.

V.K. = *Verkürzte Kammerhülse*, or shortened central tube. This is shown in the sketch above, whereas in the older pattern shrapnel the central tube was carried down nearly the whole length of the shell.

1896 Pattern 10 cm. Gun Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
10 cm. <i>Schr. Patr.</i> (fixed ammunition)	10 cm. Gun 32 (Rifling, 32 grooves)	<i>Dopp. Z. 92</i> <i>f. 10 cm. K.</i>	yards. 9,077	yards. 11,264
	10 cm. Gun 04 (Rifling, 32 grooves)	„	9,077	11,264
	10 cm. Gun 14 (Rifling, 32 grooves)	„	9,077	11,264
	10 cm. Gun with Overhead Shield (Rifling, 32 grooves)	„	9,296	11,811
	10 cm. Gun in Turret (Rifling, 32 grooves)	„	9,296	11,811
	10 cm. Gun, Re- inforced, in Turret (Rifling, 32 grooves)	„	9,296	11,811
	10 cm. Short Gun in Turret (Rifling, 32 grooves)	„	8,640	10,608

Material—Steel.

Weight—

Shell complete, 17.9 kg. (39.5 lbs.).

Bursting charge, 0.2 kg. (0.4 lb.). Black powder.

Bullets—680 11.1-g. bullets, 41 to the lb.

Employment—Against living targets in the open or insufficiently covered; to sweep roads and engage aircraft.

Sufficient effect against shielded guns only when used in connection with enfilade fire.

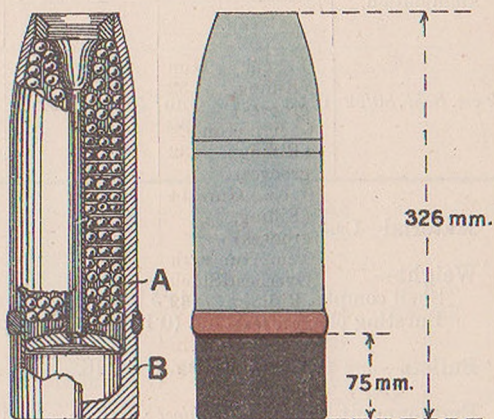
Has incendiary effect when fired as percussion shrapnel, but action is not certain.

Remarks—The space between the bullets is filled up near the base of the shell with molten resin, in the central part with black powder, and in the upper part with a mixture of resin and paraffin wax.

For range tables, see Appendix V.

10 cm. Schr. 96.

Calibre, 10.5 cm. (4.13").

SCALE— $\frac{1}{6}$.

Thickness of walls—

At A, 8 mm.

At B, 12 mm.

Thickness of base—19 mm.

Width of driving band—15 mm.

Distinctive markings—A red ring round the centre of the cylindrical portion indicates that the shrapnel is of recent manufacture.

1880/1892 Pattern 12 cm. Gun Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
12 cm. Schr. 80/92	12 cm. Heavy Gun (Rifling, 30 grooves).	Dopp. Z. 92 ...	yards. 7,218	yards. —

Material—Cast iron.

Weight—

Shell complete, 20·2 kg. (44·5 lbs.)

Bursting charge, 0·05 kg. (0·1 lb.). Black powder.

Bullets—592 13-g. bullets, 35 to the lb.

Employment—*Principal object*: to engage living targets of all kinds, sweep communications of all kinds, and bombard localities.

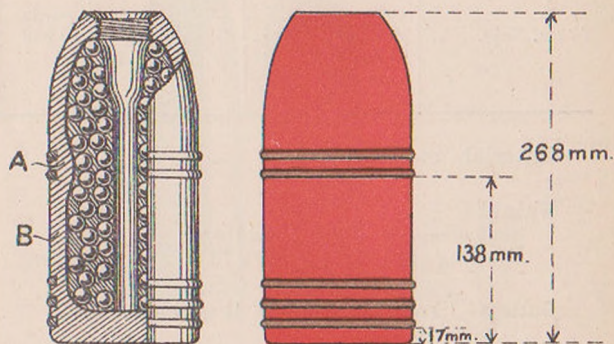
Good effect at living targets in the open or insufficiently covered, silhouetted targets and captive balloons.

Remarks—The space between the bullets is filled up with sulphur.

For range table, see Appendix VI.

12 cm. Schr. 80/92.

Calibre, 12.03 cm. (4.73").

SCALE - $\frac{1}{6}$.

Thickness of walls—

At A, 18 mm.

At B, 13 mm.

Thickness of base—26 mm.

Width of driving bands—4 mm. (15.5 mm. apart).

Distinctive markings—

13 cm. Gun Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
13 cm. Schr. ...	13 cm. Gun 36 (Rifling, grooves)	Dopp. Z. 92 f. 10 cm. K.	yards. 10,936	yards. 15,311*

Material—Steel.

Weight—

Shell complete, 40 kg. (88·2 lbs.).

Bursting charge, 0·4 kg. (0·9 lb.). Black powder.

Bullets—1,170 11·1-g. bullets, 41 to the lb.

Employment—*Principal object*: to engage living targets in the open or insufficiently covered; to sweep communications of all kinds and bombard localities; to engage captive balloons.

Good effect against targets in the open or insufficiently covered, and captive balloons.

Effective against shielded batteries, but only when used in connection with enfilade fire.

Moderate incendiary effect when fired as percussion shrapnel.

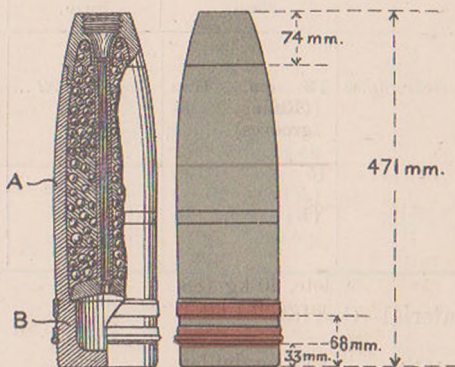
Remarks—The space between the bullets is filled up near the base of the shell with molten resin, in the centre part with black powder, and in the upper part with a mixture of resin and paraffin wax.

For range table, see Appendix VII.

* In the range table for this gun (see Appendix VII), the maximum range for percussion shrapnel is stated to be 15,857 yards, but a German document, dated 12.9.15, gives the maximum range as 15,311 yards.

13 cm. Schr.

Calibre, 13.5 cm. (5.31").

SCALE - $\frac{1}{10}$.**Thickness of walls—**

At A, 16.5 mm.

At B, 28 mm.

Thickness of base—23 mm.**Width of driving bands—24 mm.**

Distinctive markings—One or two red rings round the centre of the cylindrical portion indicate that the shrapnel is of recent manufacture.

1880/1892 Pattern 15 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Schr. 80/92	15 cm. Gun (<i>Lange Ringkanone</i>) (Rifling, 24 grooves)	<i>Dopp. Z.</i> 92 ...	yards. 7,655	yards. —
	15 cm. Gun (<i>Ringkanone</i>) (Rifling, 24 grooves)	„ ...	7,546	—

Material—Cast iron.

Weight—

Shell complete, 39·6 kg. (87·3 lbs.).

Bursting charge, 0·055 kg. (0·1 lb.). Black powder.

Bullets—633 28-g. bullets, 16 to the lb.

Employment—*Principal object*: to engage targets in the open or insufficiently covered, to sweep communications of all kinds and to bombard localities.

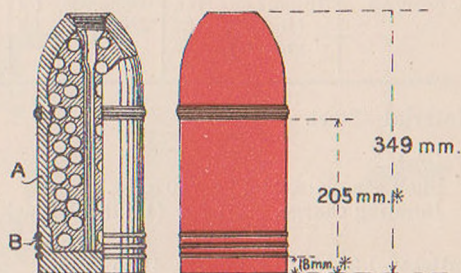
Good effect against living targets in the open or insufficiently covered, and against captive balloons.

Remarks—The space between the bullets is filled up with sulphur.

For range table of *Ringkanone*, see Appendix VIII.

15 cm. Schr. 80/92.

Calibre, 14.97 cm. (5.89").

SCALE $\frac{1}{10}$.**Thickness of walls—**

At A, 14 mm.*

At B, 18 mm.*

Thickness of base—32 mm.***Width of driving bands—**Upper band, 15 mm.*; lower bands, 5 mm.* (11 mm.* apart).**Distinctive markings—**

* Measurement approximate only, see footnote on page 33.

1892 Pattern 15 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Schr. 92 ...	15 cm. Long Gun (Rifling, 36 grooves)	Dopp. Z. 08 Dopp. Z. 92	yards. 8,968	yards. —

Material—Steel.

Weight—

Shell complete, 41·2 kg. (90·8 lbs.).

Bursting charge, 0·457 kg. (1·0 lb.). Black powder.

Bullets—1,320 11·1-g. bullets, 41 to the lb.

Employment—*Principal object*: to engage living targets in the open or insufficiently covered and targets behind cover, to sweep communications of all kinds, and to bombard localities, detraining stations, and parks.

Good effect against living targets in the open or insufficiently covered, silhouetted targets and captive balloons.

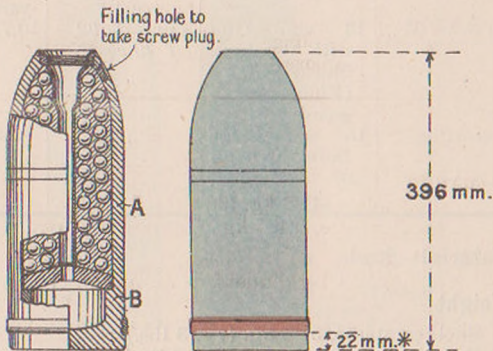
Remarks—The space between the bullets is filled up with molten resin.

There is an older pattern of this shrapnel called 15 cm. Schr. 90/92 which contains 632 24-g. bullets, 19 to the lb.

For range table, see Appendix IX.

15 cm. Schr. 92.

Calibre, 14.97 cm. (5.89").

SCALE $\frac{1}{10}$.

Thickness of walls—

At A, 15 mm.*

At B, 25 mm.*

Thickness of base—25 mm.*

Width of driving band—18 mm.*

Distinctive markings—The 15 cm. Schr. 90/92 differs from the above in that it has four vertical black stripes (35 mm. by 15 mm.) painted on the head of the shell.

* Measurement approximate only, see footnote on page 33.

1903 Pattern 15 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. <i>Schr. 03</i> ...	15 cm. Gun with Overhead Shield (<i>i.S.L.</i>) (Rifling, grooves)	<i>Dopp. Z. 92 f. 10 cm. K.</i>	yards. 10,718	yards. 17,060
	15 cm. Coast Defence Gun 07 (Rifling, grooves)	„	8,530	8,530

Material—Steel.

Weight—

Shell complete, 51·4 kg. (113·3 lbs.).

Bursting charge, 0·545 kg. (1·2 lbs.). Black powder.

Bullets—1,550 11·1-g. bullets, 41 to the lb.

Employment—Good effect against living targets in the open or insufficiently covered, against detrainig stations and parks, and to prevent the enemy deploying and forming up.

Suitable also for firing at aircraft at long ranges.

