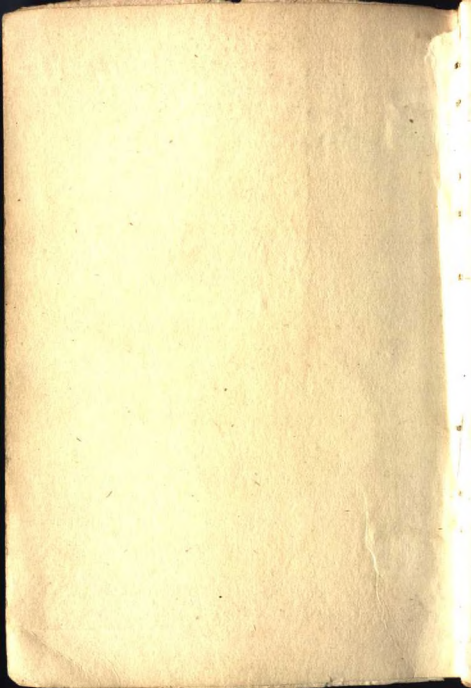




182.2
~~(a)~~ Ammunition
(shells)

15132

NOTES

ON

GERMAN SHELLS.

(SECOND EDITION.)

GENERAL STAFF (INTELLIGENCE),
GENERAL HEADQUARTERS,
1st May, 1918.



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PREFACE.

This Second Edition embodies the original "Notes on German Shells," the four "Amendments" issued at various dates, and the information received subsequently from very many sources.

The data given under the headings "Maximum range" and "Employment" are taken from captured documents in nearly every case.

The figures under "Weight" are either taken from official German handbooks or are those of specimens examined.

With the exception of those of a few obsolete shell, the drawings have been prepared from actual measurements.

A large amount of current information about H.E. shell and shrapnel has been received from individual officers and other ranks, whose zeal in collecting specimens and fragments of new shell, combined with the co-operation of the Directorate of Gas Services, has contributed considerably to the value of the book. This preliminary information has, in most cases, been supplemented by a detailed technical report based on the examination of blind shell or of captured ammunition, carried out by the Central Laboratory.

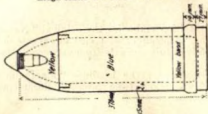
The introductory chapters on explosives and on gas shell have been specially contributed, and the portion of the book dealing with gas shell is a compilation of the reports received from the technical branches of the allied armies. In this connection, the opportunity is taken of expressing due acknowledgment to the following for their constant co-operation and for the valuable information derived from their reports :—

Grand Quartier Général Français ; Direction des Inventions, Etudes et Expériences Techniques del Artillerie ; Laboratoire Municipal de Chimie de la Ville de Paris ; Grand Quartier Général Belge ; Service de Recherches et d'Études des Projectiles Ennemis, Armée Belge.

Report on New Pattern German Shell.

(Note.—It is more convenient if dimensions are given in millimetres.)

Rough Sketch of Shell to show detail.



Calibre.....	10.5 cm. (4.13")
Nature of shell (H.E. or Shrapnel).....	H.E.
Date fired and where found	2/1/18. 28 N.E. 1. 24.d.28.
Colouring	Blue, with a yellow band and yellow head
Markings on shell body	147. Kp. 17.
Length (without fuse).....	378 mm.
Thickness of walls	15 mm.
Thickness of base	25 mm.
Material.....	Steel.
No. and position of driving bands...	1. 27 mm. above base.
Width of driving bands	14 mm.
No. of grooves on driving band.....	32 Constant, 10.3 mm.
Diameter of fuse hole:—	
At top	7½ mm.
Threaded portion.....	55 mm.
Fuse:—	
Markings.....	H.Z. 16.
Material.....	Iron.
Nature of charge.....	Amatol (?).
Remarks.....	This shell is a blind and can be seen at the map location given above.

_____(Signature)

(Date) _____

477 ml (3)

INSTRUCTIONS FOR REPORTING ON "NEW PATTERNS OF GERMAN SHELL."

1. It is desirable to obtain as much information as possible regarding new patterns of German shell, and much can be obtained from a casual inspection of "blinds" without necessarily handling them, and from portions of exploded or partially exploded shell.

2. *Means of identification.*—The most important means of identifying shell are :—

- (a) Calibre.
- (b) Length (without fuze).
- (c) Colour.
- (d) Number and position of driving bands.

3. *Colour.*—The particulars of painting of nearly all patterns of German shell which are in use are shown or stated in this book.

4. *Marks.*—Marks stamped on the shell body are also useful, as these usually give the place and year of manufacture.

5. *Position of driving bands.*—The height of the lower edges of the driving bands above the base should always be stated. In the case of shell of 10.5 cm. calibre, this assists in differentiating between howitzer shell and gun shell.

6. *Grooves on driving band.*—The number of grooves on the driving band, the width of the driving band, and the *constant* of the driving band (see Table on page 6) assist in identifying the gun from which the shell was fired.

7. *Fuze.*—Particulars of the fuze should always be given, when possible, as it is very desirable to complete our information regarding the particular fuzes employed with the various patterns of shell. The diameters of the fuze hole will frequently assist in determining the fuze when this cannot be found. Variations in the material of fuzes are also of interest.

8. *Labels on case containing bursting charge.*—Many patterns of shell have a millboard lining which contains the charge. The labels on these linings should invariably be forwarded with the report on the shell.

9. *Measurements.*—Eventually measurements are reduced to millimetres. When possible, therefore, the original measurement should be taken in millimetres. If no millimetre measure is available, measurements should be given in inches and fractions of an inch.

10. Reports on new pattern shells should be submitted on the form shown opposite, copies of which can be obtained from all Army Printing and Stationery Depôts (Army Form W 3363).

SHELL CRATERS.

The depth and width of a shell crater afford a rough indication of the calibre of the shell by which the crater has been formed.

The size of the crater is, however, dependent on so many unknown factors, such as the nature of the soil, the angle of descent, the velocity of the shell, the nature of fuze employed and whether the shell detonates well or not, that craters of widely varying dimensions will be made by shell of the same pattern and calibre.

The following table has been compiled from a very large number of reports received from the Armies in France.

Craters formed in "clay" soil.

For ordinary soil, the figures given should be somewhat increased; for chalk, they will be somewhat less.

Calibre.	Crater.		Nature of fuze.
	Average depth.	Average width.	
GUNS.			
7.7 cm.	feet. 1½	feet. 3	Non-delay.
10.5 cm.	2	5	
13 cm.	3½	6½	
15 cm.	6	13	Delay.
24 cm.	7	16	
35.6 cm.	11	23	
38 cm.	12	26	
HOWITZERS.			
10.5 cm.	3	5½	Delay.
15 cm....	5	9	
21 cm.—			
Short shell	7	15½	
Long shell... ..	10	22	
42 cm....	14	30	
MINENWERFER.			
7.6 cm.	1½	3	Non-delay.
17 cm....	5	9½	Delay.
25 cm....	10	22	
24 cm. <i>Flügelminenwerfer</i> ...	18	30	Delay (in average soil).

German Shell other than Gas Shell required for examination.

Shells and fuzes should be reported, wherever possible, on Army Form W. 3363, specimen attached.

SHELLS.

1. All shell fired by the enemy, which are not mentioned in this book, should be reported. These include Russian, Austrian and Italian shell.
2. Specimens are required of the following shell mentioned in this book :--

Calibre		Designation.	Fuze.	Colour and marking	Page.
cm.	inches.				
Artillery Shell.					
2.0	0.78	2 cm. tracer shot	None	Green	54
7.7	3.03	Field gun streamline H.E.	E.K.Z. 16 C.	Grey	78
7.7	3.03	Field gun star shell	?	Green ?	82
10.5	4.1	Light field howitzer streamline H.E.	E.H.Z. 16 C.	Grey	110
15.0	5.9	? pattern 15 cm. H.E. with false cap	Gr. Z. 04	Grey	162
15.0	5.9	1914 Pattern 15 cm. H.E. with false cap	{ Gr. Z. 14 n.A. Gr. Z. 17	Grey	176
17.0	6.7	17 cm. streamline Naval H.E. with false cap	?	Yellow	312
35.6	14.0	35.6 cm. Naval H.E. with false cap	Spgr. m. K.	Yellow	334
Shrapnel.					
10.5	4.1	1896 pattern 10 cm. gun shrapnel	Dopp. Z. 92 f. 10 cm. K.	Blue	236
13.5	5.3	13 cm. gun shrapnel	Dopp. Z. 92 lg. Brlg.	Blue	244
15.0	5.9	1903 pattern 15 cm. shrapnel	Dopp. Z. 16	Grey	256
15.0	5.9	15 cm. shrapnel with false cap	Dopp. Z. 16	Red with grey cap	254
Minenwerfer Projectiles.					
7.6	2.99	Light message shell	l.W.M. Zdr. 2	Grey with 3 black bands and the letters l.N.M.	356
17.0	6.7	Medium H.E. bomb with vanes	Percussion fuzes either delay or non-delay action	?	374
24.0	9.45	Heavy H.E. bomb with vanes		?	376
25.0	9.84	1916 pattern long heavy H.E. shell		Grey	372

Attention is particularly directed to the light field howitzer streamline H.E. shell, and the 1914 pattern 15 cm. H.E. shell with false cap.

FUZES.

All German fuzes not fully described in "Notes on German Fuzes" should be reported. In particular, specimens are required of the following:—

German designation stamped on fuze.	"Notes on German Fuzes" (2nd edition). Page
<i>E.K.Z. 16 C.</i>	32
<i>H.Z. 16</i>	48
<i>E.H.Z. 16 C.</i>	52
<i>K.Z. 16 f. 10 cm. K.</i>	56
<i>Gr. Z. 17</i>	74
<i>L.K.Z. 11 Gr.</i>	94
<i>Dopp. Z. 17</i>	—
<i>Az. 16 f. l.W.M.</i>	170
Other percussion fuzes for Minenwerfer ...	—

This list cancels all previous lists on this subject.

List of German H.E. Shell

AND

common, universal, incendiary, tracer and star shell.

German designation.	English equivalent.	Length in calibres without fuze.	Radius of head in calibres = c.r.h.*	Page.
2 cm. Anti-Aircraft Gun Shell.				
2 cm. <i>L.S. Gesch.</i> ...	2 cm. tracer shot ...	4	2	54
3·7 cm. Gun Shell.				
3·7 cm. <i>Gr. (P.)</i> ...	3·7 cm. common ...	2·3	2	56
5 cm. Gun Shell.				
5 cm. <i>Gr. (P.)</i> ...	5 cm. common ...	2·8	1	58
5·7 cm. Gun Shell.				
5·7 cm. <i>Gr. (f)</i> ...	5·7 cm. H.E. ...	3·4	3·1	60
5·7 cm. <i>Gr. m. P. (f)</i> ...	5·7 cm. A.P. ...	4	3·1	62
7·62 cm. Gun Shell.				
7·62 cm. <i>Gr.</i> ...	H.E. for infantry gun	3	2	64
7·62 cm. <i>Flak. Gr. (f)</i> ...	H.E. for anti-aircraft gun	3·2	2	66
7·7 cm. Field Gun Shell.				
<i>F.K. Gr. 96</i> ...	1896 H.E. ...	3·3	2	68
7·7 cm. <i>L.S. Gr.</i> ...	Ditto, tracer ...			
(?)	Ditto, thermit (?)			
7·7 cm. <i>Einheits-Geschoss</i> (<i>F.K. Geschoss 11</i>)	Universal ...	3·2	2	70
<i>K. Gr. 14</i> ...	1914 H.E. ...	3·2	2	72
<i>K. Gr. 15</i> ...	1915 H.E. ...	3·2	2	74
<i>K. Gr. 15 m. ger. Sprldg.</i>	Ditto, with reduced bursting charge			
<i>L.F.K. Gr.</i> ...	Long H.E. ...	5†	4	76
<i>C-Geschoss der F.K. 16</i> ...	Streamline H.E. ...	4·5†	15†	78
<i>K. Gr. 15 m. P.</i> ...	Anti-Tank ...	3·4	2	80
<i>F.K. Leucht-Geschoss L/38</i>	Star shell ...	3·8	—	82
<i>K. Gr. 16</i> ...	1916 H.E. ...	—	—	84
9 cm. Gun Shell.				
9 cm. <i>Gr. 82 (P.)</i> ...	1882 H.E. ...	2·5	1·5	90
9 cm. <i>Gr. 88</i> ...	1888 H.E. ...	2·2	1·5	92
9 cm. <i>Gr. 14 A</i> ...	1914A H.E. ...	2·2	2	94
9 cm. <i>Gr. 14</i> ...	1914 H.E. ...	2·2	1·5	96

* Thus the head of the 2 cm. tracer shot is struck with a radius of $2 \times 2 = 4$ cm.

† Including fuze.

German designation.	English equivalent.	Length in calibres without fuze.	Radius of head in calibres = c.r.h.*	Page.
95 mm. Gun Shell.				
9.5 cm. Gr. ...	H.E. for French gun ...	3.2	2.5	98
(10.5 cm.) Light Field Howitzer Shell.				
F.H. Geschoss 05 ...	} Universal ...	3.3	2	100
(10.5 cm. Einheits-Geschoss)				
H. Gr. 14 ...	} 1914 H.E. ... Ditto, incendiary	2.8	2	102
H. Gr. 15 ...				
L.F.H. Gr. ...	} 1915 ... Long H.E.	3.3	2	104
L.F.H. Gr. m. ger. Sprldg.				
F.H. Leucht-Geschoss L/3.3	} Ditto, with reduced bursting charge	3.6	2	106
C-Geschoss der 1. F.H.				
	Star shell ...	3.3	0.5	108
	Streamline H.E. ...	4.3†	—	110
10 cm. Gun Shell.				
10 cm. Gr. 96 ...	1896 H.E. ...	4.2	2.5	118
10 cm. Gr. ...	10 cm. H.E. ...	3.25	2.5	120
10 cm. Gr. 06 ...	1906 H.E. ...	—	—	122
10 cm. Gr. 14A ...	1914 A H.E. ...	—	—	124
10 cm. Gr. 14 ...	1914 H.E. ...	—	—	126
10 cm. Gr. 15 ...	1915 H.E. ...	3.9	2	128
10 cm. Gr. 16 ...	1916 H.E. ...	—	—	130
12 cm. Shell.				
12 cm. Gr. ...	H.E. for French gun ...	2.4	2	134
12 cm. Gr. 88 a/A ...	1888 old pattern H.E.	2.3	1.5	136
12 cm. Gr. 14A ...	} 1914 A H.E. ... 1914 H.E.	2.3	1.5	138
12 cm. Gr. 14 ...				
12 cm. Gr. ...	H.E. for Russian light field howitzer ...	2.3	2	140
13 cm. Gun Shell.				
13 cm. Gr. ...	} 13 cm. H.E. ... Ditto, incendiary	4.8	—	142
13 cm. Brd. Gesch. ...				
13 cm. Gr. 14 ...	1914 H.E. ...	3.8	6	144
15 cm. Shell.				
15 cm. Gr. 80 (P.) ...	1880 common ...	2.4	1	148
15 cm. Brand-Gr. C. ...	15 cm. incendiary shell "C"	2.4	1	150
15 cm. Gr. 83 ...	1883 H.E. ...	3.7	1.5	152
15 cm. Gr. 88 ...	1888 H.E. ...	2.8	1.5	154
15 cm. Gr. 96 ...	1896 H.E. ...	3.9	2.5	156
15 cm. Gr. 03 ...	1903 H.E. ...	3.8	7.5	158
15 cm. Gr. 03 (Haube) ...	1903 H.E. with false cap	4.7	7.5	160
15 cm. Gr. (?) (Haube) ...	? H.E. with false cap...	5.1	10	162
15 cm. Gr. 04 ...	1904 H.E. ...	3.3	2	164

* Thus the head of the 10.5 cm. universal shell is struck with a radius of
 $2.5 \times 10.5 = 26.25$ cm.