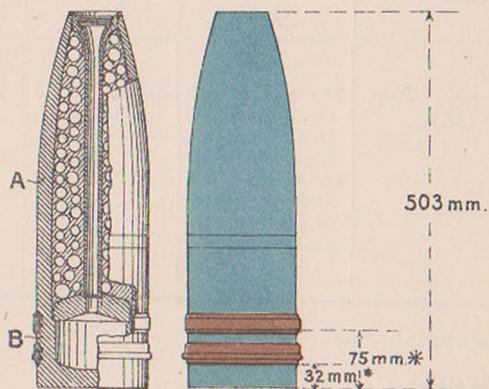
Against shielded batteries, it is effective only in connection with enfilade fire.

Remarks—The space between the bullets is filled up with molten resin.

There is a variation of this shell called 15 cm. *Schr. 03 (umg.)* which differs very slightly from it and is externally identical with it.

15 cm. Schr. 03.

Calibre, 14.97 cm. (5.89").

SCALE $\frac{1}{10}$.**Thickness of walls—**

At A, 20 mm.*

At B, 25 mm.*

Thickness of base—25 mm.***Width of driving bands—**25 mm.***Distinctive markings—**Shells of recent manufacture have a red ring round the centre of the cylindrical portion.

* Measurement approximate only, see footnote on page 33.

1903 (gr.) Pattern 15 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Schr. 03 (gr.)	15 cm. Gun with Overhead Shield (i.S.L.) (Rifling, grooves)	Dopp. Z. 92 f. 10 cm. K.	yards. 10,718	yards. 17,060
	15 cm. Coast Defence Gun 07 (Rifling, grooves)	„	8,530	8,530

Material—Steel.

Weight—

Shell complete, kg. (lbs.).
Bursting charge, kg. (lbs.).

Bullets— g. bullets, to the lb.

Employment—Good effect against living targets in the open or insufficiently covered, against detraining stations and parks, and to prevent the enemy deploying and forming up. Suitable also for firing at aircraft at long ranges.

Against shielded batteries, it is effective only in connection with enfilade fire.

It has incendiary effect.

Remarks—

15 cm. Schr. 03 (gr.).

Calibre, 14.97 cm. (5.89").

Thickness of walls—

At A, mm.

At B, mm.

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—Painted grey, with a red ring round the centre of the cylindrical portion. Shells of less recent manufacture do not have this red ring.

1907 Pattern 15 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
15 cm. Schr. 37 ...	15 cm. Long Gun (Rifling, 36 grooves)	Dopp. Z. 92 ...	yards. 8,968	yards. —

Material—Steel.

Weight—

Shell complete, 41.2 kg. (90.8 lbs.).

Bursting charge, 0.47 kg. (1.0 lb.). Black powder.

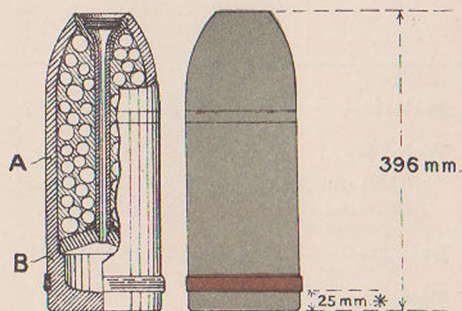
Bullets—1,600 11.1-g. bullets, 41 to the lb.

Employment—Good effect against living targets in the open or insufficiently covered, silhouetted targets and captive balloons.

Remarks—The space between the bullets is filled up with molten resin.

For range table, see Appendix IX.

15 cm. Schr. 07.
Calibre, 14.97 cm. (5.89").



SCALE— $\frac{1}{10}$.

Thickness of walls—

At A, 15 mm.*

At B, 23 mm.*

Thickness of base—25 mm.*

Width of driving band—18 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

(?) Pattern 15 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
(?)	15 cm. Gun (<i>Ring-kanone</i>) (?) (Rifling, 24 grooves)	<i>Dopp. Z. 92 ...</i>	yards. 7,546(?)	yards. —

Material—Steel.

Weight—

Shell complete, kg. (lbs.).
Bursting charge, kg. (lbs.).

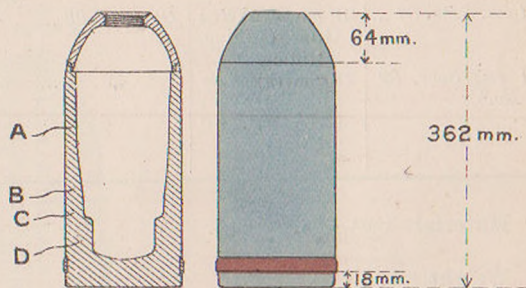
Bullets— 25 g. bullets, 18 to the lb.

Employment—

Remarks—These shrapnel have been fired against several portions of the British front.

15 cm. Schr. (?) pattern.

Calibre 14.97 cm. (5.89").

SCALE - $\frac{1}{10}$.

Thickness of walls—

At A, 12 mm.

At B, 17 mm.

At C, 23 mm.

At D, 34 mm.

Thickness of base—37 mm.

Width of driving band—20 mm.

Distinctive markings—

1889 Pattern 21 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>21 cm. Schr. 89 ...</i>	21 cm. Jacketed Gun (Rifling, 30 grooves) 21 cm. Howitzer in Turret (Rifling, 30 grooves)	<i>Dopp. Z. 92 ...</i>	yards. —	yards. —
<i>21 cm. Schr. 89 Ec.*</i>		„ ...	5,960	—

Material—Cast iron.

Weight—

Shell complete, 81·8 kg. (180·3 lbs.).

Bursting charge, 0·22 kg. (0·5 lb.). Black powder.

Bullets—1,265 28-g. bullets, 16 to the lb.

Employment—Good effect against living targets in the open or insufficiently covered.

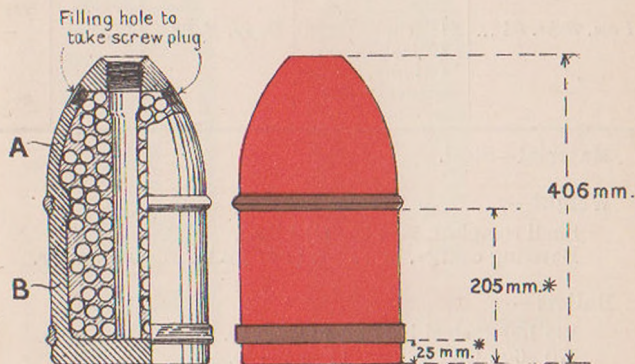
Remarks—The space between the bullets is filled up with molten resin.

For range table of 21 cm. howitzer in turret, see Appendix XVII.

* *21 cm. Schr. 89 Ec.* differs from *21 cm. Schr. 89* in that it has no upper driving band.

21 cm. Schr. 89.

Calibre, 20.93 cm. (8.24").

SCALE— $\frac{1}{10}$.

Thickness of walls—

At A, 12 mm.

At B, 25 mm.

Thickness of base—33 mm.*

Width of driving bands—Upper band, 20 mm.,* lower, 25 mm.*

Distinctive markings—21 cm. Schr. 89 Ec. is coloured as above but has no upper driving band.

* Measurement approximate only, see footnote on page 33.

1904 Pattern 21 cm. Shrapnel.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
21 cm. Schr. 04 ...	21 cm. Gun (Ringkanone) (Rifling, 30 grooves)	Dopp. Z. 92 ...	yards. 7,655	yards. —

Material—Steel.

Weight—

Shell complete, 96·6 kg. (213 lbs.).

Bursting charge, 1·077 kg. (2·37 lbs.). Black powder.

Bullets—

135 150-g. steel bullets, 3 to the lb.

170 26-g. lead bullets, 17 to the lb.

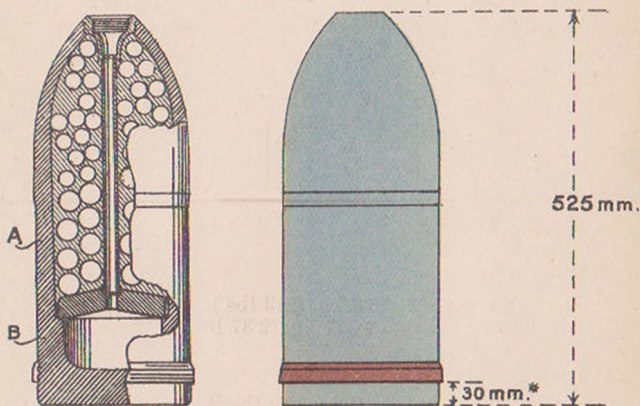
Employment—Good effect against living targets which are unprotected or protected only by light shields.

Remarks—Hard nickel steel plates, 0·47" thick, are penetrated by the 5½-oz. steel bullets up to a range of 5,468 yards and at a distance of 33 yards from the point of burst.

The space between the bullets is filled up with molten resin.

21 cm. Schr. 04.

Calibre, 20.93 cm. (8.24").

SCALE - $\frac{1}{10}$.

Thickness of walls—

At A, 22 mm.*

At B, 36 mm.*

Thickness of base—47 mm.*

Width of driving band—27 mm.*

Distinctive markings—

* Measurement approximate only, see footnote on page 33.

7.5 cm. Light Minenwerfer Gas Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Leichte Wurf-Mine (l.W.M.)</i>	7.5 cm. Light Minenwerfer (Rifling, 6 grooves)	<i>l.W.M. Zdr....</i>	yards. 1,148	yards. 1,148

Material—Drawn steel tube.

Weight—

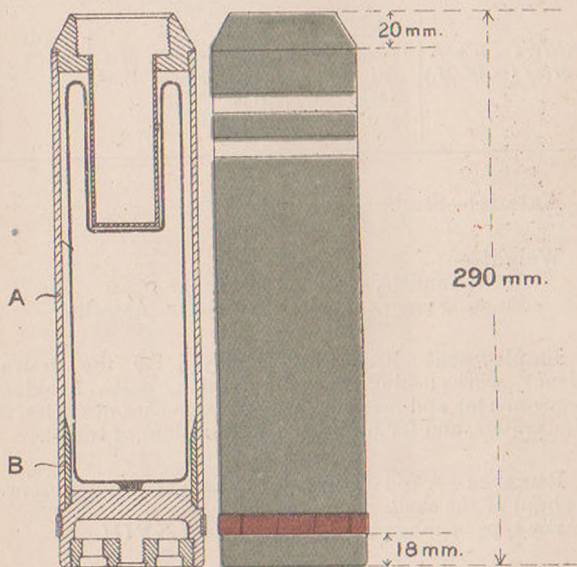
Shell complete, kg. (lbs.)
 Bursting charge, kg. (lbs.)

Employment—Employed in trench warfare as an asphyxiating and lachrymatory shell (*see* page 26).

Remarks—This shell is self-propelling (*see* "Remarks" on page 160). The walls of the shell are of steel tube, reinforced near the base by a liner of similar tube. The two tubes have apparently been acetylene-welded on to a forged base. Into the head is fitted a steel tube, closed at the bottom, and probably containing T.N.T., the liquid employed being chlormethylchloroformate. The space between the receptacle and the walls of the shell is filled with a white cement, consisting of carbonate and oxychloride of magnesium.

7.5 cm. Leichte Wurf-Mine (Gas Shell).

Calibre, 7.5 cm. (2.95").



Thickness of walls— SCALE — $\frac{1}{4}$.

At A, 3 mm.

At B, 6 mm.

Thickness of base—15 mm.

Width of driving band*—10 mm.

Distinctive markings—There are two white bands near the head, the position and width of which are shown only approximately.

* This Minenwerfer being a rifled muzzle-loader, the driving band is studded to fit the grooves of the rifling.

17 cm. Medium Minenwerfer H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Mittlere Wurf-Mine (m.W.M.)</i>	17 cm. Medium Minenwerfer (Rifling, 6 grooves)	<i>Z. m. W. M.</i> <i>Z. s.u. m. W. M.</i>	yards. 850*	yards. 850*

Material—Steel.

Weight—

Shell complete, 45.2 kg. (99.6 lbs.).

Bursting charge, 9.8 kg. (21.6 lbs.). Astralite.

Employment—Principally employed for the destruction of defence works :—dug-outs, observation posts, flanking works, trench-mortar and machine-gun emplacements, obstacles, traverses, mine craters, and for firing on concentrations of troops.

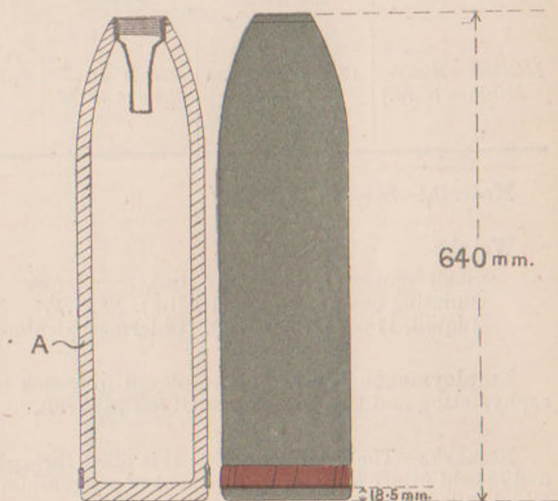
Remarks—A collar, threaded to take the fuze is screwed into the head of the shell.

For type of range table, *see* Appendix XVIII.

* The range is now probably considerably in excess of this, which is the range given in a German document dated 23. 8. 15.

17 cm. Mittlere Wurf-Mine.

Calibre, 17 cm. (6.69").



SCALE $-\frac{1}{10}$.

Thickness of walls—At A, 18 mm.

Thickness of base—25 mm.

Width of driving band*—28 mm.

Distinctive markings—

* This Minenwerfer being a rifled muzzle-loader, the driving band is studded to fit the grooves of the rifling.

17 cm. Medium Minenwerfer Gas Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Mittlere Wurf-Mine (m. W. M.)</i>	17 cm. Medium Minenwerfer (Rifling, 6 grooves)	<i>Z.m.W.M.</i> <i>Z.s.u.m.W.M.</i>	yards. 850*	yards. 850*

Material—Steel.

Weight—

Shell complete, 42 kg. (92.6 lbs.).

Bursting charge, 0.5 kg. (1.1 lbs.). T.N.T.

Liquid, 11.5 kg. (25.4 lbs.). Chlormethylchloroformate.

Employment—This shell is employed in trench warfare as an asphyxiating and lachrymatory shell (see page 26).

Remarks—The lead receptacle B is filled through the plug C and is held firmly in place by a cement of magnesium oxychloride, which fills up any empty space between the receptacle and the walls.

On top of the receptacle is a layer of cement D which keeps the gaine in place. Above this is a slab F of about 500 g. of T.N.T., which is cast in a small tin case.

Round the gaine is a charge G of 30 g. of picric acid which acts as an exploder.

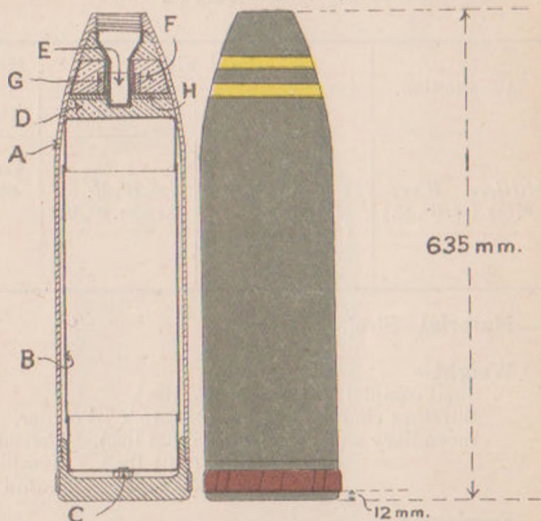
Below the bursting charge is an iron plate H, 5 mm. thick, which prevents the charge being loosened by the shock of discharge and penetrating the receptacle.

Only the upper portion of the shell is destroyed when it explodes, so that the liquid contents are scattered with but little spraying effect, which is a great advantage with an easily volatilized liquid.

* The range is now probably considerably in excess of this, which is the range given in a German document dated 28. 8. 15.

17 cm. Mittlere Wurf-Mine (Gas Shell).

Calibre, 17 cm. (6.69").



Thickness of walls—

At A, 6 mm.

At B, 6 mm.

SCALE — $\frac{1}{10}$.

Thickness of base—30 mm.

Width of driving band*—28 mm.

Distinctive markings—Two shells containing chlormethylchloroformate were painted light grey and have, near the top of the shoulder, two rings, yellow in one instance, white in the others. One bears, in red lettering, the marks

C M 12

Ladung

m W (then probably M 13).

A third shell of this type containing bromethylmethylketone was painted grey, and marked in black lettering

B M 12

Ladung

m. W. M.

* This Minenwerfer being a rifled muzzle-loader, the driving band is studded to fit the grooves of the rifling.

17 cm. Medium Minenwerfer Incendiary Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Mittlere Wurf-Mine (m.W.M.)</i>	17 cm. Medium Minenwerfer (Rifling, 6 grooves)	<i>Z.m.W.M.</i> <i>Z.s.u.m.W.M.</i>	yards. 850*	yards. 850*

Material—Steel.

Weight—

Shell complete, 37·4 kg. (82·5 lbs.).

Bursting charge, 0·01 kg. (0·02 lb.). Powder.

Incendiary charge—9·0 kg. (19·8 lbs.). Thermite.

6·4 kg. (14·1 lbs.). Metallic sodium.

0·8 kg. (1·8 lbs.). Paraffin wax.

Employment—

Remarks—In plate opposite :—

B is a wooden cylinder in the gaine of the fuze, and is pierced by a channel leading to C.

C is a tin receptacle containing the powder charge.

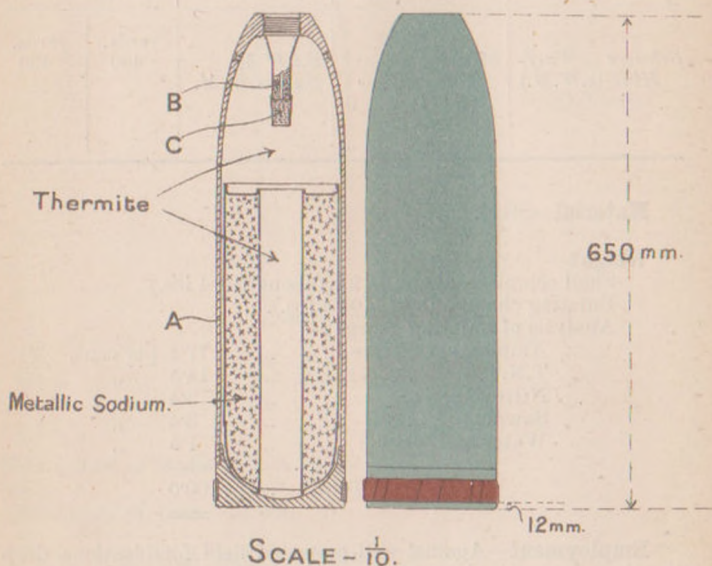
The metallic sodium is contained in a tin receptacle, which is hermetically sealed, and is kept in place by paraffin wax.

The remainder of the shell, including the channel down the centre of the metallic sodium receptacle, is filled with thermite (see page 28).

* The range is now probably considerably in excess of this, which is the range given in a German document dated 28.8.15.

17 cm. Mittlere Wurf-Mine. (Incendiary Shell.)

Calibre, 17 cm. (6·69").



Thickness of walls—At A, 5 mm.

Thickness of base—15 mm.

Width of driving band*—28 mm.

Distinctive markings—In black lettering Y. 17^h.

* This Minenwerfer being a rifled muzzle-loader, the driving band is studded to fit the grooves of the rifling.

25 cm. Heavy Minenwerfer (Long) H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Schwere Wurf-Mine (s.W.M.)</i>	25 cm. Heavy Minenwerfer (Rifling, 6 grooves)	<i>Z.s.W.M.</i> <i>Z.s.u.m.W.M.</i>	yards. 460	yards. 460

Material—Steel.

Weight—

Shell complete, about 95 kg. (about 209·4 lbs.).

Bursting charge, 43 kg. (94·8 lbs.).

Analysis of bursting charge :—

Ammonium nitrate ...	...	77·2	per cent.
T.N.T. ...	...	14·5	"
Nitroglycerine ...	...	3·4	"
Sawdust ...	...	3·4	"
Water and residue ...	...	1·5	"

Total	...	100·0
-------	-----	-------

Employment—Against well-protected field fortifications, deep trenches, dug-outs, observation posts, trench-mortar and machine-gun emplacements, mine shafts and craters, obstacles and parapets.

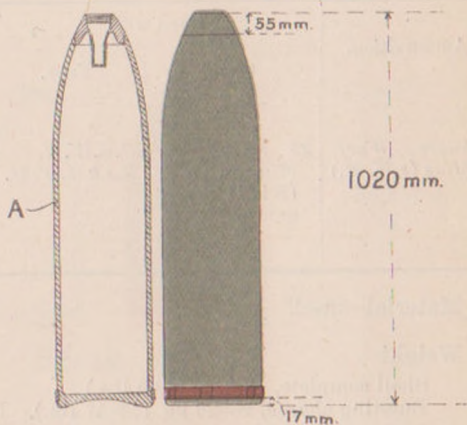
Remarks—A variation of this shell, 1,000 mm. in length, is made in one casting, and has a screwed-in base.

Another variation, 950 mm. in length, has a copper driving band which fits over the base like a collar and is prevented from slipping by 4 plates let into the base and secured by 4 set screws.

For range table, see Appendix XVIII.

25 cm. Schwere Wurf-Mine.

Calibre, 25 cm. (9·84").

SCALE— $\frac{1}{20}$.

Thickness of walls—At A, about 11 mm.

Thickness of base—15 mm.

Width of driving band*—30 mm.

Distinctive markings—

* This Minenwerfer being a rifled muzzle-loader, the driving band is studded to fit the grooves of the rifling.

25 cm. Heavy Minenwerfer (Short) H.E. Shell.

Ammunition.	Used with		Maximum range.	
	Gun.	Fuze.	Time.	Perc'n.
<i>Schwere Wurf-Mine (s.W.M.)</i>	25 cm. Heavy Minenwerfer (Rifling, 6 grooves)	<i>Z.m.W.M.</i> <i>Z.s.u.m.W.M.</i>	yards. 460 (?)	yards. 460 (?)

Material—Steel.

Weight—

Shell complete, 63 kg. (138·9 lbs.).

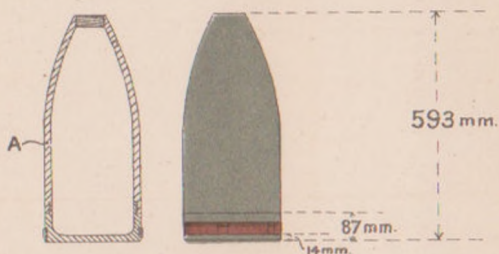
Bursting charge, 25-26 kg. (55-57 lbs.). Nitrolite.