† Including fuze.

German designation.	English equivalent.	Length in calibres without fuze.	Radius of head in calibres = c.r.h.*	Page.
15 cm. Shell—continued.				
15 cm. Gr. 06	1906 H.E.	4.1	5	166
15 cm. Gr. 12	1912 H.E.	3.7	2	168
15 cm. Gr. 12 n/A.	1912 n/A. H.E.	3.65	2	170
15 cm. Gr. 14 A	1914 A H.E.	2.83	1	172
15 cm. Brand-Gr. B	Ditto, incendiary			
15 cm. Gr. 14	1914 H.E.	2.83	1	174
15 cm. Gr. 14 (Haube)	1914 H.E. with false cap	4.5	7(?)	176
15 cm. Gr. 14 A. m.v.F.	1914 A H.E. with forward driving band	2.83	1	178
15 cm. Gr. 14 m.v.F.	1914 H.E. with forward driving band			
21 cm. Shell.				
Deutsche 20.3 cm. Gr.	H.E. for Russian howitzer	2.8	2	184
21 cm. Gr. 80 (P.)	1880 common	2.5	1.5	186
21 cm. Gr. 83	1883 H.E.	3.9	1.5	188
21 cm. Gr. 88	1888 H.E.	2.4	2	190
21 cm. Gr. 96	1896 H.E.	4.1	2	192
21 cm. Gr. 96 n/A.	1896 n/A. H.E.	4.0	2	194
21 cm. Gr. 06	1906 H.E.	2.4	2	196
21 cm. Gr. 14 A	1914 A H.E.	2.4	1.5	198
21 cm. Gr. 14	1914 H.E.	2.4	1.5	200
21 cm. Gr. 17	1917 H.E.	—	—	202
28 cm. Howitzer Shell.				
28 cm. Gr. 06	1906 H.E.	3.5	2	206
28 cm. Lggr.	Long H.E.	—	—	
28 cm. Gr. (F) 12	1912 (F) H.E.	3.6	2	208
30.5 cm. Shell.				
30.5 cm. Gr. (F)	H.E.	3.4	1.5	210
30.5 cm. Gr.	H.E. for Austrian howitzer	3.6	2	212
42 cm. Howitzer Shell.				
42 cm. Gr.	H.E. (with diaphragm)	3.7	2	214
42 cm. Gr.	H.E. (without diaphragm)	3.6	2	216

* Thus the head of the 1906 H.E. shell is struck with a radius of $5 \times 15 = 75$ cm.

Shrapnel.

German designation.	English equivalent.	Length in calibres without fuze.	Radius of head in calibres = c.r.h.*	Page.
7.7 cm. Field Gun Shrapnel.				
<i>F. Schr. 96 (umg.)</i> ...	1896 pattern (converted)	3.3	2	220
9 cm. Gun Shrapnel.				
<i>9 cm. Schr. 82</i> ...	1882 pattern ...	2.3	1	224
<i>9 cm. Schr. 91</i> ...	1891 " ...	2.2	1.5	226
<i>9 cm. Schr. 15</i> ...	1915 " ...	2.2	1.5	228
95 mm. Gun Shrapnel.				
<i>9.5 cm. Schr.</i> ...	Shrapnel for French gun	3	2	230
10.5 cm. Light Field Howitzer Shrapnel.				
<i>F.H. Schr. 16</i> ...	1916 pattern ...	3.1	2	232
10 cm. Gun Shrapnel.				
<i>10 cm. Schr. 96</i> ...	1896 pattern ...	3.1	2	236
12 cm. Gun Shrapnel.				
<i>12 cm. Schr.</i> ...	Shrapnel for French gun	2.5	2	238
<i>12 cm. Schr. 80/92</i> ...	1880/1892 pattern ...	2.2	1	240
<i>12 cm. Schr. 15</i> ...	1915 pattern ...	2.5	2	242
13 cm. Gun Shrapnel.				
<i>13 cm. Schr.</i> ...	13 cm. shrapnel ...	3.5	6	244
15 cm. Gun Shrapnel.				
<i>15 cm. Schr. 80/92</i> ...	1880/1892 pattern ...	2.3	1	248
<i>15 cm. Schr. 92</i> ...	1892 pattern ...	2.6	1.5	250
<i>15 cm. Schr. 90/92</i> ...	1890/1892 pattern ...			
<i>15 cm. Schr. 03</i> ...	1903 pattern ...	3.4	6	252
<i>15 cm. Schr. (Haube) (?)</i> ...	Ditto, with false cap ...	4.8	9	254
<i>15 cm. Schr. 03 (gr.)</i> ...	1903 pattern (grey) ...	3.3	7.6	256
<i>15 cm. Schr. 07</i> ...	1907 pattern ...	2.6	1	258
<i>15 cm. Schr. 15</i> ...	1915 " ...	2.4	1	260
<i>15 cm. Schr. 15 m.v.F.</i> ...	Ditto, with forward driving band... ..	2.3	1	262
21 cm. Gun Shrapnel.				
<i>21 cm. Schr. 89</i> ...	1889 pattern ...	2	1	268
<i>21 cm. Schr. 04</i> ...	1904 " ...	2.5	1.5	270

* Thus the head of the 1896 pattern shrapnel is struck with a radius of $2 \times 7.7 = 15.4$ cm.

LIST OF GERMAN NAVAL SHELL

German designation.

3.7 cm. Gr. (f)	...	...	...	...	...	...	...
3.7 cm. Spgr.	...	...	...	...	...	...	...
3.7 cm. L.S. Gesch.	...	...	...	...	...	...	...
6 cm. Spgr. L/3.4 (Dz.)	...	...	...	...	...	...	...
8.8 cm. Spgr. L/2.8 (Iz.)	...	...	...	...	...	...	...
8.8 cm. Spgr. L/3.6 (Kz.)	...	...	...	...	...	...	...
8.8 cm. Spgr. L/3.7 (Dz.)	...	...	...	...	...	...	...
8.8 cm. Spgr. L/3.8 (Iz.)	...	...	...	...	...	...	...
10.5 cm. Spgr. L/3.6 (Kz.)	...	...	...	...	...	...	...
15 cm. Üb. Spgr. L/2.9 (Kz.)	...	...	...	...	...	...	...
15 cm. Spgr. L/3 m. Bdz. (m. Haube)	...	...	...	...	...	...	...
15 cm. Spgr. L/3.6 (Dz.)	...	...	...	...	...	...	...
15 cm. Spgr. L/5 (Dz.) (Haube)	...	...	...	...	...	...	...
17 cm. Spgr. L/3 (Kz.)	...	...	...	...	...	...	...
17 cm. Spgr. L/4.7 (Haube) (f)	...	...	...	...	...	...	...
21 cm. Spgr. L/3.1 m. Bdz. (m. Haube) (?)	...	...	...	...	...	...	...
21 cm. Spgr. L/4.2 m. Bdz.	...	...	...	...	...	...	...
24 cm. Spgr. L/2.8 m. Bdz. (m. Haube) (?)	...	...	...	...	...	...	...
24 cm. Spgr. L/4.1 m. Bdz.	...	...	...	...	...	...	...
28 cm. Spgr. L/3.5 m. Bdz.	...	...	...	...	...	...	...
28 cm. Spgr. L/3.6 m. Bdz. (f)	...	...	...	...	...	...	...
30.5 cm. Spgr. L/3.3 m. Bdz. (f)	...	...	...	...	...	...	...
35.6 cm. Spgr. L/? m. Bdz. (m. Haube) (?)	...	...	...	...	...	...	...
38 cm. Spgr. L/3.6 m. Bdz. (m. Haube) (?)	...	...	...	...	...	...	...
38 cm. Spgr. L/4.1 m. Bdz. (f)	...	...	...	...	...	...	...
42 cm. Spgr. L/1.7 m. Bdz. (m. Haube) (f)	...	...	...	...	...	...	...
24 cm. Schr. L/4.2 (Haube) (?)	...	...	...	...	...	...	...
38 cm. Schr. L/3.6 (f)	...	...	...	...	...	...	...

* Thus, the head of the 3.7 cm. common shell is struck

USED IN LAND WARFARE.

English equivalent.	Length in calibres without fuze.	Radius of head in calibres = c.r.h.*	Page.
(a) Common, H.E., Tracer and Practice Shell.			
3·7 cm. common	2·3	2	280
3·7 cm. H.E.	2·3	2	282
3·7 cm. tracer	2·5	2	284
6 cm. H.E.	3·4	1·5	286
8·8 cm. H.E.	2·8	2	288
8·8 cm. H.E.	3·6	2	290
8·8 cm. H.E.	3·7†	2	292
8·8 cm. H.E.	3·8	2	294
10·5 cm. H.E.	3·6	2	298
15 cm. H.E. practice	2·9	2·8	300
15 cm. H.E. with false cap... ..			302
15 cm. H.E.	3·6	2·5	304
15 cm. H.E. with false cap... ..	5	10	306
17 cm. H.E.	3	2	310
17 cm. H.E. streamline with false cap.	4·7	8	312
21 cm. H.E. with false cap	4·9	10	316
21 cm. H.E.	4·2	10	318
24 cm. H.E. with false cap			320
24 cm. H.E.	4·1	10	322
28 cm. H.E.	3·5	2·7	326
28 cm. H.E.	3·6		328
30·5 cm. H.E.	3·3	2	330
35·6 cm. H.E. with false cap			334
38 cm. H.E. with false cap			336
38 cm. H.E.	4·1	5	338
42 cm. H.E. with false cap	2·5 (†)	6 (†)	340
(b) Shrapnel.			
24 cm. shrapnel with false cap	4·2	10	344
38 cm. shrapnel	3·6	3·7	348

with a radius of $3·7 \times 2 = 7·4$ cm.

† Including fuze.

Minenwerfer H.E. Shell.

German designation.	English equivalent.	Page
<i>l. W.M.</i>	Old pattern 7·6 cm. light shell ...	35
<i>l. Spr.M. 16*</i> ...	} 1916 pattern 7·6 cm. light shell...	35
<i>l. Spr.M. 16a*</i> ...		
<i>l. N.M.</i>	7·6 cm. light message shell ...	35
<i>m. W.M.</i>	Old pattern 17 cm. medium shell	36
<i>m. Spr.M. 16*</i>	1916 pattern 17 cm. medium shell	36
<i>Mittlere Brand-Mine 14</i>	1914 pattern 17 cm. medium incendiary shell	36
<i>kz.s. W.M.</i>	Old pattern 25 cm. short heavy shell	} 36
$\frac{1}{2}$ <i>s. Spr.M. 16</i>	1916 pattern 25 cm. half-size heavy shell	
<i>lg.s. W.M.</i>	25 cm. long heavy shell ...	37
<i>1/1 Spr.M. 16*</i>	1916 pattern 25 cm. full-sized heavy shell	37
<i>m. Fl.M.</i>	17 cm. medium bomb, with vanes	37
<i>s. Fl.M.</i>	24 cm. heavy bomb, with vanes	37
<i>gl. W.M.</i>	18 cm. smooth-bore bomb ...	38
<i>Laungs-Mine</i>	24 cm. canister bomb (rum jar) ...	38

* In common use.

List of Minenwerfer Gas Shell.

Calibre.	Designation.	Fuze.	Distinctive markings.	Contents.	Page.
cm. 7.6	Light gas shell ... Old pattern with conical head and lead container. (<i>leichte Gas-Mine.</i>)	<i>I. W. M. Zdr.</i> ...	One white band and white B. Two white bands and red or white C.	Xylol bromide or brommethyl-ethylketone (A. & L.). <i>B-Stoff.</i> Mono or trichloromethylchloroformate (A. & L.). <i>C-Stoff.</i>	432
7.6	Light gas shell ... Old pattern with conical head; direct filled. (<i>leichte Gas-Mine.</i>)	<i>I. W. M. Zdr.</i> ...	Three white bands and black D. or six white bands.	Phosgene (A.) <i>D-Stoff.</i>	434
7.6	Light gas shell ... Old pattern with ogival head; direct filled. (<i>leichte Gas-Mine.</i>)	<i>I. W. M. Zdr.</i> ...	Three or six white bands.	Phosgene (A.) <i>D-Stoff.</i>	436
7.6	Light gas shell ... New short pattern; direct filled. (<i>leichte Gas-Mine.</i>)	<i>I. W. M. Zdr. 2</i> ... <i>Az. 16 f. I. W. M.</i>	Three white bands and white D.	Phosgene (A.) <i>D-Stoff.</i>	438
7.6	Ditto ...	Ditto ...	White G in six places.	—	440
17.0	Medium gas shell ... Original pattern with lead container and bursting charge in circular case. (<i>mittlere Gas-Mine.</i>) <i>B—U. 12 n/A.</i> <i>C—M. 12 n/A.</i>	<i>Z. s. u. m. W. M.</i> ...	One white band. Two white bands.	Brommethyl-ethylketone (L.). <i>B-Stoff.</i> Monochloromethylchloroformate (A. & L.). <i>C-Stoff.</i>	444
17.0	Medium gas shell ... Old pattern with lead container and bursting charge in central tube. (<i>mittlere Gas-Mine.</i>) (<i>B-Mine (F.)</i>)	<i>Z. s. u. m. W. M.</i> ...	One white band and B.M.	Brommethyl-ethylketone (A. & L.). <i>B-Stoff.</i>	446
17.0	Medium gas shell ... New pattern; direct filled (<i>mittlere Gas-Mine.</i>)	<i>Z. s. u. m. W. M.</i> ...	Three white bands and white D., and sometimes white cross.	Phosgene (A.) <i>D-Stoff.</i>	448
25.0	Half-sized heavy gas shell; (<i>halbe schwere Gas-Mine.</i>) direct filled. ($\frac{1}{2}$ s. <i>Gas-Mine.</i>)	<i>Z. s. u. m. W. M.</i> ...	Three white bands and white D.	Phosgene (A.) <i>D-Stoff.</i>	452
18.0	Projector bomb ... Smooth-bore Minenwerfer gas bomb; direct filled. (<i>glatte Gas-Mine (F.)</i>)	<i>Z. s. u. m. W. M.</i> ...	Three white bands.	Phosgene (A.) <i>D-Stoff.</i> Phosgene and chloro-perin (A. & L.).	454
18.0	Ditto ...	Ditto ...	One blue cross.	Hexanitrodiphenylamine and diphenylchlorarsine.	456

* A = Asphyxiating; L = Lachrymatory. All these fillings are poisonous.