Employment—Against well-protected field fortifications:—deep trenches, dug-outs, observation posts, trench-mortar and machine-gun emplacements, mine shafts and craters, obstacles and parapets.

Remarks—

25 cm. Schwere Wurf-Mine.

Calibre, 25 cm. (9.84").

SCALE - $\frac{1}{20}$.

Thickness of walls—At A, 16 mm.

Thickness of base—12 mm.

Width of driving band*—30 mm.

Distinctive markings—"Nitrolit Leverkusen a/R" is painted in black letters on shells of this type, manufactured by Friedrich Bayer of Leverkusen-am-Rhein, near Düsseldorf.

* This Minenwerfer being a rifled muzzle-loader, the driving band is studded to fit the grooves of the rifling.

APPENDIX I.

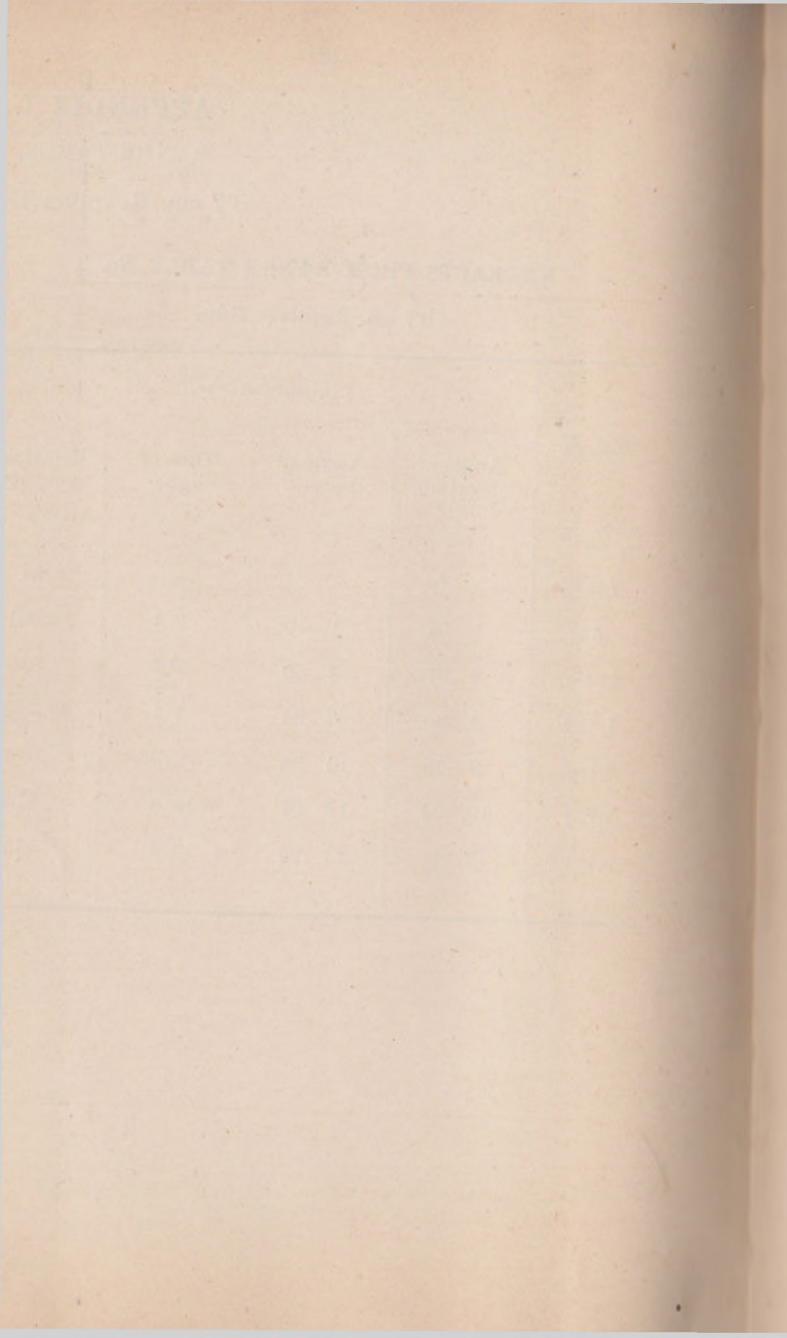
RANGE TABLE.

3·7 cm. Revolver Gun.

EXTRACTS FROM RANGE TABLE No. 3.

3·7 cm. Revolver Gun.

Range.	Common Shell.			
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
Yards.	° ' ''	° ' ''	secs.	f.s.
547	1 07	1 19	1·4	1,001
1,004	2 37	3 26	3·2	850
1,640	4 30	6 22	5·3	733
2,187	6 56	10 26	7·8	646
2,734	10 04	16 07	10·6	574
3,281	13 41	23 26	13·8	515



APPENDIX II.

RANGE TABLE.

7.7 cm. Field Gun.

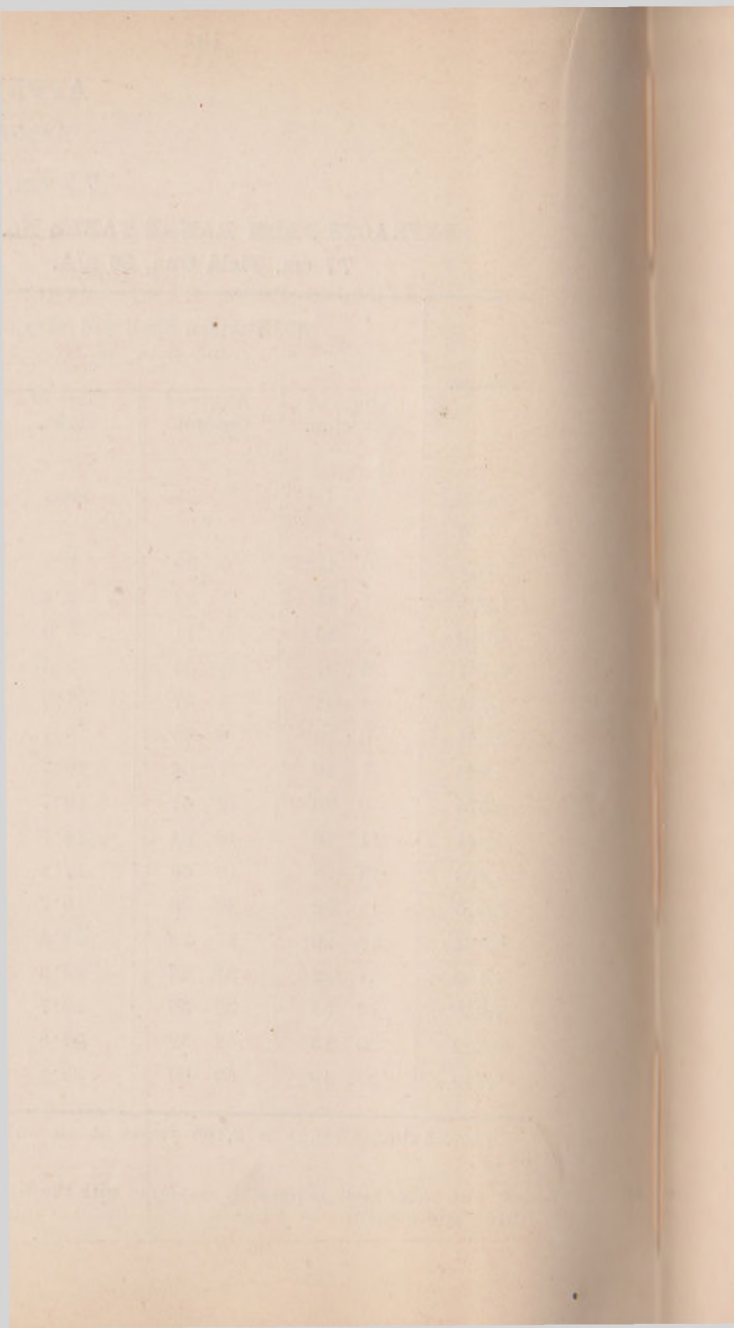
EXTRACTS FROM RANGE TABLE No. 4(?).

7.7 cm. Field Gun, 96 n/A.

Range.	1896 Pattern Shell and Shrapnel.*			
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
Yards.	° ' "	° ' "	secs.	f.s.
0	...	...	...	M.V. 1,526
547	0 45	0 49	1.2	1,339
1,094	1 34	1 52	2.4	1,203
1,640	2 30	3 11	3.9	1,102
2,187	3 37	4 45	5.4	1,024
2,734	4 52	6 37	7.0	968
3,281	6 19	8 45	8.7	919
3,828	7 49	11 04	10.7	876
4,374	9 30	13 41	12.7	840
4,921	11 26	16 34	14.7	810
5,468	13 28	19 49	17.2	784
6,015	15 52	23 26	19.7	761
6,562	18 26	27 22	22.4	741
7,109	21 22	31 52	25.3	732
7,655	24 52	36 56	28.7	725
8,202	29 15	42 49	32.8	732
8,749	35 19	50 00	38.4	748

The maximum range is 9,186 yards at an angle of elevation of 43°.

* This range table is probably employed with the Universal, 1914 and 1915 Pattern Shells.



APPENDIX III.

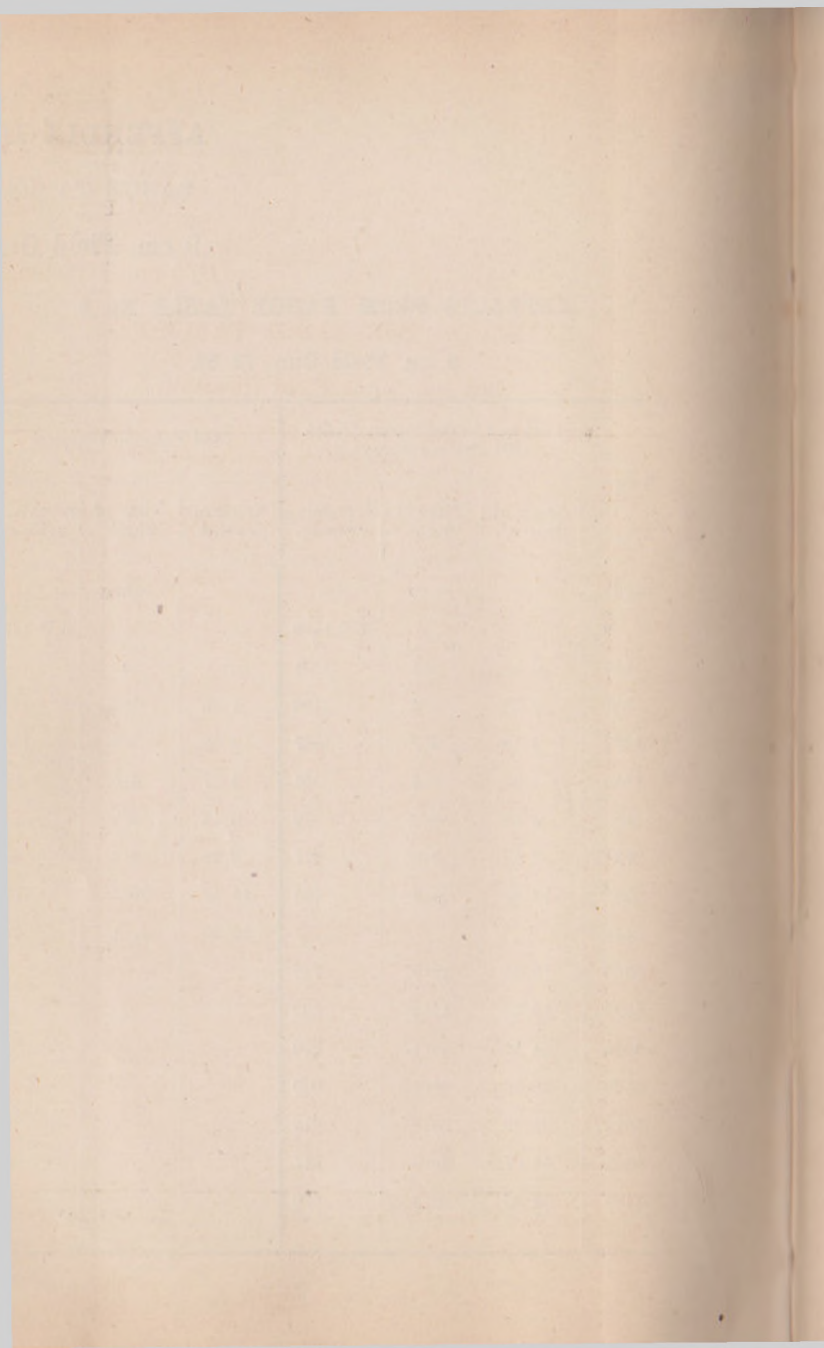
RANGE TABLE.

9 cm. Field Gun.

EXTRACTS FROM RANGE TABLE No. 5.

9 cm. Field Gun '73/'88.

Range.	1882 and 1888 Pattern Shells. 1891 Pattern Shrapnel.			1882 Pattern Shrapnel		
	Angle of descent.	Time of flight.	Remaining velocity.	Angle of descent.	Time of flight.	Remaining velocity.
yards.	° ' "	secs.	f.s.	° ' "	secs.	f.s.
0	...	...	M.V. 1450	...	...	M.V. 1375
110	0 11	0·2	1391	...	...	...
547	0 56	1·2	1196	1 00	1·3	1181
1094	2 19	2·7	1047	2 22	2·8	1050
1640	4 07	4·4	951	4 07	4·5	961
2187	6 15	6·2	879	6 15	6·2	889
2734	8 52	8·2	817	8 52	8·2	827
3281	12 00	10·3	764	11 52	10·4	771
3445	...	...	...	12 56	11·1	755
3828	15 34	12·6	722			
4374	19 45	15·2	682			
4921	24 52	18·1	650			
5468	30 56	21·4	623			
6015	37 49	25·2	610			
6562	46 07	30·3	617			
7109	59 52	39·9	679			



APPENDIX IV.

RANGE TABLE.

10.5 cm. Howitzer.

EXTRACTS FROM RANGE TABLE No. 2.

10.5 cm. Light Field Howitzer.

1905 Pattern "Universal" Shell.*						
Range.	Angle of elevation.		Angle of descent.		Time of flight.	Remaining velocity.
Yards.	°	'	°	'	Secs.	f.s.
0	...		...		...	M.V. 689
3,281	25	22	29	22	17.8	564
3,609	30	19	35	11	20.8	558
3,937	38	52	45	06	25.8	561
CHARGE No. 5.						
0	...		...		...	M.V. 764
3,828	24	22	28	45	19.1	613
4,265	29	56	36	00	22.5	600
4,593	36	00	43	11	26.5	604
CHARGE No. 6.						
0	...		...		...	M.V. 840
4,484	24	30	29	30	21.1	650
4,921	29	19	35	22	24.1	640
5,359	36	37	44	11	29.2	643
FULL CHARGE.						
0	...		...		...	M.V. 991
547	1	11	1	37	1.7	955
1,094	2	49	3	26	3.4	925
1,640	4	34	5	22	5.3	892
2,187	6	30	7	34	7.2	860
2,734	8	30	10	00	9.2	830
3,281	10	41	12	45	11.3	800
3,828	13	15	15	56	13.7	771
4,374	15	56	19	30	16.1	745
4,921	18	56	23	26	18.8	728
5,468	22	30	28	04	21.9	712
6,015	26	41	33	30	25.4	702
6,562	32	30	40	26	30.0	699
6,890†	38	00	46	45	34.3	709

* This range table is probably employed with the Long, 1914 and 1915 Pattern Shells.

† Maximum range.

EXTRACTS FROM RANGE TABLES Nos. 6, 7 and 8.

RANGE TABLE No. 6.					RANGE TABLE No. 7.				RANGE TABLE No. 8.				
10 cm. Gun. 10 cm. Gun '04.*					10 cm. Gun, with Overhead Shield. 10 cm. Gun in Turret. 10 cm. Gun, Reinforced, in Turret.				10 cm. Short Gun in Turret.				
10 cm. Shell. 1896 Patterns Shell and Shrapnel.					10 cm. Shell and 1896 Pattern Shrapnel.				10 cm. Shell and 1896 Pattern Shrapnel.				
Range.	Angle of elevation	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Range.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	yards.
0	...	...	...	M.V. 1,830	...	...	...	M.V. 1,923	...	...	...	M.V. 1,637	0
547	0 22	0 26	0.8	1,667	0 30	0 34	0.9	1,755	0 37	0 41	1.1	1,496	547
1,094	0 56	1 07	1.8	1,516	1 00	1 04	1.9	1,604	1 19	1 30	2.2	1,371	1,094
1,640	1 34	1 52	3.0	1,384	1 34	1 45	3.0	1,470	2 04	2 26	3.5	1,257	1,640
2,187	2 15	2 56	4.3	1,276	2 11	2 45	4.1	1,345	2 56	3 37	4.8	1,168	2,187
2,734	3 04	4 15	5.7	1,184	2 52	3 52	5.4	1,240	3 52	5 00	6.3	1,096	2,734
3,281	3 56	5 41	7.1	1,109	3 45	5 11	6.8	1,152	4 56	6 37	7.8	1,013	3,281
3,828	4 56	7 22	8.7	1,050	4 37	6 45	8.3	1,086	6 11	8 30	9.3	997	3,828
4,374	6 07	9 11	10.4	1,004	5 41	8 26	9.9	1,037	7 26	10 22	11.0	965	4,374
4,921	7 19	11 11	12.1	964	6 49	10 19	11.5	997	8 52	12 30	12.8	932	4,921
5,468	8 37	13 22	13.9	932	8 00	12 19	13.3	965	10 19	14 41	14.8	905	5,468
6,015	10 04	15 45	15.8	905	9 22	14 34	15.1	935	11 56	17 07	16.8	883	6,015
6,562	11 37	18 15	17.7	882	10 49	16 56	17.0	909	13 37	19 45	18.9	863	6,562
7,109	13 19	21 00	19.8	863	12 19	19 30	19.0	889	15 26	22 34	21.1	846	7,109
7,655	15 11	24 00	22.2	843	14 00	22 11	21.2	869	17 34	25 41	23.4	833	7,655
8,202	17 15	27 07	24.6	833	15 41	24 49	23.3	856	19 49	29 00	25.9	820	8,202
8,749	19 26	30 30	27.1	827	17 26	27 30	25.5	846	22 22	32 37	28.6	814	8,749
9,296	21 56	34 15	29.8	820	19 19	30 19	27.8	843	25 11	36 30	31.6	810	9,296
9,843	24 41	38 15	32.9	820	21 30	33 30	30.3	843	28 26	40 45	35.0	817	9,843
10,389	27 52	42 30	36.4	827	24 04	37 11	33.2	846	32 26	45 41	39.2	830	10,389
10,608†	...	...	...	...	...	...	...	...	34 45	48 19	41.3	837	10,608
10,936	31 49	47 22	40.5	846	27 11	41 22	36.6	850	...	...	...	...	10,936
11,264‡	34 41	50 19	43.2	863	...	...	...	...	...	...	...	...	11,264
11,583	...	...	...	...	31 11	46 34	40.8	863	...	...	...	...	11,583
11,811§	...	...	...	...	34 41	50 34	44.4	876	...	...	...	...	11,811

* This range table is probably employed with the 10 cm. Gun 14, and with all three guns when using the 1914 and 1914A Pattern Shells

† Maximum range of 10 cm. Short Gun in Turret.

‡ Maximum range of 10 cm. Gun, 10 cm. Gun 04, and 10 cm. Gun 14.

§ Maximum range of 10 cm. Gun with Overhead Shield and 10 cm. Guns in Turret and Reinforced in Turret.

APPENDIX VI.

RANGE TABLE.

12 cm. Gun.

EXTRACTS FROM RANGE TABLE No. 9.

12 cm. Heavy Gun.

Range.	1888 a/A Pattern Shell.				1880/92 Pattern Shrapnel.			
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
0	...	...	...	...	...	...	...	M.V. 1,280
547	...	...	...	...	0 56	1 00	1.3	1,148
1,094	...	...	...	...	2 04	2 26	2.8	1,053
1,640	...	...	...	...	3 22	4 04	4.4	984
2,187	...	...	...	...	4 49	5 56	6.2	928
2,297	4 34	6 04	6.3	922	...	...	...	...
2,724	5 49	7 52	7.8	876	6 26	8 11	8.0	879
3,281	7 30	10 30	9.9	827	8 11	10 45	10.0	840
3,828	9 26	13 30	12.0	784	10 04	13 30	12.1	804
4,374	11 37	16 56	14.4	751	12 07	16 34	14.2	778
4,921	14 00	20 49	16.8	722	14 22	19 52	16.6	755
5,468	16 45	25 15	19.6	696	16 45	23 19	19.1	738
6,015	19 45	30 04	22.2	679	19 30	27 19	21.9	728
6,562	23 30	35 37	25.8	669	22 34	31 37	24.8	718
7,109	28 00	42 00	29.9	668	25 56	36 15	28.1	715
7,218*	...	...	...	...	26 37	37 15	28.8	715
7,655	33 45	49 34	35.4	689				
7,984†	38 49	55 45	39.9	715				

* Maximum range with shrapnel.

† Maximum range with shell.

APPENDIX VII.

RANGE TABLE.

13 cm. Gun.

EXTRACTS FROM RANGE TABLE No. 10.

13 cm. Gun.