LIST OF GERMAN

Calibre.	German designation.	Pattern of shell.	Fuze.	Colour and distinctive markings.
cm. 7.7	<i>K. Gr. 15 Grkz.</i> ... <i>L.F.K. Gr. Grkz.</i> ... <i>L.F.K. Gr. Grkz. 1.</i> <i>L.F.K. Gr. Blau-kreuz.</i> <i>L.F.K. Gr. Gelb-kreuz.</i>	1915 field gun shell. Long field gun shell.	<i>K.Z. 14</i> ... <i>K.Z. 14</i> ... <i>K.Z. 14 n. A.</i> <i>E.K.Z. 17.</i> <i>E.K.Z. 16</i> <i>K.Z. 116r.</i> <i>E.K.Z. 17</i> ...	Grey, yellow head Blue, yellow head. Green cross on base of shell and on base of cartridge case. Cap of fuze green (?). Blue, yellow head. Blue cross on cylindrical portion. Blue, yellow head, 3 yellow crosses; 2 diametrically opposed on the cylindrical portion and 1 on the base.
10.5	<i>L.F.H. Gr. Grkz.</i> <i>L.F.H. Gr. Grkz. 1.</i> <i>L.F.H. Gr. Blau-kreuz.</i> <i>L.F.H. Gr. Gelb-kreuz.</i> <i>L.F.H. Gr. Gelb-kreuz 1 (?)</i> <i>10 cm. Gr. 15 Grkz. 1</i>	Long light field howitzer shell. 1915 10 cm. gun shell.	<i>H.Z. 14.</i> <i>E.H.Z. 17</i> ... <i>H.Z. 05 Gr.</i> ... <i>H.Z. 15.</i> <i>E.H.Z. 17</i> ... <i>E.H.Z. 17</i> <i>Gr. Z. 04.</i> <i>Gr. Z. 14 n/A.</i>	Blue, yellow head. Green cross on base. Cap of fuze green (?). Blue, yellow head. Blue cross on shoulder. Blue, yellow head, 3 yellow crosses; 2 diametrically opposed on the cylindrical portion and 1 on the base. Ditto Grey

ARTILLERY GAS SHELL.

Filling.‡	German name.	English equivalent.	Effect.†	Page.
Diphosgene *	<i>Grünkreuz</i> ...	Green cross ...	A. and slight L. ...	392
Diphosgene or brommethyl- ethylketone	<i>Grünkreuz</i> ...	Green cross ...	A. and slight L. ...	394
Diphosgene (30 %–70 %) and chloropicrin (70 %–30 %).	<i>Grünkreuz 1</i>	Green cross 1...	A. and L. ...	
Diphenylchlorarsine (16 %) and H.E. (84%).	<i>Blaukreuz</i> ...	Blue cross ...	H.E. and S. ...	396
Dichlorethylsulphide (80 %–90 %) and solvents: carbon tetra- chloride (20 %–10 %), chloro- benzene (20 %–10 %).	<i>Gelbkreuz</i> ...	Yellow cross ...	V. and delayed L. and A.	398
Diphosgene or brommethyl- ethylketone.	<i>Grünkreuz</i> ...	Green cross ...	A. and slight L. ...	402
Diphosgene (30 %–70 %) and chloropicrin (70 %–30 %).	<i>Grünkreuz 1</i>	Green cross 1...	A. and L. ...	
Diphenylchlorarsine (24 %) and H.E. (76 %).	<i>Blaukreuz</i> ...	Blue cross ...	H.E. and S. ...	404
Dichlorethylsulphide (80 %–90 %) and solvents: carbon tetra- chloride (20 %–10 %), chloro- benzene (20 %–10 %).	<i>Gelbkreuz</i> ...	Yellow cross ...	V. and delayed L. and A.	406
Ethylchlorarsine (47.7%) and dichloromethylether (52.3%).	<i>Gelbkreuz 1</i> (?)	Yellow cross 1(?)	...	
Diphosgene (30 %–70 %) and chloropicrin (70 %–30 %).	<i>Grünkreuz 1</i>	Green cross 1...	A. and L. ...	410

* Trichlormethylchloroformate.

† Also known as Per-Stoff.

‡ A. = Asphyxiant, lethal, poisonous; L. = Lachrymator (tear-gas); S. = Sternutator (causes irritation and pain in the nose and throat, and often sneezing); V. = Vesicant (skin irritant, causing blisters); H.E. = High Explosive.

§ Percentages by volume, except for blue cross shell where they are given by weight.

LIST OF GERMAN

Calibre.	German designation.	Pattern of shell.	Fuze.	Colour and distinctive markings.
15 (14.97)	15 cm. Gr. 12 T. ...	1912 ...	Gr. Z. 04 ...	Grey, black head, black T. ...
	15 cm. Gr. 12 T., grün.	...	...	Grey, green head, green T. ...
	15 cm. Gr. 12 K. ...	...	...	Grey, yellow head and yellow K.
	15 cm. Gr. 12 n/A. Grkz.	1912 n/A....	Gr. Z. 14 n/A.	Grey, 2 blue bands, green cross on base and shoulder (?).
	15 cm. Gr. 12 n/A. Grkz. 1.	...	...	...
	(?)	Ditto ...	Ditto ...	Ditto (?) ...
	15 cm. Gr. 12 n/A. Grkz. 2.	1912 n/A....	Gr. Z. 9 ...	Green cross and "2" on base and cylindrical portion.
	15 cm. Gr. 12 n/A. Gelbkreuz.	1912 n/A....	Gr. Z. 17 ...	3 yellow crosses; 2 diametrically opposed on the cylindrical portion and 1 on the base.
	15 cm. Gr. 12 n/A. Blaukreuz.	1912 n/A. ...	Gr. Z. 14 n/A.	Grey, 2 blue bands, 2 blue crosses diametrically opposed on the cylindrical portion and 1 on the base.
21 (21.1)	21 cm. Gr. (erst) ? Gelbkreuz.	?	Gr. Z. 14 n/A.	3 yellow crosses; 2 diametrically opposed on the cylindrical portion and 1 on the base.
	21 cm. Gr. ? (Haube), Gelbkreuz.	?	Gr. Z. 04 ...	Ditto ...
	21 cm. Gr. 90 n/A. Grkz. 2.	1896 n/A....	Gr. Z. 92 ...	Grey, black band (?) ...
	21 cm. Gr. 90 n/A. Gelbkreuz.	1896 n/A. ...	...	Grey, 3 yellow crosses; 2 diametrically opposed on the cylindrical portion and 1 on the base.

ARTILLERY GAS SHELL.

Filling. §	German name.	English equivalent.	Effect. †	Page.
Xylol or benzyl bromide ...	<i>T-Stoff</i> ...	"T" ...	L. ...	412
Xylol bromide (88 %) and brom-methylethylketone (12 %).	<i>T-grün</i> ...	Green "T" ...	L. ...	
Mono-chloromethylchloroformate	<i>K-Stoff</i> ...	"K" ...	A. and slight L. ...	414
Diphosgene or brom-methylethylketone.	<i>Grünkreuz</i> ...	Green cross ...	A. and slight L. ...	
Diphosgene (30 %–70 %) and chloropicrin (70 %–30 %).	<i>Grünkreuz 1</i> ...	Green cross 1 ...	A. and L. ...	416
Phenyl carbylamine chloride ...	?	?	L. ...	
Phosgene (60 %), diphosgene (25 %), and diphenylchlorarsine (15 %).	<i>Grünkreuz 2</i> ...	Green cross 2 ...	A., S., and slight L.	418
?	<i>Gelbkreuz</i> ...	Yellow cross ...	V. and delayed L. and A.	
Diphenylchlorarsine (28 %) and H.E. (72 %).	<i>Blaukreuz</i> ...	Blue cross ...	H.E. and S. ...	420
Dichlorethylsulphide (80 %), and a solvent, chlorobenzene (20 %).	<i>Gelbkreuz</i> ...	Yellow cross ...	V. and delayed L. and A.	422
...	<i>Gelbkreuz</i> ...	Yellow cross ...	V. and delayed L. and A.	426
Phosgene (60 %), diphosgene (25 %), and diphenylchlorarsine (15 %).	<i>Grünkreuz</i> ...	Green cross 2 ...	A., S., and slight L.	428
Dichlorethylsulphide (75 %) and dichloromethylether (5 %), in addition to a solvent, chlorobenzene (15 %).	<i>Gelbkreuz</i> ...	Yellow cross ...	V. and delayed L. and A.	

† A. = Asphyxiant, lethal, poisonous; L. = Lachrymator (tear-gas; S. = Sternutator, causes irritation and pain in the nose and throat, and often sneezing; V. = Vesicant (skin irritant, causing blisters); H.E. = High Explosive.

§ Percentages by volume, except for blue cross shell where they are given by weight.

TABLE SHOWING PARTICULARS OF RIFLING OF GERMAN GUNS AND HOWITZERS,
AND NATURE OF SHELL EMPLOYED.

(For particulars of German Naval Guns, see page 276.)

Name.	Calibre. cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth. mm.	Width. mm.		
2 cm. Anti-Air- craft Gun <i>2 cm. Flugzeug- Kanone</i>	2.0 (?)	—	9	—	—	2 cm. L.S. Gesch.	
3.7 cm. Anti-Air- craft Gun <i>3.7 cm. Flak.</i>	3.7	—	12	—	—	3.7 cm. L.S. Gesch.	
3.7 cm. Revolver Gun*	.7	6°	12	0.4	7.8	3.7 cm. Gr. (P.). 3.7 cm. Spgr.	
3.7 cm. Rev. K. 5 cm. Gun on Shielded Mount- ing (or on Case- mate Mounting)* <i>5 cm. K. (i. P.L.) or cm. K. (i. Kas. L.)</i>	5.3	1° 11' to 5° 56'	24	0.4	5.2	5 cm. Gr. (P.).	

5.7 cm. Q.F. Gun on Pivot Mount- ing*	5.7	—	24	—	—	5.7 cm. Gr. (?) 5.7 cm. Gr. m.P. (?)	
7.62 cm. Infantry Gun (converted Russian Field Gun) <i>Inf. Gesch.</i>	7.62 (3-in.)	—	24	—	—	7.62 cm. Gr.	
7.62 cm. Anti-Air- craft Gun (converted Russian Field Gun) <i>7.62 cm. besp. Flak.</i>	7.62 (3-in.)	—	24	—	—	7.62 cm. Flak. Gr. (?)	
(7.7 cm.) Field Gun,* '96 n/A. <i>F.K. 96 n/A.</i>	7.7	4°-7° 9'	32	0.75	5	<i>F.K. Gr. 96</i> <i>F.K. Gesch. 11</i> <i>K. Gr. 14</i> <i>K. Gr. 15</i> <i>K. Gr. 15 m.P.</i> <i>L.F.K. Gr.</i> <i>F.K. Leucht-Geschoss L/3-8</i>	<i>F. Schr. 96</i> <i>F. Schr. 96 (ung.)</i>
(7.7 cm.) Field Gun '16 <i>F.K. 16</i>	7.7	8° 30'	32	—	—	<i>K. Gr. 15</i> <i>L.F.K. Gr.</i> <i>K. Gr. 16</i> <i>C-Gesch. der F.K. 16</i>	<i>F. Schr. 96 (ung.)</i>

* These guns also fire case-shot.

Name.	Calibre. cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth. mm.	Width. mm.		
(10.5 cm.) Light Field Howitzer '98/'09 <i>l. F.H. 98/09</i>	10.5	5°—12°	32	1.25	6.8	<i>F.H. Gesch. 05</i> <i>H. Gr. 14</i> and incendiary shell <i>H. Gr. 15</i> <i>L.F.H. Gr.</i> <i>F.H. Leucht - Geschoss</i> <i>L/3.3</i>	<i>F.H. Schr. 16</i>
(10.5 cm.) Light Field Howitzer '16 <i>l. F.H. 16</i>	10.5	—	32	1.25	6.3	} <i>H. Gr. 15</i> <i>L.F.H. Gr.</i> <i>C-Gesch. der l. F.H.</i>	<i>F.H. Schr. 16</i>
(10.5 cm.) Light Field Howitzer, Krupp <i>l. F.H. Krp.</i>	10.5	—	—	—	—		

9 cm. Gun '73/'88 or '73* 9 cm. K. 73/88 9 cm. K. 73	8.8	3° 10'	24	1.25	8.5	9 cm. Gr. 82 (P.) 9 cm. Gr. 88 9 cm. Gr. 14 9 cm. Gr. 14 A	9 cm. Schr. 82 9 cm. Schr. 91 9 cm. Schr. 15
9 cm. Anti-Air- craft Gun 9 cm. B.A.K.	8.8	3° 10'	24	1.25	8.5	9 cm. Gr. 14	
95 mm. French Gun franz. 95 mm. K.	9.5	1° 57' - 7°	28	0.8	10.6	9.5 cm. Gr.	9.5 cm. Schr.
10 cm. Gun '14 10 cm. K. 14	10.5	4° - 8°	32	1.25	6.8	10 cm. Gr. 96 10 cm. Gr. 10 cm. Gr. 14 10 cm. Gr. 14 A 10 cm. Gr. 15 L.F.H. Gr.	10 cm. Schr. 96
10 cm. Gun '97 10 cm. K. 97							
10 cm. Gun '04 10 cm. K. 04							
10 cm. Gun* 10 cm. K.							

* Formerly, these guns also fired case-shot.

Name.	Calibre. cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth. mm.	Width. mm.		
10 cm. Gun on Carriage with Overhead Shield (or in Turret)* 10 cm. K. (i. S.L.) 10 cm. T.K. 10 cm. Gun, Reinforced, in Turret* 10 cm. T.K. (verst.) 10 cm. Short Gun in Turret kz. 10 cm. T.K. 10 cm. Coast Defence Gun 10 cm. Kst. K. 10 cm. Coast Defence Gun on Wheeled Carriage 10 cm. Kst. K.i.R.L.	10.5 —	4"-7" 10' —	32 —	1.25 —	6.8 —	10 cm. Gr. 10 cm. Gr. 14 10 cm. Gr. 14 A 10 cm. Gr. 15+ 10 cm. Gr. 06 10 cm. Gr. 06 10 cm. Gr. 16	10 cm. Schr. 96

French 120 mm. Long Gun <i>franz. lg. 120 mm. K.</i>	—	—	36	—	—	12 cm. Gr.	12 cm. Schr.
12 cm. Heavy Gun <i>s. 12 cm. K.</i>	12.03	4°	30	1.3	8.4	12 cm. Gr. 88 a/A. 12 cm. Gr. 14 12 cm. Gr. 14 A	12 cm. Schr. 80/92 12 cm. Schr. 15
Russian Light Field Howitzer '09 <i>russ. l.F.H. 09</i>	12.19	—	36	—	—	12 cm. Gr.	
13 cm. Gun ... <i>13 cm. K.</i>	13.5	7° approx.	36	1.3 approx.	7 approx.	13 cm. Gr. and incendiary shell. 13 cm. Gr. 14	13 cm. Schr.
15 cm. Gun with Chase Rings <i>15 cm. R.K.</i>	14.97	3° 4'	24	1.6	16.3-12.3	15 cm. Gr. 80 (?) 15 cm. Gr. 14 m.v.F. 15 cm. Gr. 14 A.m.v.F.	15 cm. Schr. 80/92 15 cm. Schr. 15 m.v.F.
15 cm. Long Gun with Chase Rings <i>lg. 15 cm. R.K.</i>	14.97	3° 10'	24	1.6	17-14.5		

* These guns also fire case shot.