Range.	13 cm. Shell.*				13 cm. Shrapnel.			
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
0	...	...	...	M.V. 2,280	...	...	...	M.V. 2,280
547	0 11	0 19	0.7	2,172	0 11	0 19	0.7	2,185
1,094	0 34	0 41	1.5	2,070	0 34	0 37	1.5	2,093
1,640	0 52	1 07	2.4	1,968	0 52	1 00	2.3	1,998
2,187	1 15	1 34	3.2	1,873	1 15	1 30	3.1	1,906
2,734	1 37	2 04	4.1	1,781	1 37	2 00	4.0	1,821
3,281	2 04	2 41	5.0	1,693	2 00	2 34	4.9	1,736
3,828	2 30	3 22	6.0	1,608	2 26	3 11	5.9	1,653
4,374	3 00	4 07	7.1	1,526	2 56	3 52	6.9	1,578
4,921	3 30	4 56	8.2	1,450	3 26	4 41	8.0	1,506
5,468	4 04	5 52	9.4	1,381	3 56	5 34	9.1	1,437
6,015	4 41	6 52	10.7	1,316	4 30	6 30	10.3	1,375
6,562	5 26	8 00	11.9	1,260	5 07	7 34	11.5	1,319
7,109	6 07	9 11	13.3	1,206	5 49	8 49	12.8	1,266
7,655	6 52	10 30	14.7	1,165	6 34	10 07	14.2	1,220
8,202	7 41	12 00	16.2	1,125	7 19	11 30	15.6	1,178
8,749	8 37	13 37	17.7	1,092	8 07	13 00	17.1	1,142
9,296	9 34	15 22	19.4	1,066	9 00	14 37	18.7	1,112
9,843	10 34	17 19	21.1	1,047	9 56	16 22	20.3	1,086
10,389	11 37	19 19	22.8	1,030	10 56	18 15	21.9	1,066
10,936	12 49	21 26	24.6	1,017	12 00	20 11	23.7	1,050
11,483	13 56	23 37	26.3	1,010	13 04	22 11	25.4	1,037
12,030	15 11	25 52	28.2	1,004	14 19	24 22	27.3	1,024
12,577	16 26	28 04	30.2	997	15 34	26 34	29.3	1,017
13,124	17 52	30 19	32.2	997	17 00	28 52	31.3	1,010
13,670	19 19	32 34	34.3	997	18 30	31 19	33.5	1,007
14,217	20 52	34 52	36.5	997	20 07	33 52	35.8	1,004
14,764	22 34	37 11	38.8	1,004	22 00	36 30	38.3	1,007
15,311†	25 19	39 37	41.2	1,010	23 56	39 15	41.0	1,010
15,748‡	25 45	41 37	43.3	1,017	...	...	...	...
15,857‡	...	...	...	...	26 04	42 04	43.7	1,020

* The maximum range with the 1914 Pattern Shell is stated to be 15,311 yards, or the same as that with percussion shrapnel (see below), so that it appears probable that the range table for 13 cm. Shrapnel is employed for the 1914 Pattern Shell.

† The maximum ranges with shell and shrapnel, as stated in the German range table, are 15,748 and 15,857 yards, respectively, but according to recent German documents the maximum range with percussion shrapnel is 15,311 yards, while that with time shrapnel is 10,936 yards.



APPENDIX VIII.

RANGE TABLE.

15 cm. Ringkanone.

EXTRACTS FROM RANGE TABLE No. 12.

15 cm. Gun with Chase Rings. (*Ringkanone.*)

Range.	1880 Pattern Shell.				1880/92 Pattern Shrapnel.			
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
0	...	...	...	M.V. 1,499	...	...	...	M.V. 1,322
547	0 41	0 52	1·2	1,293	0 52	1 00	1·3	1,197
1,094	1 34	2 04	2·5	1,138	1 56	2 19	2·8	1,102
1,640	2 37	3 37	4·0	1,037	3 07	3 45	4·3	1,037
2,187	3 52	5 19	5·7	968	4 26	5 22	5·9	981
2,734	5 19	7 26	7·3	909	5 52	7 19	7·6	938
3,281	6 52	9 49	9·2	860	7 22	9 26	9·4	899
3,828	8 37	12 30	11·3	820	9 04	11 45	11·3	866
4,374	10 34	15 34	13·5	781	10 52	14 22	13·2	837
4,921	12 41	18 56	15·8	751	12 49	17 11	15·3	810
5,468	15 00	22 34	18·2	725	14 52	20 07	17·5	791
6,015	17 30	26 26	20·8	712	17 04	23 22	19·8	778
6,562	20 15	30 41	23·6	702	19 30	26 52	22·4	768
7,109	23 22	35 22	27·0	699	22 15	30 37	25·2	761
7,646*	...	...	...	...	24 34	33 52	27·6	761
7,655	27 15	41 00	30·8	695	...	...	...	...
8,202	33 37	49 34	36·3	712	...	...	...	...
8,312†	36 49	53 19	38·8	718	...	...	...	...

* Maximum range with shrapnel.

† Maximum range with shell.

APPENDIX IX.

RANGE TABLE.

15 cm. Long Gun.

EXTRACTS FROM RANGE TABLE No. 14.

15 cm. Long Gun.

Range.	1888 Pattern Shell.				1892 and 1890/1892 Patterns Shrapnel.*			
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
0	...	...	...	M.V. 1,624	...	...	...	M.V. 1,640
547	0 37	0 41	1.1	1,480	0 34	0 37	1.0	1,512
1,094	1 19	1 30	2.3	1,345	1 15	1 26	2.2	1,394
1,640	2 04	2 30	3.5	1,234	1 56	2 22	3.4	1,286
2,187	2 56	3 45	4.8	1,145	2 49	3 37	4.7	1,196
2,734	4 00	5 15	6.3	1,079	3 45	4 56	6.1	1,129
3,281	5 07	6 56	7.9	1,024	4 45	6 26	7.5	1,073
3,828	6 19	8 49	9.6	984	5 52	8 04	9.2	1,027
4,374	7 37	10 49	11.4	948	7 04	9 52	10.8	991
4,921	9 04	13 00	13.2	915	8 22	11 49	12.6	958
5,468	10 41	15 26	15.2	889	9 45	14 00	14.5	932
6,015	12 22	18 00	17.2	866	11 19	16 19	16.4	909
6,562	14 07	20 41	19.3	846	13 00	18 49	18.4	889
7,109	16 00	23 34	21.5	833	14 45	21 30	20.5	873
7,655	18 00	26 37	23.8	820	16 41	24 26	22.7	860
8,202	20 15	29 49	26.3	814	18 49	27 34	25.1	846
8,749	22 41	33 15	29.1	810	21 07	30 56	27.8	837
8,968†	...	...	...	...	22 11	32 26	28.9	837
9,296	25 30	37 00	32.1	810	...	...	...	...
9,843	28 37	41 07	35.4	817	...	...	...	...
10,389	32 34	45 56	39.3	833	...	...	...	...
10,936‡	39 11	53 15	45.6	860	...	...	...	...

* This table is probably employed with the 1907 Pattern Shrapnel.

† Maximum range with time shrapnel.

‡ Maximum range with shell.

RANGE TABLE.

15 cm. Howitzer '13.

EXTRACTS FROM RANGE TABLE No. 15.(?)*

15 cm. Heavy Field Howitzer, '13.

1883, 1888, 1896, 1904 and 1912 Pattern Shells.†

1904 and 1912 Pattern Shells.

Range.	Charge No. 4. 0.81 kg. (1.8 lbs.).				Charge No. 5. 0.95 kg. (2.1 lbs.).				Charge No. 6. 1.2 kg. (2.6 lbs.).				Charge No. 7. 1.35 kg. (3.0 lbs.).				Range.
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	
yards	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	yards.
0	...	...	...	M.V. 833	...	...	...	M.V. 942	...	...	...	M.V. 1,106	...	...	...	M.V. 1,196	0
1,094	...	...	...	...	...	...	...	...	2 26	2 15	3.2	1,060	...	...	...	...	1,094
1,640	...	...	...	...	...	...	...	...	3 41	3 45	4.8	1,010	...	...	...	...	1,640
2,187	...	...	...	...	...	...	...	...	5 15	5 30	6.4	971	...	...	...	...	2,187
2,734	...	...	...	...	...	...	...	...	6 49	7 34	8.2	938	...	...	...	...	2,734
3,281	...	...	...	...	...	...	...	...	8 37	9 56	10.1	909	...	...	...	...	3,281
3,828	18 11	20 34	15.8	709	...	...	...	...	10 30	12 26	12.1	879	...	...	...	...	3,828
4,374	22 07	25 22	18.9	692	16 52	19 41	16.5	758	12 26	14 56	14.2	853	...	...	...	...	4,374
4,921	27 07	31 19	22.7	675	19 56	23 49	19.2	738	14 37	17 41	16.4	833	...	...	...	...	4,921
5,468	32 26	37 49	26.4	669	...	...	...	...	...	...	...	...	...	...	...	...	5,468
6,015	...	...	...	...	23 45	28 30	22.4	722	16 56	20 45	18.7	817	...	...	...	...	6,015
6,562	...	...	...	...	28 19	34 11	26.0	712	19 30	24 04	21.2	800	...	...	...	...	6,562
7,109	...	...	...	...	33 07	39 52	29.8	712	...	...	...	...	...	...	...	...	7,109
7,655	...	...	...	...	...	...	...	...	22 30	27 56	24.0	791	...	...	...	...	7,655
8,093†	...	...	...	...	...	...	...	...	25 49	32 11	27.0	781	22 34	28 59	25.3	807	8,093
8,202	...	...	...	...	...	...	...	...	29 52	37 11	30.7	781	25 45	33 00	28.3	797	8,202
8,749	...	...	...	...	...	...	...	...	34 04	42 04	34.1	784	...	...	...	...	8,749
9,296§	...	...	...	...	...	...	...	...	...	...	...	...	30 04	37 41	31.7	797	9,296
	...	...	...	...	...	...	...	...	...	...	...	...	34 07	42 59	35.3	807	
	...	...	...	...	...	...	...	...	...	...	...	...	40 59	49 59	41.8	810	

* This is a provisional range table and it is not quite certain whether it actually corresponds to the latest range table for the Heavy Field Howitzer '13, which is numbered 15.

† This table is employed with the 1914 and 1914A Pattern Shells, but their maximum range is stated in a German document to be 8,147 yards.

‡ Maximum range with 1883, 1888 and 1896 Pattern Shells. It will be observed that this is less than the maximum range of the same shells with the older pattern Heavy Field Howitzer '02.

§ Maximum range with 1904 and 1912 Pattern Shells.

APPENDIX XI.

RANGE TABLE.

15 cm. Howitzer '02.

EXTRACTS FROM RANGE TABLE No. 16.

15 cm. Heavy Field Howitzer '02.

Range.	1883, 1888, 1896, 1904 and 1912 Pattern Shells.*							
	Charge No. 5, 0.95 kg. (2.09 lbs.).				Charge No. 6, 1.2 kg. (2.65 lbs.).			
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
0	...	...	...	M.V. 902	...	...	...	M.V. 1,066
1,094	3 34	4 07	3.8	853	...	...	...	...
1,640	5 30	6 19	5.8	830	...	...	...	...
2,187	7 34	8 45	7.8	804	...	...	...	...
2,734	10 00	11 26	10.0	784	...	...	...	...
3,281	12 34	14 26	12.3	761	...	...	...	...
3,828	15 22	17 52	14.7	745	...	...	...	...
4,374	18 26	21 45	17.3	728	...	...	...	...
4,921	21 52	26 00	20.2	715	...	...	...	...
5,468	26 00	31 07	23.6	702	...	...	...	...
6,015	31 41	37 56	27.9	695	21 30	27 22	22.5	748
6,452	40 45	48 22	35.0	705	...	...	...	...
6,562	...	...	...	...	24 41	31 37	25.6	738
7,109	...	...	...	...	28 34	36 26	29.0	738
7,655	...	...	...	...	33 37	42 22	33.4	748
8,147†	...	...	...	...	41 26	50 45	40.0	774

* This range table is employed with the 1914 and 1914A Pattern Shells.

† Maximum range.

RANGE TABLE.

15 cm. Howitzer in Turret.