† Not fired by *kz.10 cm. T.K.*

Name.	Calibre. cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth. mm.	Width. mm.		
15 cm. Long Gun <i>lg. 15 cm. K.</i>	14.97	3°-7°	36	1.5	9.5	15 cm. Gr. 88 15 cm. Gr. 96 15 cm. Gr. 12 15 cm. Gr. 12n/A. 15 cm. Gr. 14 15 cm. Gr. 14 (Haube) 15 cm. Gr. 14 A	15 cm. Schr. 90/92 15 cm. Schr. 92 15 cm. Schr. 07 15 cm. Schr. 15
15 cm. Experi- mental Gun on Wheeled Car- riage <i>15 cm. Vers. K.i.R.L.</i>	14.97	6° approx.	48(I)	—	—	15 cm. Gr. 03 15 cm. Gr. 03 (Haube) 15 cm. Gr. (I) (Haube)	15 cm. Schr. 03 (gr.) 15 cm. Schr. (Haube)(I)
15 cm. Gun '16 ... <i>15 cm. K. 16</i>		6° approx.	48(I)			Probably same	as above (I)
15 cm. Gun on Coast Defence Mounting '07 <i>15 cm. K. i. Rst. L. 07</i>	14.97	—	44(I)	—	—	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	—	44(?)	—	—	15 cm. Gr. 03 15 cm. Gr. 06	15 cm. Schr. 03 15 cm. Schr. 03(gr.)
15 cm. Heavy Field Howitzer <i>s. F.H.</i>	14-97	4°-12°	36	1-3	9-5	15 cm. Gr. 83 15 cm. Gr. 88 15 cm. Gr. 96 15 cm. Gr. 04	
15 cm. Heavy Field Howitzer '02 <i>s. F.H. 02</i>	14-97	6°-13°	36	1-3	9-5	15 cm. Gr. 12 and smoke shell 15 cm. Gr. 12 n/A. 15 cm. Gr. 14 15 cm. Gr. 14 A	
15 cm. Heavy Field Howitzer '13 <i>s. F.H. 13</i>	14-97	—	36	—	—	15 cm. Brand-Gr. B 15 cm. Brand-Gr. C	
15 cm. Long Heavy Field Howitzer '13* <i>lg. s. F.H. 13</i>	14-97	—	32	—	—	15 cm. Gr. 12. 15 cm. Gr. 12 n/A. 15 cm. Gr. 14. 15 cm. Gr. 14 (Haube).	
15 cm. Howitzer in Turret <i>15 cm. T.H.</i>	14-97	4°-12°	36	1-3	9-5	15 cm. Gr. 88 15 cm. Gr. 14 15 cm. Gr. 14 A	
15 cm. Heavy Coast Defence Howitzer	14-97	—	—	—	—	15 cm. Gr. 88	

* Also fires 15 cm. Gr. 14 (Haube).

Name.	Calibre. cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth. mm.	Width. mm.		
20.3 cm. Russian Howitzers '77 and '92 <i>russ. 20cm. H. 77 u. 92</i>	20.3 (8-in.)	—	46	—	—	<i>Deutsche 20.3 cm. Gr.</i>	
21 cm. Gun with Chase Rings <i>21 cm. R.K.</i>	20.93	2° 10'	30	2.6	18.5-14.6	<i>21 cm. Gr. 06</i>	<i>21 cm. Schr. 04</i>
21 cm. Howitzer in Turret <i>21 cm. T.H.</i>	20.93	2°-10°	30	2.4	15.5	<i>21 cm. Gr. 80 (P.)</i>	<i>21 cm. Schr. 89 Ec. or 21 cm. Schr. 89 abg.</i>
21 cm. Bronze Coast Defence Mortar <i>21 cm. Br. Kst. Mrs.</i>	20.93	2°-12°	30	2.4	15.5	<i>21 cm. Gr. 06</i>	

21 cm. Mortar ... 21 cm. Mrs. (1902 pattern)	21.1 .	5° 8' to 11° 50'	64	1.5	6.85	21 cm. Gr. 88 21 cm. Gr. 88 21 cm. Gr. 96 21 cm. Gr. 96 n/A. 21 cm. Gr. 14 21 cm. Gr. 14 A 21 cm. Gr. 17
"Mortar" (21 cm.) Mrs. (1910 pattern)	21.1	—	—	—	—	21 cm. Gr. 96 n/A. 21 cm. Gr. 14 21 cm. Gr. 17
"Long Mortar" (21 cm.) lg. Mrs. (new pattern)	21.1	—	—	—	—	21 cm. Gr. 96 n/A. 21 cm. Gr. 14 21 cm. Gr. 17
28 cm. Howitzer on Wheeled Carriage 28 cm. H.i.R.L.	28.0 (?)	—	—	—	—	28 cm. Gr. 12 (?)
28 cm. Coast Defence Howitzer Kst. H. i. Kst. H.L.	28.0 (?)	—	—	—	—	28 cm. Gr. 06 28 cm. Lggr.
30.5 cm. Austrian Howitzer	30.5	—	68	—	—	30.5 cm. Gr.
30.5 cm. Heavy Coast Defence Mortar '96 s. Kst. Mrs. 96 (30.5 cm.)						30.5 cm. Gr. (?)

Name.	Calibre, cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth, mm.	Width, mm.		
30.5 cm. Heavy Coast Defence Mortar '09 <i>s. Kat. Mra. 09 (30.5 cm.)</i>						30.5 cm. Gr. (?)	
42 cm. Mortar (on Platform Mount- ing) <i>42 cm. Mra.</i>	42.0 (?)	8° 30'	120	4	—	42 cm. Gr. (with dia- phragm). 42 cm. Gr. (without dia- phragm).	

(For particulars of German Naval Guns, see page 276.)

DISTINGUISHING MARKS ON GERMAN AMMUNITION.

For coloured markings on gas shell *see* pages 17-21.

For marks on German Fuzes *see* pages 14 and 15 of (S.S. 306)
"Notes on German Fuzes" (Second edition).

I.—COLOURED MARKINGS ON SHELL.

Mark.	Shell.	Signification.
Vertical black stripe ...	Field gun and light field howitzer shell	Without smoke producer.
Green band above driving band	Field gun and light field howitzer shell	Bursting charge of picric acid.
Blue, yellow or red band above driving band	Field gun and light field howitzer shell	Bursting charges that differ from the regulation 40/60 amatol.
"kl. Ldg." stencilled in white	1914 pattern field gun shell	Reduced propelling charge.
"m.V." stencilled in black	Field gun shell...	Delay action percussion fuze.
"Am." stencilled in white...	Field gun shell...	Part of nitrocellulose propelling charge replaced by a slab of an ammonium nitrate explosive.
"A" stencilled in white ...	Field gun shell...	Variation of propelling charge (<i>see</i> page 73).
"St." stencilled in black ...	Field gun shrapnel	Steel bullets.
"R" stencilled in black ...	H.E. shell of foot artillery	With smoke producer.
Black ring round nose ...	Shell of 7.7 cm. to 21 cm. calibre	Bursting charge of amatol (<i>Fp. 60/40</i> , a mixture of 60 per cent. T.N.T. and 40 per cent. ammonium nitrate).
Blue ring round nose ...	Shell of 9 cm. to 21 cm. calibre	Bursting charge, mixture of dinitrobenzene and T.N.T. or dinitrobenzene and trinitroanisole.
1 blue and 1 black ring round nose	Shell of 9 cm. to 21 cm. calibre	Bursting charge, mixture of dinitrobenzene and <i>Fp. 60/40</i> or dinitrobenzene and <i>An. 60/40</i> .

I.—COLOURED MARKINGS ON SHELL—continued.

Mark.	Shell.	Signification.
White ring round nose ...	Shell of 9 cm. to 21 cm. calibre	Bursting charge, ammonium nitrate mixture containing no nitroglycerine (T.N.T. and Di. ²⁰ / ₅₀).
4 short black vertical strokes, radiating from nose	<i>12 cm. Schr. 80/92</i> <i>15 cm. Schr. 80/92</i> <i>15 cm. Schr. 90/92</i> <i>15 cm. Gr. 14 and 14A</i> <i>15 cm. Gr. 14 m.e.F.</i> <i>15 cm. Gr. 14A m.e.F.</i> <i>9 cm. Gr. 14 ...</i>	Fuze hole screw-threaded to take <i>Dopp. Z. 92</i> . Bursting charge moulded so that <i>Dopp. Z. 92</i> can be used.
2 blue bands round cylindrical portion	<i>12 cm. Gr. 14 ...</i> <i>15 cm. Gr. 12 n/A.</i>	To distinguish this shell from <i>15 cm. Gr. 12</i> .
Black M below shoulder ...	<i>15 cm. Gr. 12 ...</i>	On shell made by "Mannesmann" process.
"φ 12, 19," "φ 15, 24," "φ 20, 3"	Shell of 12-19 cm., 15-24 cm., 20-3 cm. calibre	German shell for captured Russian guns (4-8 in., 6 in., 8 in.).
"Brandgr." ...	<i>15 cm. Brand-granate C.</i>	Incendiary shell C.
Black B with date marked below in black	<i>15 cm. Brand-granate B.</i>	Incendiary shell B with date of filling.
Black nose of yellow shell "N"	Naval H.E. shell, 15 cm. smoke shell (1912 pattern shell)	"Filled" shell. <i>Nebel</i> or smoke.
2 red rings round cylindrical portion	<i>13 cm. Gr. ...</i> <i>13 cm. Schr. ...</i>	Increased thickness of walls. Increased thickness of walls, and bullets set in resin.
1 red ring round cylindrical portion	<i>10 cm. Schr. 96...</i> <i>13 cm. Schr. ...</i> <i>15 cm. Schr. 03 (gr.)</i>	Bullets set in resin.
Black ring below shoulder, or below forward driving band	On some shrapnel	Steel bullets.
Red head ...	<i>10 cm. Schr. 96...</i>	Filled with short lengths of chain for use against aerial targets.
+ or - on head or base ...	9 to 21 cm. ...	Shell of non-standard weight.
One black band round cylindrical portion	Original H.E. shell of 7-6 cm. and 17 cm. "Minenwerfer"	H.E. filling (as distinct from gas).
Three black bands round cylindrical portion	1916 patterns of above	To distinguish from above.
Green bands round cylindrical portion	17 cm. "Minenwerfer" H.E. shell	Bursting charge of potassium perchlorate mixture.

II.—STAMPINGS ON SHELL.

The stampings of chief interest are those denoting the nature of the bursting charge and the date of manufacture.

Stamping.	Shell.	Signification.
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On body and base of shell.

Distinguishing mark stamped on all shells and fuzes of naval origin.

On head of shell.

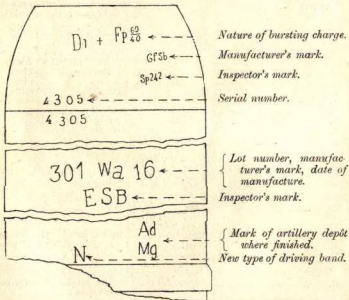
These relate to the filling.

Fp.	...	<i>Fp. 02</i> = <i>Fallpulver</i> or T.N.T. (introduced in 1902).	
Fp. 60/40	...	60 per cent. T.N.T. and 40 per cent. ammonium nitrate, i.e., a $\frac{40}{60}$ amatol.	
An.	...	Trinitroanisole.	
An. 60/40	...	60 per cent. trinitroanisole and 40 per cent. ammonium nitrate.	
Di.	...	Dinitrobenzene.	
Di. 60/40	...	60 per cent. diinitrobenzene and 40 per cent. ammonium nitrate.	
Da.	...	<i>Donarit A</i> (free from nitroglycerine)	Ammonium nitrate mixtures.
Wa.	...	<i>Westfalit A</i> (free from nitroglycerine)	
G.	...	<i>Glückauf</i>	
L.	...	<i>Lignosit</i>	
F.	...	<i>Fram</i>	
Wo.	...	<i>Wodanit</i>	
P.	...	<i>Perrumpit</i>	
A.	...	<i>Aldorfit</i>	
	9 cm. Gr. 14 <i>14A</i>		
	10 cm. Gr. 14 <i>14A</i>		
R.	12 cm. Gr. 14 <i>14A</i>	Shell contains smoke producer.	
	15 cm. Gr. 14 <i>14A</i>		
	9 cm. Schr. 15 ...		
	10 cm. Schr. 96 ...		
	12 cm. Schr. 80/92		
B.	12 cm. Schr. 15 ...	Bullets set in pitch made from brown coal (<i>Braunkohlenpech</i>).	
	15 cm. Schr. 15 ...		
	15 cm. Schr. 15 <i>m.e.F.</i>		
S.	same as for B ...	Bullets set in pitch (<i>Steinkohlenpech</i>).	

II.—STAMPINGS ON SHELL—*continued.*

On cylindrical portion of shell.

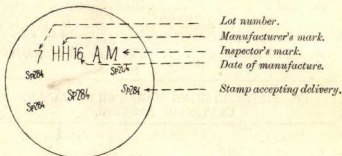
Stamping.	Remarks.
Serial number	Only on shell with screwed adapter.
Lot number	} Generally together.
Manufacturer's mark	
Date of manufacture	
Stamp accepting delivery...	On all shell.
N immediately above driving band on the left of stamp accepting delivery (inspector's mark?)	On most shell and shrapnel on which the driving band is of a new pattern. This stamping is missing when the new pattern driving band differs externally from the old pattern, e.g., narrower driving band, one driving band less than before, driving band of different metal.
Abbreviations such as Ad. or Mg. immediately above the driving band on the right of the stamp accepting delivery (inspector's mark?)	Mark of the artillery depôt where the shell was finished.



II.—STAMPINGS ON SHELL—*continued.*

—On base of shell.

Stamping.	Remarks.
Serial-number	Only on shell with screwed base, in which case it is stamped on the rim of the base.
Lot number	} Sometimes present; generally together.
Manufacturer's mark	
Date of manufacture	
Stamp accepting delivery (inspector's mark ?)	On all shell hitherto examined with very few exceptions.



III.—LETTERING, &c., ON CARTRIDGE CASES.

Mark.	Ammunition.	Signification.
V.R.P.	10 cm. cartridge cases for fixed and separate ammunition	<i>Verkürztes Röhren-Pulver.</i> Tubular powder cut in short lengths.
E.P., Ers. R.P.	10 cm. cartridge cases for fixed and separate ammunition	} <i>Ersatz Röhren-Pulver.</i> Substitute for tubular powder.
"Nur für 15 cm. Vers. K."	13 cm. cartridge case	
	Cartridge cases for 15 cm. experimental gun on wheeled carriage (<i>15 cm. Vers. K. i. R. L.</i>)	<i>Nur für 15 cm. Versuchs-Kanone.</i> Distinguishing mark.
"Mit Vorl."	Cartridge cases of 15 cm. heavy or naval gun (<i>s. 15 cm. K. or 15 cm. S. K. L/40</i>)	<i>Mit Vorlage.</i> Cartridge case contains flash reducer.

III.—LETTERING, &c., ON CARTRIDGE CASES—continued.

Mark.	Ammunition.	Signification.
"Haub. Gr."	Cartridge cases of 15 cm. heavy or naval gun (<i>s. 15 cm. K.</i> or <i>15 cm. S. K. L/40</i>)	<i>Hauben-Granate.</i> Only for use with shell with false cap.
On cardboard cover of cartridge case in white lettering "Nur für Gr. 14 und 14A verwendbar"	On cartridge cases for (21 cm.) mortar containing a charge of 3.82 kg. W.P. ($10 \times 10 \times 1\frac{1}{4}$)	For use with <i>Gr. 14</i> and <i>Gr. 14A</i> only.
+ or — on base of cartridge case	10 cm. cartridge for <i>10 cm. Gr. 14</i> or <i>10 cm. Gr. 14A</i>	Shell of non-standard weight.
Yellow stripe across base of cartridge case	Russian and Japanese cartridge cases	Ammunition for captured Russian and Japanese guns.
White stripe across base of cartridge case.	German 7.7 cm. cartridge cases.	Reduced propelling charge.

IV.—DISTINGUISHING MARKS ON SHELL AND CARTRIDGE BASKETS.

Mark.	Basket.	Signification.
Blue tape	10 cm. shell basket (fixed ammunition)	Contents: <i>10 cm. Schr. 96</i> , fitted with <i>Dopp. Z. 92 f. 10 cm. K.</i> or with <i>Dopp. Z. 92 K. 15</i> .
Red tape	10 cm. shell basket (fixed ammunition)	Contents: <i>10 cm. Schr. 96</i> , fitted with <i>Dopp. Z. 92 lg. Brig.</i>
	15 cm. shell basket ...	Contents: <i>15 cm. Gr. 14</i> , fitted with <i>Dopp. Z. 92 lg. Brig.</i>
Yellow tape	15 cm. shell basket ...	Contents: K shell.
Black tape		T shell.
Green tape		Green T shell (<i>T—Geschoss, grün.</i>)
"Nur für 15 cm. Vers. K."	Shell basket of 15 cm. experimental gun on wheeled carriage (<i>15 cm. Vers. K. i. R. L.</i>)	<i>Nur für 15 cm. Versuchs-Kanone.</i> Distinguishing mark.
Wooden label marked "Haub. Gr."	Cartridge baskets of 15 cm. heavy or naval gun (<i>s. 15 cm. K.</i> or <i>15 cm. S. K. L/40</i>)	Contents: cartridges for shell with false cap.
Yellow cross on each face	Cartridge baskets or boxes	Ammunition for captured Russian or Japanese guns.

Abbreviations used in connection with German Ordnance and Ammunition.

For stamps and markings *see* pages 33-38.

Abbreviation.	Signification.	English equivalent.
A.	Artillerie	Artillery.
a/A.	alter Art	Of old pattern.
abg.	abgeändert	Converted.
	Abpraller	Ricochet.
Am.	Ammonsalpeter	Ammonium nitrate.
An.	Trinitroanisol... ..	Trinitroanisole.
An. 60/40	Anisol 60/40	60 per cent. trinitroanisole and 40 per cent. ammo- nium nitrate.
As.	Arsenik	Arsenic.
Az.	Aufschlag-Zünder	Percussion fuze.
Az.m.V.	Aufschlagzünder mit Ver- zögerung	Delay action percussion fuze.
Az.u. Bz.	Aufschlag- und Brenn- Zünder	Percussion and time fuze (T. & P.).
B., Bat., Battr. ...	Batterie	Battery.
b., belg.	belgisch	Belgian.
B.A.K.	Ballon-Abwehr-Kanone	Anti-aircraft gun.
Bd.G., Brd. Gesch.	Brand-Geschoss	} Incendiary shell.
Brand. Gr.	Brand-Granate	
Bett. Gesch.	Bettungs-Geschütz	Gun on platform mounting.
Bd. Z.	Boden-Zünder	Base fuze.
Bl.	Blind	Blind.
	Blaukreuz	Blue cross.
	Bleiplombe	Lead seal or protective cap (of fuze).
Br. Mrs.	Bronze-Mörser	Bronze mortar.
Bl. P.	Blättchen-Pulver	Flaked powder.
B-Stelle	Beobachtungs-Stelle	Observation post.
Bz.	Brenn-Zünder	Time fuze.
C-Gesch.	C-Geschoss	"C" shell (streamline).
C/92	Construction/92	1892 pattern.
D.d.G.	Dum-dum-Geschoss	Dum-dum bullet.
Di.	Dinitrobenzol... ..	Dinitrobenzene.
Dz., Dopp. Z.	Doppel-Zünder	Time and percussion fuze.

Abbreviation.	Signification.	English equivalent.
E.	Empfindlich	Sensitive, i.e., instantaneous (fuze).
E., Eis.	Eisenbahn	Railway, i.e., on railway mounting.
Ee.	Eisen-Centrierung	With rear driving band only.
E.H.Z.	Empfindlicher Haubitze-Zünder.	Sensitive, i.e., instantaneous howitzer fuze.
E.K.Z.	Empfindlicher Kanonen-Zünder.	Instantaneous gun fuze.
E.P., Ers. R.P. ...	Ersatz Röhren-Pulver ...	Substitute tubular powder.
Ers.	Ersatz	Substitute.
f., fr., franz. ...	französisch	French.
f. 10 cm. K.	für 10 cm. Kanone	For 10 cm. gun.
Fb. or Fliehb. ...	Fliehbolzen	Centrifugal bolt (safety device).
Fest.	Festung	Fortress.
F. Gr.	Feld-Granate	Field gun H.E. shell.
F.H.	Feld-Haubitze	Field howitzer.
F. H. Schr.	Feld-Haubitz-Schrapnel ...	Light field howitzer shrapnel.
F.K.	Feld-Kanone	Field gun.
Fl.	Flügel	Vanes (on bomb).
Fl. M.W.	Flügel-Minenwerfer ...	Trench mortar that fires a bomb fitted with vanes.
Flak.	Flug-Abwehr-Kanone ...	Anti-aircraft gun.
F. Patr.	Feld-Patrone	Field gun cartridge (fixed ammunition).
Fp. 02 or Fp. C/02	Füllpulver Construction 02	1902 pattern explosive (T.N.T.).
Fp. 60/40	Füllpulver 60/40	40/60 amatol (i.e., 40 per cent. ammonium nitrate and 60 per cent. T.N.T.).
F. Schr.	Feld-Schrapnel	Field gun shrapnel.
G.	Granate	H.E. shell.
g.	Gas	Gas.
g.	Gramm	Gramme.
gel.	geliefert	Manufactured.
Gel.	Geladen	Loaded.
Gesch.	Gelbkreuz	Yellow cross.
gez.	(Geschütz	Gun.
Gf.	(Geschoss	Projectile.
Gg.	gezogen	Rifled.
G. Gr.	(Geschütz-Fabrik	Gun factory.
gl.	(Geschoss-Fabrik	Shell factory.
gl. W. M.	Granguss	Cast iron.
Gr.	Gas-Granate	Gas shell.
(gr.)	glatt	Smooth-bore.
gr. Bl. P.	glatte Wurf-Mine	Smooth-bore "Minenwerfer" bomb.
	Gröss	Large.
	grau	Grey.
	grobes Blättchen-Pulver ...	Powder in large flakes (propellant).

Abbreviation.	Signification.	English equivalent.
Grf. 88 ...	Granatfüllung 88 ...	1888 pattern explosive (picric acid).
Grkz. ...	Grünkreuz ...	Green cross.
Gr. W. ...	Granatwerfer ...	Bomb thrower.
Gr. Z. ...	Granat-Zünder ...	Fuze for H.E. shell.
Gr. Zdlg. ...	Grosse Zündladung ...	Large exploder.
H. ...	Haubitze ...	Howitzer.
Haub. ...	Haube ...	False cap.
Haub. Gr. ...	Hauben-Granate ...	Shell with false cap.
Haub. Schr. ...	Hauben-Schrapnel ...	Shrapnel with false cap.
H. Gr. ...	Haubitz-Granate ...	Howitzer shell.
H Rg. P. ...	Haubitz-Ring-Pulver ...	Powder in rings for light field howitzer.
H. Schr. ...	Hülsenreisser ...	Split cartridge case (steel).
H.Z. ...	Haubitz-Schrapnel ...	Howitzer shrapnel.
Hülsenkart. ...	Haubitz-Zünder ...	Howitzer fuze.
	Hülsen-Kartusche ...	Cartridge case as opposed to bag.
i. H. ...	in Haubitz-Lafette ...	On howitzer carriage.
Inf. Gesch. ...	Infanterie-Geschütz ...	Infantry gun.
i. Kas. L. ...	in Kasematten-Lafette ...	On casemate mounting.
i. Kst. L. ...	in Küsten-Lafette ...	On coast defence mounting.
i. P.L. ...	in Panzer-Lafette ...	On shielded mounting.
i. R. L. ...	in Rad-Lafette ...	On wheeled carriage.
i. S.L. ...	in Schirm-Lafette ...	On carriage with overhead [shield.
Iz. ...	Innen-Zünder ...	Internal fuze.
J., jap. ...	japanisch ...	Japanese.
K. ...	Kanone ...	Gun.
K., kz. ...	Kurz ...	Short.
K., Kt. ...	Kartätsche ...	Case shot.
Kal. ...	Kaliber ...	Calibre.
Kart. ...	Kartusche ...	Cartridge.
Kart. einf. ...	Kartusche einfach ...	Cartridge in bag, as opposed to metal case.
Kart. Hülse, Karth. ...	Kartusch-Hülse ...	Cartridge case (separate ammunition).
kg. ...	Kilogramm ...	Kilogramme (2.2 lbs.).
— kg. m. B. ...	— Kilogramm mit Beutel ...	—kg.including weight of bag.
K. Gr. ...	Kanonen-Granate ...	Gun shell.
K. i. H. ...	Kanone in Haubitz-Lafette ...	Gun on howitzer carriage.
Kl., kl. ...	klein ...	Small.
kl. Ldg. ...	kleine Ladung ...	Reduced propelling charge.
kl. Zdlg. ...	kleine Zündladung ...	Small exploder.
Kp. ...	Kappe ...	Cap (of fuze).
Kst. ...	Küste ...	Coast (defence).
Kst. H. ...	Küsten-Haubitze ...	Coast defence howitzer.
Kst. K. ...	Küsten-Kanone ...	Coast defence gun.
Kst. Mrs. ...	Küsten-Mörser ...	Coast defence mortar.
K.Z. ...	Kanonen-Zünder ...	Gun fuze.
Kz. ...	Kopf-Zünder ...	Nose fuze.
kz. Bd. Z. ...	kurzer Boden-Zünder ...	Short base fuze.
kz. Mar. Kan. 14	kurze Marine-Kanone 14	1914 pattern short naval gun.

Abbreviation.	Signification.	English equivalent.
L., l	Leicht	Light.
L.	Lang	Long.
L....	Lafette	Carriage.
Ldg.	Ladung	Propellant charge.
L. E.-Munition	Luft-Einschiess-Munition ...	Explosive tracer ammunition (rifle).
L.S.-Munition ...	Licht-Spur-Munition ...	Tracer ammunition.
lg. Bd. Z. ...	langer Boden-Zünder ...	Long base fuze
lg. Brlg., l.B. ...	lange Brennlänge ...	Long burning (fuze).
L. Gr., Lggr. ...	Lang-Granate... ..	Long shell
lg. Zdr.	Leuchtgeschoss-Zünder ...	Fuze for star shell.
l F. H.	leichte Feld-Haubitze ...	Light field howitzer.
lg. Mrs.	langer Mörser	Long mortar (21 cm.).
l. gez. W.M. ...	leichte gezogene Wurf-Mine	Light rifled "Minenwerfer" shell.
L. K. Z.	Langer Kanonen-Zünder ...	Long fuze for gun.
l. M.W.	leichter Minenwerfer ...	Light "Minenwerfer."
l. N.M.	leichte Nachrichten-Mine ...	Light "Minenwerfer" message shell.
L. S. Gesch. ...	Licht-Spur-Geschoss ...	Tracer shot.
L. S. Gr....	Licht-Spur-Granate ...	Tracer shell.
l Spr. M.	leichte-Spreng-Mine... ..	Light "Minenwerfer" R.E. shell.
l W. M. Zdr. ...	leichter Wurf-Mine-Zünder	Fuze of light "Minenwerfer."
L/40, &c.	Used in the nomenclature of naval guns to indicate that the length is 40, &c., calibres.	
L/3.1, &c.	Used in the nomenclature of naval projectiles to indicate that the length is 3.1, &c., calibres.	
M.	Mine	"Minenwerfer" shell.
m.	Meter	Metre.
m.	mit	With.
Mdlochb.	Mundlochbüchse	Old pattern type of fuze.
Mdlochf.	Mundlochfutter	Gaine.
M. Flak....	3.7 cm. Flug - Abwehr Maschinen-Kanone	3.7 cm. automatic anti-aircraft gun.
M.G.	Maschinen-Gewehr	Machine gun.
m. ger. Sprldg. ...	mit geringerer Sprengladung	With reduced bursting charge.
m. M.W....	mittlerer Minenwerfer ...	Medium "Minenwerfer."
m. Ozdg.	mit Oberzündung	With overhead ignition.
m. P.	mit Panzerkopf	With armour-piercing head.
Mrs.	Mörser	Mortar.
Mtl. K.	Mantel-Kanone	Jacketed gun.
M.V., m.V. ...	Mit Verzögerung	With delay action.
m.Vorl.	mit Vorlage	With flash reducer.
m.v.F.	mit vorderem Führungsring	With forward driving band.
m.V.u.K.	mit Verzögerung und Klap-pensicherung	With delay action and centrifugal safety device.
M.W.	Minenwerfer	"Minenwerfer" (German trench mortar).

Abbreviation.	Signification.	English equivalent.
N. ...	Nebel ...	Smoke (shell).
n/A., n.A.	neuer Art ...	Of new pattern.
n.F.	neuer Form ...	Of new shape.
n.Gew.P.71	neues Gewehr-Pulver 71	'71 pattern powder (for igniters).
Nr. ...	Nummer ...	Number.
o.Az. ...	ohne Aufschlagzündung ...	Without percussion system.
O.V., o.V. ...	Ohne Verzögerung ...	Without delay action (direct action).
P. ...	Phosphor ...	Phosphorus.
P. (P.) ...	Pulver ...	Powder (usually black powder, i.e., common shell).
Patr. ...	Patrone ...	Cartridge (fixed ammunition).
Patr. Hülse, Patr.	Patronen-Hülse ...	Cartridge case (fixed ammunition).
R. ...	Rauchentwickler ...	Smoke producer.
r., russ.	russisch ...	Russian.
Rev. K. ...	Revolver-Kanone ...	Revolver gun.
Rg. P. ...	Ring-Pulver ...	Powder in rings (propellant).
R.L. ...	Rad-Lafette ...	Wheeled carriage.
R.K. ...	Ring-Kanone ...	Gun with chase rings.
R. Munition ...	Rillen-Munition ...	S.A.A. (groove round bullet into which cartridge case is crimped).
R.P. ...	Röhren-Pulver ...	Tubular powder (propellant).
S. ...	Schwer ...	Heavy.
S., Sch., Schr. ...	Schrapnel ...	Shrapnel.
Sch.Grab.K. ...	Schützen-Graben-Kanone ...	Trench gun.
Schlg.zd.schr., Schlgzdschr.	Schlagzündschraube ...	Primer (to screw into cartridge case).
Sek. ...	Schusstafel ...	Range table.
s.F.H. ...	Sekunden ...	Seconds.
s.Fl.M.W. ...	schwere Feld-Haubitze ...	Heavy field howitzer.
	schwerer Flügel-Minenwerfer	Heavy "Minenwerfer" (which fires a bomb fitted with vanes).
S.m.K.-Munition	Spitz-Munition mit Kern ...	Armour-piercing S.A. ammunition.
S-Munition ...	Spitz-Munition ...	Ordinary S.A.A. (pointed bullet).
s.M.W. ...	schwerer Minenwerfer ...	Heavy "Minenwerfer."
Spgr., Spgr. ...	Spreng-Granate ...	H.E. shell.
Spgrldg. ...	Sprengladung ...	Bursting charge.
Spgr.m.K. ...	Sprenggranatenzündler mit Klappensicherung	Fuze with centrifugal safety device, H.E. shell.
St. ...	Stahl ...	Steel (bullets).
	Schlagstift ...	Percussion rod (inserted in instantaneous firing before firing).