EXTRACTS FROM RANGE TABLE No. 18.

15 cm. Howitzer in Turret.

1888 Pattern Shell.

Range.	Charge No. 6. 0.8 kg. (1.8 lbs.).				Charge No. 7. 0.9 kg. (2 lbs.).				Charge No. 8. 1 kg. (2.2 lbs.).				Charge No. 9. 1.2 kg. (2.6 lbs.).				Range
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	yards.
0	...	...	...	M.V. 810	...	...	...	M.V. 883	...	...	...	M.V. 955	...	...	...	M.V. 1,079	0
2,843	13 45	14 52	11.5	709	...	...	...	...	...	...	...	...	...	...	...	...	2,843
3,281	16 26	18 04	13.7	696	13 30	14 49	12.4	755	...	...	...	...	...	...	...	...	3,281
3,664	...	...	...	...	...	...	...	...	13 11	14 56	13.1	791	...	...	...	...	3,664
3,828	20 07	22 30	16.7	682	16 22	18 11	14.9	738	14 00	15 52	13.7	784	...	...	...	...	3,828
4,265	...	...	...	...	...	...	...	...	...	...	...	...	12 41	14 52	13.8	833	4,265
4,375	24 19	27 37	19.9	669	19 37	22 11	17.6	722	16 37	19 11	16.2	764	13 04	15 26	14.2	827	4,375
4,921	29 45	34 00	23.9	659	23 11	26 49	20.6	712	19 30	22 56	18.8	748	15 15	18 26	16.5	801	4,921
5,359	37 15	42 19	28.7	663	...	...	...	...	...	...	...	...	...	...	...	...	5,359
5,468	...	...	...	...	27 37	32 15	24.2	702	22 56	27 11	21.8	732	17 41	21 49	19.0	778	5,468
6,015	...	...	...	...	34 00	39 34	29.0	696	27 04	32 22	25.2	719	20 26	25 45	21.8	761	6,015
6,234	...	...	...	...	38 45	45 00	32.3	699	...	...	...	...	...	...	...	...	6,234
6,562	...	...	...	...	...	...	...	...	32 37	39 04	29.6	715	23 45	30 19	24.8	748	6,562
6,890	...	...	...	...	...	...	...	...	39 11	46 30	34.4	722	...	...	...	...	6,890
7,109	...	...	...	...	...	...	...	...	...	...	...	...	27 41	35 30	28.3	738	7,109
7,655	...	...	...	...	...	...	...	...	...	...	...	...	33 37	43 00	33.4	738	7,655
7,874*	...	...	...	...	...	...	...	...	...	...	...	...	38 15	48 15	37.1	741	7,874*

* Maximum range with full charge.

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EXTRACTS FROM RANGE TABLE No. 12.
21 cm. Mortar.

Range.	1883 and 1896 Pattern Shells.*							
	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
CHARGE No. 8, 2.2 kg. (4.8 lbs.). M.V. = 800 f.s.								
4,046	...	...	...	...	66 45	70 07	44.1	728
4,374	...	...	...	...	64 30	68 00	43.4	725
4,703	25 11	27 52	21.0	709	...	...	...	...
4,921	27 08	30 04	22.4	705	60 07	63 49	41.7	725
5,468	33 30	37 04	26.9	702	54 04	58 00	39.2	722
5,796	39 34	43 41	31.3	699	47 37	51 37	36.0	715
CHARGE No. 9, 2.3 kg. (5.1 lbs.). M.V. = 827 f.s.								
4,265	...	...	...	...	66 45	70 19	45.3	748
4,374	...	...	...	...	66 04	69 41	45.1	748
4,921	...	...	...	...	62 22	66 11	43.8	745
5,031	25 34	28 22	22.0	725	...	...	...	...
5,468	29 41	33 00	25.0	718	57 41	61 41	41.8	741
6,015	37 11	41 22	30.3	715	50 26	54 37	38.6	738
6,124	39 41	44 04	32.1	715	47 45	51 56	37.2	735
CHARGE No. 10, 2.4 kg. (5.3 lbs.). M.V. = 853 f.s.								
4,593	...	...	...	...	66 15	69 52	46.3	764
4,921	...	...	...	...	64 07	67 52	45.6	764
5,249	25 11	27 56	22.2	741	...	...	...	...
5,468	26 52	29 52	23.5	741	60 07	64 03	44.1	761
6,015	32 26	36 00	27.7	738	54 52	59 07	41.7	755
6,452	39 52	45 00	33.4	741	47 03	51 37	37.4	748
CHARGE No. 11, 2.5 kg. (5.5 lbs.). M.V. = 876 f.s.								
4,820	...	...	...	...	66 15	69 49	47.5	784
4,921	...	...	...	...	65 34	69 15	47.3	784
5,468	...	...	...	...	62 00	66 00	45.9	781
5,577	25 37	28 34	23.2	758	...	...	...	...
6,015	29 15	32 37	26.0	755	57 37	61 49	44.1	778
6,562	35 41	40 00	31.0	748	51 11	55 30	40.9	771
6,780	40 45	46 15	35.4	755	45 22	50 15	37.7	764
CHARGE No. 12, 2.6 kg. (5.7 lbs.). M.V. = 899 f.s.								
5,031	...	...	...	...	66 19	70 11	48.7	800
5,468	...	...	...	...	63 45	67 37	47.6	800
5,796	25 15	28 11	23.5	774	...	...	...	...
6,015	26 49	30 00	24.8	774	59 49	64 00	46.1	794
6,562	31 49	35 30	28.6	771	54 45	59 34	43.8	787
7,109	41 30	47 07	36.0	774	44 45	50 22	37.6	781
CHARGE No. 13, 2.7 kg. (5.9 lbs.). M.V. = 925 f.s.								
5,140	...	...	...	...	66 52	70 49	51.5	817
5,468	...	...	...	...	65 04	69 07	50.5	817
6,015	25 00	28 00	23.8	791	61 34	65 52	48.5	814
6,562	29 04	32 37	27.1	787	57 26	62 04	46.3	807
7,109	34 37	39 00	31.6	784	51 52	56 49	43.0	804
7,327	38 30	43 37	34.5	787	47 37	53 07	40.6	800
CHARGE No. 14, 2.8 kg. (6.2 lbs.). M.V. = 945 f.s.								
7,109	31 30	35 26	29.6	797	...	...	...	...
7,655	39 49	46 00	37.3	800	...	...	...	...
CHARGE No. 15, 2.9 kg. (6.4 lbs.). M.V. = 968 f.s.								
7,327	31 07	34 52	30.0	810	...	...	...	...
7,655	34 37	38 52	32.3	810	...	...	...	...
7,874	38 15	44 00	36.0	814	...	...	...	...
CHARGE No. 16, 3.0 kg. (6.6 lbs.). M.V. = 987 f.s.								
7,655	31 56	35 49	31.6	820	...	...	...	...
8,202	39 52	48 00	38.8	823	...	...	...	...
CHARGE No. 17, 3.1 kg. (6.8 lbs.). M.V. = 1,010 f.s.								
7,874	31 45	35 45	31.3	827	...	...	...	...
8,202	35 11	39 37	34.5	827	...	...	...	...
8,421†	38 26	45 11	37.9	833	...	...	...	...

Not applicable to 1883 Pattern Shell.

APPENDIX XIII.
RANGE TABLE
21 cm. Mortar.

* This range table is probably employed with the 1896 n/A Pattern Shell.

† Maximum range for 1896 Pattern Shell with full charge. A recent German document, however, gives the maximum range as 7,874 yards, implying that Charges Nos. 16 and 17 are no longer used.

EXTRACTS FROM RANGE TABLE No. 12

21 cm. Mortar.

1888 Pattern Shell.*									
Range.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Range.
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	yards.
CHARGE No. 4, 2.1 kg. (4.6 lbs.). M.V.=863 f.s.									
4,265	...	...	...	...	66 22	71 34	45.7	738	4,265
4,375	...	...	...	...	65 37	70 56	45.4	735	4,375
4,921	...	...	...	...	61 26	67 22	43.9	728	4,921
5,031	25 04	29 34	22.0	689	56 00	62 34	41.5	715	5,031
5,468	29 15	34 34	25.2	686	46 07	53 15	36.4	696	5,468
6,015	40 00	46 49	32.6	686	...	...	...	...	6,015
CHARGE No. 5, 2.3 kg. (5.1 lbs.). M.V.=925 f.s.									
4,812	...	...	...	...	66 00	71 30	48.4	778	4,812
4,921	...	...	...	...	65 19	70 56	48.1	774	4,921
5,468	...	...	...	...	61 30	67 45	46.6	768	5,468
5,687	25 49	30 52	24.0	719	...	...	...	...	5,687
6,015	28 37	34 19	26.3	715	56 45	63 37	44.4	758	6,015
6,562	36 00	42 52	31.9	715	49 30	56 56	40.6	738	6,562
6,671	38 45	45 56	33.8	719	46 07	53 37	38.6	732	6,671
CHARGE No. 6, 2.5 kg. (5.5 lbs.). M.V.=988 f.s.									
5,249	...	...	...	...	66 11	71 52	50.9	814	5,249
5,468	...	...	...	...	64 49	70 45	50.4	810	5,468
6,015	...	...	...	...	61 15	67 45	48.9	801	6,015
6,234	25 45	31 11	25.1	748	...	...	...	...	6,234
6,562	28 22	34 22	27.3	741	57 15	64 19	46.9	791	6,562
7,109	34 30	41 30	32.3	741	51 15	58 49	43.7	774	7,109
7,327	39 22	46 52	35.8	748	46 30	54 19	40.8	764	7,327
CHARGE No. 7, 2.7 kg. (6.0 lbs.). M.V.=1,047 f.s.									
5,687	...	...	...	...	66 07	72 04	53.0	846	5,687
6,015	...	...	...	...	64 22	70 34	52.4	840	6,015
6,562	...	...	...	...	61 04	67 52	50.9	833	6,562
6,890	26 52	32 56	27.2	768	...	...	...	...	6,890
7,109	28 37	35 04	28.7	764	57 07	64 30	48.8	820	7,109
7,655	34 15	41 34	33.3	768	51 26	59 22	45.6	807	7,655
7,874	37 52	45 37	36.2	771	48 04	56 07	43.5	797	7,874
CHARGE No. 8, 2.8 kg. (6.2 lbs.). M.V.=1,076 f.s.									
7,546	30 22	37 22	30.7	774	...	...	...	...	7,546
7,655	31 26	38 37	31.6	774	...	...	...	...	7,655
8,202	38 30	46 34	37.3	784	...	...	...	...	8,202
CHARGE No. 9, 2.9 kg. (6.4 lbs.). M.V.=1,102 f.s.									
7,874	31 00	38 22	31.8	784	...	...	...	...	7,874
8,202	34 34	42 30	34.8	787	...	...	...	...	8,202
8,530	40 30	49 00	39.6	801	...	...	...	...	8,530
CHARGE No. 10, 3 kg. (6.6 lbs.). M.V.=1,132 f.s.									
8,093	30 41	38 19	32.1	791	...	...	...	...	8,093
8,202	31 41	39 30	33.0	794	...	...	...	...	8,202
8,749	39 30	48 15	39.6	807	...	...	...	...	8,749
CHARGE No. 11, 3.1 kg. (6.8 lbs.). M.V.=1,158 f.s.									
8,312	30 34	38 34	32.6	801	...	...	...	...	8,312
8,749	35 15	43 56	36.6	807	...	...	...	...	8,749
8,968	39 15	48 19	40.0	817	...	...	...	...	8,968

* This range table is employed with the 1914 and 1914A Pattern Shells.

RANGE TABLE.

Mortar.*

EXTRACTS FROM RANGE TABLE No. 22.

Mortar.*

Range.	1883 and 1896 Pattern 21 cm. Shells.†												1896 Pattern 21 cm. Shell.†				Range.	Remarks.
	Charge No. 6. 4.3 kg. (9.5 lbs.).				Charge No. 7. 4.9 kg. (10.8 lbs.).				Charge No. 8. 5.2 kg. (11.5 lbs.).				Charge No. 9. 5.6 kg. (12.3 lbs.).					
	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.		
yards.	" /	" /	secs.	f.s.	" /	" /	secs.	f.s.	" /	" /	secs.	f.s.	" /	" /	secs.	f.s.	yards.	
0	...	...	...	M.V.991	...	...	...	M.V.1,089	...	...	...	M.V.1,188	...	...	...	M.V.1,203	0	With angles of elevation above 45°.
5,577	07 52	71 41	52.7	866	...	...	...	...	...	...	...	...	...	...	...	...	5,577	
6,015	05 37	69 41	51.9	863	...	...	...	...	...	...	...	...	...	...	...	...	6,015	
6,343	...	...	...	...	67 41	72 00	57.1	923	...	...	...	...	...	...	...	...	6,343	
6,562	02 30	66 52	50.6	856	66 52	71 19	56.8	925	...	...	...	...	...	...	...	...	6,562	
6,671	...	...	...	...	...	...	...	...	67 45	72 22	59.0	951	...	...	...	...	6,671	
7,109	58 40	63 34	48.9	850	64 22	69 11	55.8	922	65 56	70 52	58.3	948	67 34	72 41	60.9	981	7,109	
7,655	54 07	59 11	46.3	840	61 37	66 45	54.5	915	63 34	68 49	57.3	945	65 30	70 56	60.1	978	7,655	
8,093	47 52	53 07	42.6	827	...	...	...	...	...	...	...	...	...	...	...	...	8,093	
8,202	...	...	...	...	58 22	63 49	52.9	909	60 52	66 30	56.0	938	63 07	68 56	59.1	971	8,202	
8,749	...	...	...	...	54 11	59 56	50.5	896	57 41	63 37	54.2	928	60 30	66 45	57.7	964	8,749	
9,186	...	...	...	...	48 56	55 00	46.8	882	...	...	...	...	...	...	...	...	9,186	
9,296	...	...	...	...	...	...	...	...	53 34	59 52	51.6	910	57 22	64 00	56.0	955	9,296	
9,733	...	...	...	...	...	...	...	...	47 15	53 49	47.1	899	...	...	...	...	9,733	
9,843	...	...	...	...	...	...	...	...	...	...	...	...	53 22	60 26	53.3	942	9,843	
10,280	...	...	...	...	...	...	...	...	...	...	...	...	46 45	54 15	48.2	922	10,280	
6,671	25 10	28 41	25.0	817	...	...	...	...	...	...	...	...	...	...	...	...	6,671	With angles of elevation below 45°.
7,109	28 11	32 00	27.4	814	...	...	...	...	...	...	...	...	...	...	...	...	7,109	
7,546	...	...	...	...	25 11	29 26	26.9	846	...	...	...	...	...	...	...	...	7,546	
7,655	32 41	37 00	31.0	814	25 45	30 07	27.4	846	...	...	...	...	...	...	...	...	7,655	
8,093	41 30	46 30	37.5	820	29 04	33 52	30.4	846	...	...	...	...	...	...	...	...	8,093	
8,202	...	...	...	...	33 15	38 37	34.0	846	30 07	35 41	32.2	860	...	...	...	...	8,202	
8,749	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	8,749	
9,186	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9,186	
9,296	...	...	...	...	41 00	46 52	40.4	860	34 15	40 22	36.1	868	30 45	37 34	33.7	869	9,296	
9,733	...	...	...	...	...	...	...	...	40 22	46 49	41.4	879	...	...	...	...	9,733	
9,843	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9,843	
10,280	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10,280	

* That is the latest pattern 21 cm. Mortar, as distinct from the previous pattern which is entitled "21 cm. Mortar."

† These range tables are probably employed with the 1896 n/A Pattern Shell.

‡ Maximum range with full charge and 1896 Pattern Shell. The German regulations lay down that the full charge should only be employed in exceptional circumstances, when the tactical situation renders it absolutely necessary. The maximum range in ordinary circumstances is therefore 9,733 yards.

EXTRACTS FROM RANGE TABLE No. 22.

Mortar.*

1888 Pattern 21 cm. Shell.†

Charge No. 6. 4.8 kg. (10.5 lbs.).				Charge No. 7. 4.9 kg. (10.8 lbs.).				Charge No. 8. 5.2 kg. (11.5 lbs.).				Charge No. 9. 5.6 kg. (12.3 lbs.).				Range.
Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	
		secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	f.s.	yards.
0	0	...	M.V. 1,073	...	...	...	M.V. 1,191	...	...	...	M.V. 1,250	...	...	...	M.V. 1,332	0
0.000	00 11	00 00	25.7	787	...	...	...	...	...	...	...	...	...	...	...	6,890
0.100	00 20	00 00	26.9	787	...	...	...	...	...	...	...	...	...	...	...	7,109
0.200	00 30	00 04	30.3	791	...	...	...	...	...	...	...	...	...	...	...	7,655
0.300	...	...	...	27 19	34 22	29.6	807	...	...	...	...	...	...	...	...	7,983
0.400	00 07	40 15	35.1	797	28 41	36 00	30.8	807	...	...	...	...	...	...	...	8,202
0.500	41 45	40 10	38.8	804	...	...	...	...	...	...	...	...	...	...	...	8,421
0.600	...	...	...	...	...	...	...	29 52	38 22	32.7	810	...	...	...	...	8,640
0.700	...	...	...	32 52	40 56	34.7	814	30 41	39 19	33.5	814	...	...	...	...	8,749
0.800	...	...	...	...	...	...	...	...	...	...	...	29 40	30 30	33.2	804	8,858
0.900	...	...	...	41 26	50 22	42.0	833	35 37	44 56	38.1	823	33 00	43 11	36.4	814	9,296
1.000	...	...	...	...	...	...	...	41 49	51 30	43.3	846	...	...	...	...	9,624
1.100	...	...	...	...	...	...	...	...	...	...	...	39 15	49 52	41.8	843	9,843
1.200	...	...	...	...	...	...	...	...	...	...	...	41 49	52 30	43.0	856	9,952

* This is the latest pattern 21 cm. Mortar, as distinct from the previous pattern which is entitled "21 cm. Mortar."

† This range table is employed with the 1914 and 1914 A Pattern Shells.

RANGE TABLE.

21 cm. Howitzer in Turret.

EXTRACTS FROM RANGE TABLE No. 23.

21 cm. Howitzer in Turret.

Range	1880 Pattern Shell.								1880 Pattern Shrapnel.				Range
	Charge, 2.4 kg. (5.3 lbs.).				Charge, 3.7 kg. (8.2 lbs.).				Charge, 2 kg. (4.4 lbs.).				
	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	
yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	yards.
0	...	...	...	M.V.1,030	...	...	...	M.V.1,168	...	...	...	M.V.902	0
1,129	...	...	...	...	...	...	...	...	5 04	5 26	4.9	830	1,422
1,750	5 00	5 30	5.5	909	...	...	...	...	5 52	6 26	5.7	820	1,750
2,187	6 26	7 11	7.0	883	...	...	...	...	8 07	8 56	7.8	797	2,187
2,704	8 19	9 22	8.9	856	...	...	...	...	10 34	11 49	10.0	774	2,734
3,261	10 15	11 52	10.9	830	...	...	...	...	13 07	14 56	12.3	751	3,281
3,828	12 22	14 34	13.1	810	...	...	...	...	16 00	18 30	14.8	732	3,828
4,374	14 45	17 22	15.3	791	...	...	...	...	19 07	22 26	17.5	715	4,374
4,921	17 15	20 34	17.7	774	...	...	...	...	22 45	27 07	20.6	699	4,921
5,468	20 00	24 11	20.3	761	...	...	...	...	27 22	32 52	24.2	686	5,468
6,000*	...	...	...	...	...	...	...	...	33 07	39 49	28.5	682	5,960
6,615	23 07	28 15	23.2	751	...	...	...	...	...	...	...	...	6,015
6,562	26 56	32 52	26.5	745	...	...	...	...	...	...	...	...	6,562
7,109	31 56	38 52	30.4	741	24 04	30 41	26.0	784	...	...	...	...	7,109
7,546	38 45	46 30	35.9	751	...	...	...	...	...	...	...	...	7,546
7,655	...	...	...	...	27 22	34 56	29.3	781	...	...	...	...	7,655
8,202	...	...	...	...	31 30	40 00	33.1	784	...	...	...	...	8,202
8,749†	...	...	...	...	38 52	48 19	39.3	801	...	...	...	...	8,749

* Maximum range with time shrapnel

† Maximum range with shell.

RANGE TABLES.

"Minenwerfer."

EXTRACTS FROM RANGE TABLES.

Heavy "Minenwerfer."

Charge No. 1. M.V.=164 f.s.			Charge No. 2. M.V.=216 f.s.		
Range.	Angle of elevation.	Setting of fuze.	Range.	Angle of elevation.	Setting of fuze.
yds.	degs.	secs.	yds.	degs.	secs.
104	70	11.5	273	70	14.5
101	68	11.5	300	68	14.5
910	64	11.0	328	66	14.0
940	57	10.5	355	64	14.0
970	47	9.5	383	62	14.0
			410	58	13.5
			437	54	13.0
			460	49	12.5

Light "Minenwerfer."

Range.	Angle of elevation.	Setting of fuze.	Range.	Angle of elevation.	Setting of fuze.
Charge No. 1. (6 g.)			Charge No. 3. (12 g.)		
yds.	degs.	secs.	yds.	degs.	secs.
175	75	13	612	67	19
197	73	13	634	66	19
219	70½	13	656	65	19
240	68½	12	678	63½	19
262	66	12	700	62½	19
284	63	12	722	61½	19
306	60	12	744	60½	19
328	56	12	765	58½	19
350	50½	11	787	57½	18
			809	55½	18
			831	53½	17
			853	51	17
			875	45	17
Charge No. 2. (9 g.)			Charge No. 4. (15 g.)		
yds.	degs.	secs.	yds.	degs.	secs.
372	69½	10	897	65½	23
394	68	10	919	64½	23
416	66½	10	940	63½	23
437	65	10	962	63	23
459	63½	10	984	62	23
481	61½	10	1,006	61	23
503	59½	10	1,018	60	23
525	57½	10	1,050	58½	23
547	55	10	1,072	57½	23
569	51½	10	1,094	55½	23
590	45	10	1,116	53	20
			1,137	49½	20
			1,148	45	20

Specimen Range Table for a Medium "Minenwerfer" firing a Projectile of 51 lb. (112.4 lbs.).

Charge.		Range.
No.	Weight.	
	grammes.	yards.
1	44	115— 240
2	66	191— 386
3	88	268— 537
4	110	341— 689
5	132	415— 840
6	154	765—1,006