Abbreviation.	Signification.	English equivalent.
St.	Stellstift	} Fuze setter.
	Stellschlüssel	
St.O.Gas	} Stabs-Offizier für Gas	Army Gas Officer.
Stogas		
T.H.	Turm-Haubitze	Howitzer in turret.
T.K.	Turm-Kanone	Gun in turret.
	Teilladung	Partial propellant charge for howitzer.
T₁	Treibladung	Propellant charge.
U.	Unterrichts-	Instructional.
u.	und	and.
Üb.	Übungs-	Practice.
Übgr.	Übungsgranate	Practice shell.
Üb. Ldg.	Übungsladung	Practice charge.
Umg.	Umgeändert or umgearbeitet	Converted.
92 umg.	1892 umgeändert	1892 pattern converted.
1. V.	erste Verzögerung	Short delay.
2. V.	zweite "	Long delay.
0-05 Sek. Verz.	0-05 Sekunden Verzögerung	1/20th second delay.
Vers.	Versuchs-	Experimental.
Verst.	Verstärkt	Reinforced.
V.H.	Versuchs-Haubitze	Experimental howitzer.
V.K.	Verkürzte Kammerhülse	Shortened central tube (of shrapnel. See page 217).
Vrst. Vst. Vorst.	Vorstecker	Safety pin (on fuze).
V.B.P.	Verkürztes Röhren-Pulver	Tubular powder cut in short lengths.
W.M.	Wurf-Mine	"Minenwerfer" shell.
W.P.	Würfel-Pulver	Flaked powder (propellant in small rectangular tablets).
Z., Zdr.	Zünder	Fuze.
Zdg.	Zündung	Fuze.
Zldg., Zdlg.	Zündladung	Exploder.
Zgl. W.M.	Zünder glatter Wurf-Mine	Fuze of smooth-bore "Minenwerfer" shell.
Zl.	Zinklegierung	Zinc alloy.
Z.m. W.M.	Zünder mittlerer Wurf-Mine	Fuze for medium "Minenwerfer."
Z.s. W.M.	Zünder schwerer Wurf-Mine	Fuze for heavy "Minenwerfer."
Z.s.u.m. W.M.	Zünder schwerer und mittlerer Wurf-Mine.	Fuze for heavy and medium "Minenwerfer."
Z.V.	Zünder-Vorrichtung	Fuze (Austrian term).
Zyl.P.	Zylinder-Pulver	Powder in cylindrical pellets.
14A	1914A	Designation of cast-iron shell introduced in 1914.

EXPLOSIVES USED IN GERMAN SHELL.

In addition to the black powder used as a bursting charge for shrapnel shell, for common shell, and for opening the light field howitzer star shell, the Germans use the following explosives at shell fillings :—

Granatfüllung 88 (Grf. 88) or Picric Acid (2, 4, 6-Trinitrophenol ; $\text{H.O.C}_6\text{H}_2(\text{NO}_2)_3$).

Appearance and special properties.—Picric acid is a bright yellow powder. It stains the skin yellow, has an intensely bitter taste, and the fine powder, if breathed into the nose, causes sneezing. The chief danger with picric acid is its property of forming very sensitive salts with most heavy metals and their oxides, especially with lead, lead compounds, lead alloys and most paints, &c. ; it is therefore most important that at no time shall picric acid come into direct contact with lead and many other metals. Pure, lead-free tin, and lead-free aluminium do not, however, form sensitive compounds with picric acid.

Picric acid burns, in the open and in small quantities, with a reddish smoky flame.

Employment.—With very few exceptions, picric acid does not form the main bursting charge of German shell ; its place has been almost entirely taken by *Füllpulver 02*, *Füllpulver 60/40*, and other explosives.

A bursting charge of picric acid pressed into a millboard container was, however, found recently in a German 17 cm. naval shell, but this was an old pattern shell manufactured before 1910.

A few 1915 pattern field gun and light field howitzer shell contain a picric acid bursting charge ; the picric acid is contained in a cardboard cylinder, and has been melted and poured in. These shell are painted grey, with a yellow head, and the picric acid bursting charge is indicated by a green band immediately above the driving band.

Picric acid is usually met with in the form of solid blocks and cylinders, made by compressing the small crystals. The surface is almost invariably protected by paraffin wax, which has been pressed on to the blocks, and the blocks are then wrapped in waxed paper.

The cylinders are used as exploders for some H.E. shell and are placed in the main bursting charge immediately below the fuze. The gaine of fuzes for H.E. shell and gas shell (as distinct from shrapnel) contain this form of picric acid, pressed to the required shape.

In some fuzes, where the fulminate detonator is separated from the picric acid in the gaine by an obturating bolt, the channel leading from the detonator to the bolt, the cavity in the bolt, and

the channel leading from the bolt to the gaine, are filled with powdered picric acid, lightly pressed in, and without any paper or paraffin wax covering.

Melting point.—When pure, 121.5°C . ; usually, about 119°C .

Density.—As cast into shell, 1.63 ; after compression to 10 tons per square inch, 1.65.

Solubility.—Slightly soluble in water, a very small amount imparting a yellow colour to the water.

Explosive effect.—Slightly greater than that of an equal weight of compressed *wet* guncotton, and still greater than that of an equal bulk.

Colour of smoke.—On complete detonation, black ; on partial detonation, brown to yellowish brown.

Safety for storage.—Relatively safe for storage (so far as any explosive may be considered "safe") provided the blocks or boxes have not been damaged. If the slightest leakage of a yellow powder is noticed, the package should be condemned.

Fullpulver 02 (*Fp. 02*), or **T.N.T.** (Trotyl).
(2, 4, 6-Trinitrotoluol ; $\text{CH}_3 \cdot \text{C}_6\text{H}_2(\text{NO}_2)_3$)

Appearance.—When pure, a creamy white powder. Cast T.N.T. has a crystalline structure, the crystals radiating from the core, which solidifies last ; the colour of cast T.N.T. varies from brownish yellow to brown or reddish brown.

This explosive is also called Trinitrotoluene, Tolite (French), Tritolo (Italian), Trilit (Spanish), and, very rarely, Trinol.

Employment.—T.N.T. in the form of blocks of compressed powder, sometimes with the addition of a small amount of paraffin wax to act as a binding material, is found in most German naval shell, and in many shell of 21 cm. calibre and upwards.

Cast T.N.T., i.e., T.N.T. which has been melted by heat and poured into the shell or into a container, is found as a bursting charge in some gas shell, and as a filling for many H.E. shell.

Melting point.—Pure T.N.T. melts at 81°C . ; but as usually found in shell, its melting point is about $78-79^{\circ}\text{C}$.

Density.—As cast into shell, about 1.55 ; after compression to 10 tons per square inch, 1.58.

Solubility.—Almost insoluble in water, but soluble in benzene, hot alcohol, and most easily in acetone.

Explosive effect.—Slightly less than that of picric acid.

Colour of smoke.—Black, on complete detonation ; grey to greyish white, on partial detonation.

Safety for storage.—Relatively safe for storage. T.N.T. has none of the disadvantages of picric acid, e.g., liability to form very sensitive compounds with lead, &c.

Fällpulver 60/40 (*Fp.* 60/40).—This explosive is a mixture of *Fp.* 02 (T.N.T.), 60 per cent., and ammonium nitrate, 40 per cent. The English name for the mixture in these proportions is 40/60 Amatol.

Appearance.—Yellow to brown in colour, and crystalline.

Employment.—*Fp.* 60/40 is usually cast into shell; although the ammonium nitrate does not melt at the temperature employed, the molten T.N.T. renders the mixture sufficiently fluid to be poured. During cooling, the ammonium nitrate settles to a certain extent to the bottom, hence the composition of the charge is not uniform throughout.

Melting point.—Indefinite; the T.N.T. portion melts at 78° C. or 79° C., and the mixture is then fairly fluid; the ammonium nitrate does not melt below 165° C., above which temperature it starts to decompose.

Density.—From about 1.4 to 1.5, according to the composition, rate of cooling, &c.

Solubility.—Partially soluble in water, the ammonium nitrate dissolving. Partially soluble in benzene, the T.N.T. dissolving.

Explosive effect.—Good.

Colour of smoke.—Brown.

Safety for storage.—Probably fairly safe, but cannot be considered as safe as T.N.T. alone.

Dinitrobenzene (*Dinitrobenzol*, *Di*).

(Meta-Dinitrobenzene; $C_6H_4(NO_2)_2$)

Appearance.—Cast dinitrobenzene is a tough mass of fibrous crystals of a pale yellow colour.

Employment.—This explosive is not often used alone, owing to the difficulty of producing complete detonation throughout. It forms the lower portion of the bursting charge of some German shell, the upper portion being either *Fp.* 02, *Fp.* 60/40, Trinitroanisole (*An.*), or *An.* 60/40; this upper charge acts as a large exploder for the dinitrobenzene.

Dinitrobenzene is melted and poured into shell.

It has been found mixed with potassium perchlorate in a 17 cm. *Minenwerfer* shell; the mixture, which is poured into the shell in a semi-fluid state, forms a hard, light brown solid on cooling.

It has also been found mixed with ammonium nitrate in a 25 cm *Minenwerfer* H.E. shell. The mixture is a fairly hard, yellowish brown solid.

Melting point.—The pure substance melts at 89.8° C., but the substance found in shell melts between 80° C. and 84° C.

Density.—About 1.35.

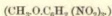
Solubility.—Practically insoluble in cold water. Slightly soluble in hot water. Fairly soluble in cold alcohol. Easily soluble in hot alcohol. Easily soluble in benzene.

Explosive effect.—Much less than that of T.N.T.

Colour of smoke.—Black, on complete detonation.

Safety for storage.—Relatively safe.

Trinitroanisole (*Trinitroanisol*, *An*).



Appearance and special properties.—A greenish yellow crystalline solid.

This explosive produces dermatitis (inflammation of the skin) more readily than the other nitro-explosives; care must be taken in handling it, and all contact of the skin with it avoided.

Since trinitroanisole is decomposed into picric acid by moisture, the same precautions as regards contact with lead and other heavy metals must be taken as with picric acid.

Employment.—Trinitroanisole has not been found as a complete shell filling, but forms the upper portion of the filling of some of the H.E. shell which contain dinitrobenzene in the lower portion. It has also been found in the upper portion of some 10.5 cm. howitzer shell above an ammonium nitrate explosive free from nitroglycerine.

Trinitroanisole is employed in aeroplane bombs, and very often constitutes the charge of "land mines" or "mobile charges"; these are rectangular metal boxes containing about 64 lbs. of explosive.

Melting point.—In the crude state in which it is used, about 63.8 C. to 64° C. When pure, 67° C.

Density.—About 1.4.

Solubility.—Slightly soluble in water, slowly decomposing into picric acid and methyl alcohol. Moderately soluble in hot alcohol. Fairly soluble in benzene.

Explosive effect.—Almost equal to that of picric acid, but complete detonation is not so easily produced.

Colour of smoke.—Black, on complete detonation.

Safety for storage.—The same as for picric acid.

An. 60/40 (a mixture consisting of trinitroanisole, 60 per cent. and ammonium nitrate, 40 per cent.). Also known as **Nitrolit**.

Appearance.—A crystalline solid greenish yellow to green in colour.

Employment.—This mixture has been found in 25 cm. *Minenwerfer* short shell and is also used as the upper portion of the filling of those H.E. shell which contain dinitrobenzene in the lower portion.

Melting point.—In the neighbourhood of 64° C.; only the trinitroanisole melts, the ammonium nitrate remaining solid.

Density.—About 1.4.

Solubility.—Water dissolves the ammonium nitrate and slowly decomposes the trinitroanisole, but complete solution is not effected except by very large quantities of water. Alcohol and benzene dissolve the trinitroanisole fairly readily.

Explosive effect.—Not definitely known; about the same as that of *Fp. 60/40*.

Colour of smoke.—The smoke is not often seen alone, since *An. 60/40* is usually only part of a shell filling. The colour is probably greyish white on complete detonation and yellowish on partial detonation.

Safety for storage.—Probably fairly safe, but should be protected from damp.

Ammonium Nitrate Explosives.

(Other than *Fp. 60/40*, *An. 60/40* and the dinitrobenzene and ammonium nitrate mixture.)

(Ammonium nitrate = *Ammonsalpeter* = *Am.*)

Ammonium Nitrate.—*Appearance and special properties.*—A colourless crystalline inorganic salt, very soluble in water and extremely hygroscopic, absorbing water vapour from the atmosphere at a rapid rate, until the salt is entirely dissolved in the absorbed water. When mixed with organic nitro bodies or oily substances, the latter protect it to a certain extent from the action of water vapour, but the absorption of water vapour takes place nevertheless, and all mixtures containing ammonium nitrate must be protected from access of air.

Employment.—Firstly *mixed*, as described above, with relatively pure nitro bodies, such as T.N.T., dinitrobenzene or trinitroanisole.

Secondly, as the *main constituent* (70/90 per cent.) of a large class of explosive mixtures used for general blasting, for mine charges and as a filling for *Minenwerfer* shell, trench mortar bombs of all types, stick-bombs, many hand grenades, the 1913 pattern rifle grenade, improvised grenades, &c.

Astralite.

Is the name which was applied to the earlier mixtures captured from the Germans, the mixture being found to correspond most nearly to the known "Astralite" mixture.

The following are the German names for these mixtures :—

Glückauf (Contraction : *G.*).

New type (1916).

Ammonium nitrate ...	85 per cent.
Woodmeal	6 "
Dinitrotoluene ...	5.6 "
Nitroglycerine ...	3.4 "
	100.0

<i>Donarit A</i> (Contraction ; <i>Da.</i>)	}	<i>Wa.</i>)	}	Ammonium nitrate mixtures free from nitroglycerine.
<i>Westfalit</i> (" "				
<i>Lignosit</i> (" "	}	<i>L.</i>)	}	All essentially ammonium nitrate mixtures (exact constitution unknown).
<i>Fram</i> (" "				
<i>Wodanit</i> (" "	}	<i>Wo.</i>)	}	
<i>Perrumpit</i> (" "				
<i>Aldorfit</i> (" "	}	<i>P.</i>)	}	
				<i>A.</i>)

Perdit (contraction not known) is of recent introduction, and appears to be superseding *Glückauf* and similar mixtures. It differs from the above mixtures in that part of the ammonium nitrate is replaced by *potassium perchlorate* (about 9 to 10 per cent. of the whole explosive). In some samples, T.N.T. has been found instead of dinitrotoluene.

A typical sample was found to consist of :—Ammonium nitrate, 75 per cent. ; potassium perchlorate, 9.3 per cent. ; T.N.T. and D.N.T., &c. (nitrated T.N.T. residues), 12.5 per cent. ; the rest being woodmeal, nitroglycerine and a little nitrocellulose and impurities.

Properties.—The above-mentioned ammonium nitrate explosives are in form of mealy powders, somewhat oily, very often compressed into fairly hard blocks, which can be broken easily, and which crumble readily.

The colour varies from faintly brownish white to dark brown.

They are difficult to ignite, and burn slowly with very little smoke.

Many specimens have an odour somewhat resembling "bitter almonds," due to the presence of small quantities of impurities such as nitrobenzene and nitrotoluene.

Ammonium nitrate explosives should be handled as little as possible, owing to the poisonous nature of dinitrotoluene and nitroglycerine.

Density.—This varies considerably ; a sample of *Donarit* had a density of 1.25.

Solubility.—Water removes the ammonium nitrate, and in the case of *Perdit*, the potassium perchlorate as well, the other constituents remaining undissolved.

Explosive effect.—Varies with composition, density, &c. ; provided the explosive is in good condition and detonates throughout, the effect is good.

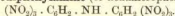
Colour of smoke.—Whitish.

Stability and safety for storage.—Ammonium nitrate mixtures of this type are not very stable, and are not safe for long storage; they have an acid reaction, and contain impurities such as rust, iron particles, sand, &c.; they do not contain any stabilizer; internal chemical action and decomposition of the nitroglycerine and nitrocellulose is, therefore, to be expected.

Instances have occurred of spontaneous explosions which have been attributed to these mixtures.

The following two explosives are also used by the Germans, but not as shell fillings :—

Hexanitrodiphenylamine (or hexanitrophenylaniline)



Appearance and special properties.—This substance is yellow, almost orange yellow in colour.

It is poisonous and causes dermatitis, usually after an interval of eight or nine days. It stains the skin brown; this colour is intensified by application of an alkali.

Employment.—This explosive is never used alone, but is mixed with T.N.T. and is used as a filling for aircraft bombs. A sample from an aeroplane bomb had the following composition :—

Hexanitrodiphenylamine	...	33	per cent.
T.N.T.	...	66	" "

The mixture is semi-fluid above 79° C. (the melting point of the T.N.T.), and is poured in this state into the bomb.

Melting point.—About 240° C.

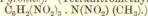
Solubility.—Very sparingly soluble in the usual solvents except hot glacial acetic acid, in which it is fairly soluble.

Explosive effect.—Practically the same as that of picric acid, but is rather more sensitive to blows.

Colour of smoke.—Black on complete detonation, either alone or mixed with T.N.T.

Safety for storage.—Stable and safe for storage.

Tetryl (French *Pyronite*). (Tetranitromethylaniline,



Appearance and special properties.—A pale yellow powder, usually met with in the form of compressed cylinders.

Tetryl fairly readily causes dermatitis. It stains the skin a dark yellow, which becomes reddish brown on application of an alkali.

Employment.—This explosive, which has a very high rate of detonation, is used as an "exploder" for some aeroplane bombs, and also in conjunction with mercury fulminate in "composite" detonators. It is never used as a shell filling.

Melting point.—129° C. to 130° C. when pure, but as usually found, it melts at about 126° C.

Density.—Varies with degree of compression.

Solubility.—Practically insoluble in water. Fairly soluble in cold benzene. Easily soluble in hot benzene.

Explosive effect.—Greater than that of picric acid.

2 cm. Tracer Shot.

Gun.	Maximum Range.
2 cm. anti-aircraft gun* (rifling, 9 grooves)	3,500 yards or a maximum height of 2,734 yards.

Material—Steel.

Weight—

Shot complete, kg. (lbs.).

Tracer composition, kg. (lbs.).

Employment—Against low-flying aircraft.

Remarks—This shot is filled with tracer composition, and emits a trail of sparks. It does not explode.

According to a German document, these 2 cm. anti-aircraft guns are posted in pairs between the infantry positions, not more than 1,650 to 2,200 yards behind the front line.

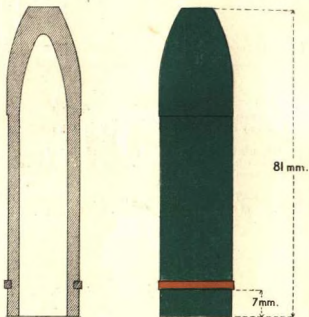
Their rate of fire is 120 rounds per minute.

* The German designation is 2 cm. *Flak-Grabenkanone* or 2 cm. *Flugzeugkanone*.

2 cm. L.S.Gesch.*

Fixed ammunition.

Calibre, 2 cm. (0.78") approx.



FULL SIZE.

Thickness of walls—3 mm.

Width of driving band—2 mm.

Distinctive markings—

* *Licht-Spur-Geschoss.*

3.7 cm. Revolver Gun Common Shell.

2.2 calibres long; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
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 lbs.).

Bursting charge, 0.023 kg. (0.05 lb.). Black powder.

Employment—*Principal object*: bombardment of trenches.

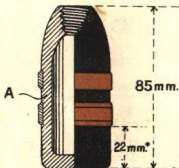
Sufficient effect at living targets. This shell replaces case shot at ranges exceeding 330 yards.

Remarks—The revolver gun also fires the ammunition (*Spgr. Patr.*) of the trench gun (3.7 cm. *Sch. Gr. K.*) described on page 276.

3·7 cm. Gr. (P.).

Fixed ammunition; designation of complete round,
Rev. K. Patr.

Calibre, 3·7 cm. (1·46").



SCALE — $\frac{1}{2}$.

Thickness of walls—At A, 5 mm.*

Thickness of base—8 mm.*

Width of driving bands—Upper, 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.

5 cm. Gun Common Shell.

2·8 calibres long ; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
5 cm. gun on shielded mounting (i. P.L.) (rifling, 24 grooves)	5 cm. Gr. Z.	—	3,280

Material—Cast iron.

Weight—

Shell complete, 1·67 kg. (3·68 lbs.).

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

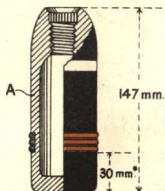
Employment—Sufficient effect against living targets ; employed (instead of case shot) at ranges over 440 yards.

Remarks—It is stated in a German document that the maximum effective range of this gun against tanks is about 1,100 yards.

5 cm. Gr. (P.).

Fixed ammunition; designation of complete round, 5 cm.
Gr. Patr.

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 57.

5.7 cm. Gun H.E. Shell.

3.4 calibres long ; 3.1 c.r.h.

Used with		Maximum range, percussion.
Gun.	Fuze.	
5.7 cm. Q.F. gun on pivot mounting* (rifling, 24 grooves)	5.7 cm. <i>K.Z.m.F.</i> ...	Fired at close range.

Material—Steel.

Weight—

Shell complete, 2.75 kg. (6.0 lbs.).

Bursting charge, 0.16 kg. (0.35 lb.). *Fp.* .02 (cast T.N.T.).

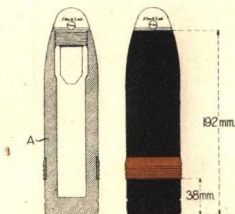
Employment—In German tanks.

Remarks—In the specimens examined, the brass cartridge case is of Belgian manufacture.

* Possibly Belgian.

5.7 cm. Gr. (P).

Calibre, 5.7 cm. (2.2").



SCALE — $\frac{1}{4}$.

Thickness of walls—13 mm.

Thickness of base—18 mm.

Width of driving band—23 mm.

Distinctive markings—The base of the cartridge case is painted red, and a black **V** = *Verzögerung*, or "delay," is stencilled on it. There is also a red ring round the cylindrical portion of the case.

5.7 cm. Armour-Piercing Shell.

4 calibres long ; 3.1 c.r.h.

Used with		Maximum range, percussion.
Gun.	Fuze.	
5.7 cm. Q.F. gun on pivot mounting* (rifling, 24 grooves)	Internal delay action percussion fuze.	Fired at close range.

Material—Steel, with hardened steel head.

Weight—

Shell complete, 3.1 kg. (6.8 lbs.).

Bursting charge, 0.12 kg. (0.26 lb.). *Fp.* .02 (cast T.N.T.).

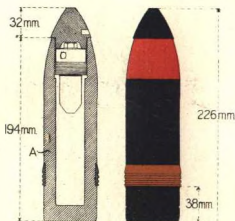
Employment—In German tanks.

Remarks—In the specimens examined, the brass cartridge case is of Belgian manufacture.

* Possibly Belgian.

5.7 cm. Gr. m. P. (P).

Calibre, 5.7 cm. (2.2").

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

Thickness of walls—13 mm.

Thickness of base—17 mm.

Width of driving band—23 mm.

Distinctive markings—The base of the cartridge case is painted red and a black **V** = *Verzögerung*, or "delay," is stencilled on it. A red ring is also painted round the cylindrical portion of the case.

7.62 cm. German H.E. Shell for Infantry Gun.

3 calibres long; 2 c.r.h.

Used with			Maximum range.	
Gun.	Fuze.		Time.	Perc'n.
7.62 cm. converted Russian field gun (<i>Infanterie-Geschütz</i>) (rifling, 24 grooves)	<i>K.Z. 14</i> ...	...	yards.	yards.
	<i>L.K.Z. 16 m.V.</i>		—	1,968

Material—Steel.

Weight—

Shell complete, 6.0 kg. (13.4 lbs.).

Bursting charge, 0.39 kg. (0.86 lb.). Amatol.

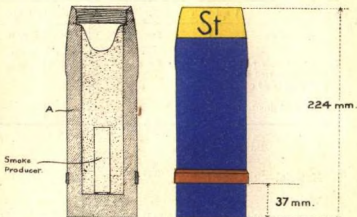
Employment—For close-range work in trench warfare, both in attack and defence; to prepare for raids, to repel infantry assaults and to engage tanks.

Remarks—A smoke producer is embedded in the bursting charge. The cartridge case is shorter than that of 7.7 cm. shell. It is made of brass, with a steel base plate. The propelling charge of tubular nitrocellulose is only $\frac{2}{3}$ ths of the full charge used with the 7.7 cm. 96 n/A. pattern field gun.

7.62 cm. Gr. for Infantry Gun.

(Fixed ammunition.)

Calibre, 7.62 cm. (3").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 15 mm.

Thickness of base—26 mm.

Width of driving band—13 mm.

Distinctive markings—The letters "St" or possibly "Sf" are stencilled on the head in black.

7.62 cm. German H.E. Shell for Anti-Aircraft Gun.

3.2 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
7.62 cm. anti-aircraft gun L/30 (converted Russian field gun) (7.62 cm. <i>besp.</i> <i>Flak.</i>) (rifling, 24 grooves)	<i>K.Z. 11 Gr. o. Az.*</i> ...	yards.	yards.
		10,280†	—

Material—Steel.

Weight—

Shell complete, 6.86 kg. (15.11 lbs.).

Bursting charge, 0.34 kg. (0.75 lbs.). *Fp.* $\frac{60}{40}$ (amatol).

Employment—Against aircraft.

Remarks—These converted Russian field guns are referred to in a document as *pferde-bespannte 7.62 cm. russ. 00 u. 02*, i.e., 1900 and 1902 patterns 7.62 cm. Russian field guns, horse drawn. They are mounted on a heavy wheeled carriage. The length of the gun is 30 calibres.

The propelling charge consists of 964 g. (2.1 lbs.) of tubular nitrocellulose (*Röhren-Pulver*). A brass cartridge case is used.

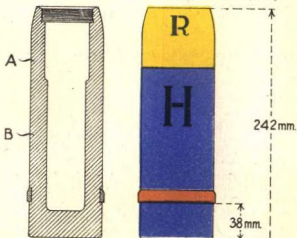
* A modification of the *K.Z. 11 Gr.* fuze; graduated from 2.4 to 30.2 in seconds and fifths of a second. It has no percussion system.

† Most favourable range, 6,500–7,500 yards.

7.62 cm. Flak. Gr. (P).

(Fixed ammunition.)

Calibre, 7.62 cm. (3.0").

SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 14 mm. ; at B, 18 mm.

Thickness of base—28 mm.

Width of driving band—13 mm.

Distinctive markings—On the head is stencilled in black the letter "R" or possibly "P," and on the body, also in black the letter "H."

1896 Pattern Field Gun H.E. Shell.

3·3 calibres long; 2 c.r.h.

Used with			Maximum range.	
Gun.	Fuze.		Time.	Perc'n.
(7·7 cm.) field gun 96 n/A. (rifling, 32 grooves)	<i>Dopp. Z. 96 n/A.</i> ...		yards. 5,850*	yards. 9,186

Material—Steel casting.

Weight—

Shell complete, 6·82 kg. (15·06 lbs.)

Bursting charge, 0·155 kg. (0·34 lb.). *Grf. 88* (picric acid, stemmed in); or 0·22 kg. (0·48 lb.) *Fp. 02* (T.N.T.) or amatol (cast).

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.

The exploder (*Zdlg. 92*) is in a brass gaine, which is screwed separately into the fuze hole below the fuze.

A variation of this shell has been found which differs in the following respects:—

Material—Cast iron.

Colour—Red.

Thickness of walls—At B and C, 20 mm.

Thickness of base—23 mm.

Filling—Cast T.N.T. and pitch, 124 g. Small shot, 215 g. "Smoke producer," 40 g., consisting of 36 g. red phosphorus and paraffin wax in cardboard cylinder.

Tracer shell—This shell has also been used as a tracer, the H.E. bursting charge being replaced by a cardboard cylinder containing about 0·3 kg. (0·66 lb.) of tracer composition. Five escape holes are drilled in the shoulder.

Thermit shell—A 7·7 cm. thermit shell has been reported, but no details are available, nor has the pattern of this shell been identified.

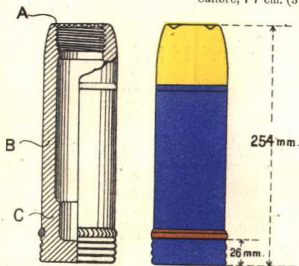
For range table, see Appendix I.

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

F.K. Gr. 96.

Fixed ammunition; designation of complete round, *F.Gr.Patr.*

Calibre, 7.7 cm. (3.03").



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

Thickness of walls—At A, 8 mm. : at B, 14* mm. ; at C, 18 mm.

Thickness of base—19† mm.

Width of driving band—8 mm.

Distinctive markings—Shell of less recent manufacture are coloured yellow with blue head.

* 16 mm. in shell of less recent manufacture.

† 22 mm. in shell of less recent manufacture.

Field Gun Universal Shell.

3·2 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(7·7 cm.) field gun 96 n/A. (rifling, 32 grooves)	<i>K.Z. 11</i>	yards. 5,468	yards. 9,186
	<i>K.Z. 11 l. B.</i>	7,874	9,186

Material—Cast steel.

Weight—

Shell complete, 6·8 kg. (15·0 lbs.).

Bursting charge—0·25 kg. (0·55 lb.). T.N.T.

Burster in 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.

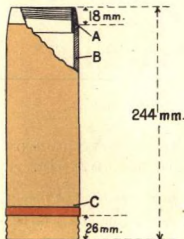
When used as time shrapnel in air, the head flies forward forming a high-explosive shell on its own account, the remainder of the shell acting as shrapnel.

For range table, *see* Appendix I.

F.K. Geschoss 11. Einheits-Geschoss.

Fixed ammunition; designation of complete round, *F.K. Patr.*

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 101).

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.

In shell of more recent manufacture, the bullets in this box are embedded in a mixture of red phosphorus arsenic and paraffin wax.

(B 13641)

1914 Pattern Field Gun H.E. Shell.

3.2 calibres long; 2 c.r.b.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(7.7 cm.) field gun 96 n/A. (rifling, 32 grooves)	<i>K.Z. 14 n.A.</i>	yards.	yards.
	<i>E.K.Z. 17</i>	—	—

Material—Cast iron.

Weight—

Shell complete, 6.8 kg.† (15.0 lbs.†).

Bursting charge, 0.18 kg. (0.4 lb.). $Fp. \frac{60}{40}$ (amatol).

Employment—Same as for the 7.7 cm. long shell (*see* page 76), but is far less effective. Mostly used for high-angle harassing fire with reduced propelling charge (*see* below).

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 shell. 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 74).

For smoke producer, *see* page 74.

This shell, fitted *K.Z. 14 n.A.* or *E.K.Z. 17* fuze, is also issued with a reduced propelling charge, in which case the letters "**kl. Ldg.**" (*kleine Ladung* = reduced charge) are stencilled in white on the cylindrical portion of the shell. A white band, 2 cm. wide, is painted across the base of the cartridge case.

For range table, *see* Appendix I.

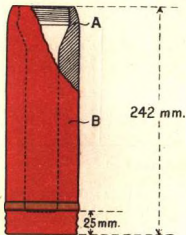
* With normal charge; the maximum range with reduced charge is 6,562 yards.

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

K. Gr. 14.

Fixed ammunition; designation of complete round,
F. Gr. Patr. 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—A white ring, 3 cm. wide, painted round the head indicates an experimental bursting charge, free from nitroglycerine, such as the following:—Amatol in the base, surmounted by a smoke cylinder embedded in astralite, and in the head a small quantity of T.N.T. This explosive mixture is inferior to the regulation amatol (*Fp.* $\frac{60}{40}$).

A black ring painted round the head indicates a bursting charge of amatol (*Fp.* $\frac{60}{40}$).

A vertical black stripe indicates "without smoke producer."

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.

3.2 calibres long ; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
7.7 cm. field gun 96 n/A. ...	<i>L.K.Z. 11 Gr.</i> ...	yards. 5,468*	yards. 9,186
	<i>K.Z. 11 Gr.</i> ...	7,874†	9,186
	<i>L.K.Z. 16 m. V.</i> ...	—	9,186
	<i>E.K.Z. 16</i> ...		
	<i>E.K.Z. 17</i> ...		
7.7 cm. field gun '16 (rifling of both guns, 32 grooves)	<i>L.K.Z. 11 Gr.</i> ...	5,468*	9,952‡
	<i>L.K.Z. 16 m. V.</i> ...	—	10,389‡
	<i>E.K.Z. 16</i> ...		

Material—Cast steel.

Weight—Shell complete :—

With round-nosed fuze, 6.8 kg. (15.0 lbs.).

With pointed fuze, 7.1 kg. (15.6 lbs.).

Bursting charge, 0.38 kg. (0.84 lb.) amatol or 0.27 kg. (0.6 lb.) picric acid.

Employment—As for the long pattern field gun H.E. shell, but the effect is less. It is more accurate, however, at long ranges than the long shell.

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

This shell is also issued, for use only with the 96 n/A. field gun with a reduced bursting charge (0.23 kg.), and is then known as **K.Gr. 15 m. ger. Sprldg.** (*Kanonen-Granate 15 mit geringerer Sprengladung*). It is fuzed with either *K.Z. 14 n.A.* or *E.K.Z. 17*, the maximum range being 9,186 yards.

One shell in each basket (33 per cent.) contains, in addition to the H.E. bursting charge, a "smoke producer" either weighing 42 g. and consisting of a cardboard cylinder containing 37 g. of a mixture of red phosphorus and paraffin wax, or weighing 53 to 57 g. and containing arsenic in addition.

For range tables, see Appendices I, II and IIIA.

* Fuzes of older manufacture are graduated up to 7,200 metres (7,874 yards).

† *K.Z. 11 Gr.* fuze is used principally against aeroplanes.

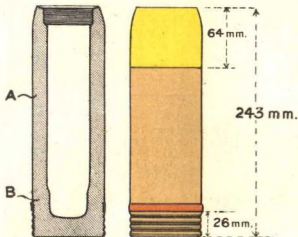
‡ With charge No. 2 ; 6,562 yards with charge No. 1.

K. Gr. 15.

Fixed ammunition for 96 n/A. field gun; designation of complete round, *K. Gr. Patr. 15.*

Separate ammunition for '16 field gun.

Calibre, 7.7 cm. (3.03").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 15 mm.; at B, 17 mm.

Thickness of base—20 mm.

Width of driving band—8 mm.

Distinctive markings—A green band above the driving band indicates that the shell is filled with *Grf. 88* (picric acid).

A red band indicates a shell of the original type with a bursting charge of 0.35 kg. (0.77 lb.) *Fp.* $\frac{60}{40}$ (amatol). Some specimens examined contained a somewhat larger bursting charge.

A yellow band indicates an additional picric acid exploder.

A vertical black stripe indicates "without smoke producer."

Shell fitted with delay action percussion fuze have "m.v." stencilled on the cylindrical portion and on the fuze.

Shell marked "420" in black are used with the 7.7 cm anti-aircraft gun and have no "smoke producer."

Long Pattern Field Gun H.E. Shell.

Complete with pointed fuze, 5 calibres long ; 4 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(7.7 cm.) field gun 96 n/A.	<i>L.K.Z. 11 Gr.</i> ...	yards. 5,468*	yards. 8,202
	<i>L.K.Z. 16 m. V.</i>	—	8,202
	<i>E.K.Z. 16</i> ...		
(7.7 cm.) field gun '16 (rifling of both guns, 32 grooves)	<i>L.K.Z. 16 m. V.</i>	—	6,562†
	<i>E.K.Z. 16</i> ...		

Material—Cast steel.

Weight—Shell complete :

With round-nosed fuze, 7.18 kg. (15.8 lbs.).

With pointed fuze, 7.35 kg. (16.2 lbs.).

Bursting charge—(a) 0.93 kg. (2 lbs.) amatol, or
(b) 0.7 kg. (1.5 lbs.) picric acid, or
(c) 0.82 kg. (1.8 lbs.) amatol + 0.075 kg.
(0.16 lb.) picric acid.

Employment—With *non-delay percussion fuze*: against all living targets in the open or concealed ; against villages, woods, camps, &c. (in conjunction with delay action and time shell).

With *delay action fuze*: (a) *Destructive effect*.—Destruction of targets capable of offering resistance ; destruction of trenches, observation posts, machine gun emplacements, dug-outs, effect against the interior of houses.

(b) *Ricochet effect*.—Against all living targets in the open, concealed or close behind low cover such as shields (occupied trenches, batteries), at ranges up to 4,374 yards when the ground is suitable.

With *instantaneous fuze*: against living targets and matériel in the open.

With *time fuze*: against all living targets, especially when these are close behind cover (batteries in action, protected observation posts, occupied fire trenches, communication and cover trenches, reserves behind houses, and in woods).

Remarks—This shell was introduced in 1916.

One shell in each basket (*i.e.*, 1 in 3) contains, in addition to the H.E. bursting charge, a "smoke producer" weighing 74.5 g. and consisting of a cardboard cylinder containing 66 g. of a mixture of red phosphorus, arsenic and paraffin wax.

For range tables, see Appendices I, II and II A.

* Fuzes of older manufacture are graduated up to 7,200 metres (7,874 yards).

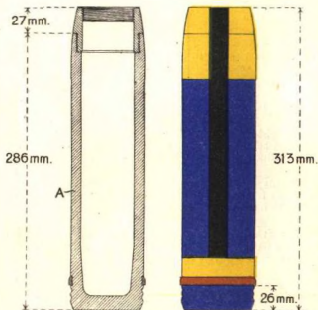
† With charge No. 1 ; charge No. 2 is not used with this shell.

L. F. K. Gr.

Fixed ammunition for 96 n/A. field gun; designation of complete round, *L. F. K. Gr. Patr.*

Separate ammunition for '16 field gun.

Calibre, 7.7 cm. (3.03").



SCALE— $\frac{1}{4}$.

Thickness of walls—A A, 10 mm.

Thickness of base—15 mm.

Width of driving band—8 mm.

Distinctive markings—A green band above the driving band indicates the bursting charge (b), while a similar yellow band indicates the bursting charge (c).

A vertical black stripe indicates "without smoke producer."

Shell fitted with delay action percussion fuze sometimes have a black "m.V." stencilled on the cylindrical portion.

Field Gun Streamline H.E. Shell. ("C" Shell.)

Complete with pointed fuze, 4.5 calibres long; 15 c.r.h.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
(7.7 cm.) field gun '16 (rifling, 32 grooves)	E.K.Z.16C	...	...	yards. —	yards. 11,762*

Material—Steel.

Weight—

Shell complete, 6.09 kg. (13.41 lbs.).

Bursting charge, 0.55 kg. (1.21 lbs.).

Employment—Against living targets and *matériel* in the open. The effect is somewhat less than that of the long pattern field gun shell with instantaneous fuze (*see* page 76).

Remarks—Specimens examined contained a smoke cylinder weighing 63 g., composed of red phosphorus and arsenic.

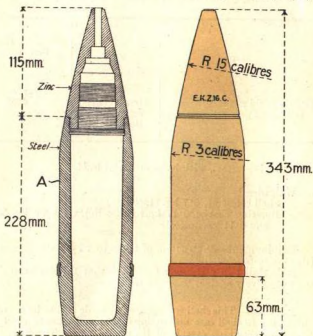
For range table, *see* Appendix IIA.

* With charge No. 2; charge No. 1 is not used with this shell.

(7.7 cm.) C-Geschoss der F.K. 16.

Separate ammunition.

Calibre, 7.7 cm. (3.03").

SCALE — $\frac{1}{4}$.

Thickness of walls—At A, 10 mm.

Thickness of base—16 mm.

Width of driving band—13 mm.

Distinctive markings—

Field Gun Anti-Tank Shell.

3.4 calibres long; 2 c.r.h.; internal fuze.

Used with		Maximum range. Percussion.
Gun.	Fuze.	
(7.7 cm.) field gun 96 n/A. (rifling, 32 grooves)	Internal delay action percus- sion fuze	yards. 5,468*

Material—Steel, with hardened steel head.

Weight—

Shell complete, 6.7 kg. (14.8 lbs.).

Bursting charge, 0.17 kg.† (0.38 lb.), viz. 0.06 kg. T.N.T.
and 0.11 kg. amatol.

Employment—Destruction of tanks by 7.7 cm. close-range guns (*Nahkampfs-Geschütze*).

It is stated in a German document that this shell can also be used effectively against troops in the open.

Remarks—This shell was apparently made at first by converting the *K. Gr. 15* shell case and fitting it with a hardened steel head. The brass cartridge case is of the usual length. The fuze, of the delay action percussion type with centrifugal safety device, is enclosed in an aluminium container screwed into the body of the shell.

The exploder of T.N.T. (24.5 g.) is in a steel gaine screwed on to the fuze container.

The bursting charge consists of a hollow cylinder of compressed T.N.T. placed above a cylinder of amatol. The smoke producer consists of 40 g. of a mixture of red phosphorus and paraffin wax, contained in an aluminium box.

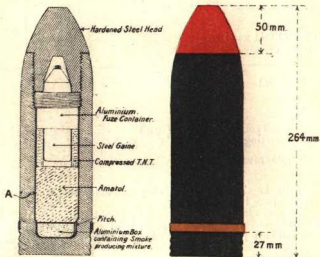
* Maximum effective range against tanks (according to a German document).

† Officially laid down as 0.23 kg. (0.51 lb.).

K. Gr. 15 m. P.

Fixed ammunition; designation of complete round,
K.Gr. Patr. 15 m. P.

Calibre, 7.7 cm. (3.03").



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

Thickness of walls—At A, 15 mm.

Thickness of base—20 mm.

Width of driving band—9 mm.

Distinctive markings—In some specimens, the letters "Am" are stencilled on the body in white paint and indicate that, in the propelling charge, a block of ammonium nitrate explosive is substituted for a part of the tubular nitrocellulose.

Field Gun Star Shell.

3·8 calibres long ; c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(7·7 cm.) field gun 96n/A. (rifling, 32 grooves)		yards. 4·812	yards. —

Material—

Weight—

Shell complete, 5·7 kg. (12·5 lbs.).

Bursting charge, kg. (lbs.).

Employment—

Remarks—This shell probably resembles the 10·5 cm. star shell (*see* page 108).

The range table is calculated for a height of burst of 1,182 feet at all ranges. It is stated that in falling from this height, the flare will have just burnt out by the time it reaches the ground.

F.K. Leuchtgeschoss L/3'8.

Calibre, 7·7 cm. (3·03").

Thickness of walls—

Thickness of base—

Width of driving bands—

Distinctive markings—

1882 Pattern 9 cm. Gun Segment Shell.

2.5 calibres long; 1.5 c.r.h.

Used with				Maximum range.	
Gun.		Fuze.		Time.	Perc'n.
9 cm. 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—

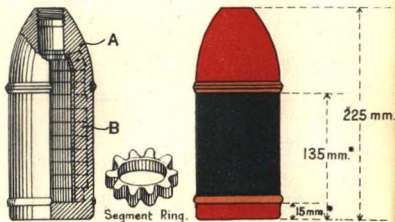
Remarks—This is an old-fashioned segment shell.

The 9 cm. 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 IV.

9 cm. Gr. 82 (P.).

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 mm.*

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

Distinctive markings—

* Measurement approximate only, see footnote on page 57.

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

2·2 calibres long; 1·5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
9 cm. gun '73/'88 ... (rifling, 24 grooves)	<i>Dopp. Z. 91</i> ...	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 into a millboard case).

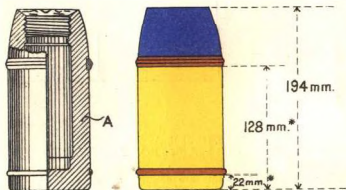
Employment—Good effect against *matériel*, shielded batteries (direct hits), and masonry which is weak or already shaken.

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

Remarks—In the bottom of the cavity is a cardboard case, 57 g. in weight, filled with a smoke-producing mixture.

For range table, *see* Appendix IV.

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—

* Measurement approximate only, see footnote on page 57.

1914 A Pattern 9 cm. Gun H.E. Shell.

2.2 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Pere'n.
9 cm. '73/88 gun ... (rifling. 24 grooves)	H.Z. 14 Forst....	yards. —	yards. 7,109

Material—Cast iron.

Weight—

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

Bursting charge, 0.165 kg.* (0.36 lb.). Amatol.

Employment—Direct hits are effective against *matériel*, and even against shielded batteries and weak and shattered masonry.

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

Remarks—Specimens of this shell have been found which, in addition to the H.E. bursting charge, contain a "smoke producer" weighing 42 g. and consisting of a cardboard cylinder containing 37 g. of a mixture of red phosphorus and paraffin wax.

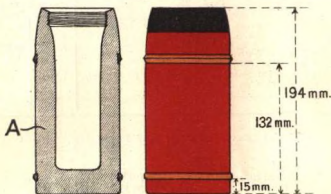
In some specimens the upper driving band is 5 mm. wide and 136 mm. above the base; the rib of the upper driving band is, however, invariably 138 mm. above the base in all these shell.

For range table, see Appendix IV.

* Officially laid down as 0.2 kg. (0.44 lb.).

9 cm. Gr. 14 A.

Calibre, 8.8 cm. (3.46").

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

Thickness of walls—At A, 20 mm.

Thickness of base—25 mm.

Width of driving bands—Upper band, 10 mm.*; lower, 6 mm.

Distinctive markings—

* See Remarks opposite.

1914 Pattern 9 cm. Gun H.E. Shell.

2.2 calibres long ; 1.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
9 cm. gun '73/'88... (rifling, 24 grooves)	<i>Gr. Z. 14</i>	yards. —	yards. 7,109
9 cm. anti-aircraft gun, converted '73/'88 (rifling, 24 grooves)	<i>Dopp. Z. 92 lg. Brlg. o. Az.</i>	7,109	—

Material—Body, cast steel ; head, forged steel.

Weight—

Shell complete, 7.4 kg. (16.3 lbs.).

Bursting charge, 0.3 kg.* (0.66 lb.). Amatol.

Employment—Direct hits are effective against *matériel*, and even against shielded batteries and weak and shattered masonry.

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

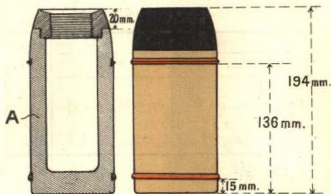
Remarks—In some specimens the upper driving band is 10 mm. wide and 132 mm. above the base ; the rib of the upper driving band is, however, invariably 138 mm. above the base in all these shells.

For range table, see Appendix IV.

* Officially laid down as 0.25 kg. (0.55 lb.).

9 cm. Gr. 14.

Calibre, 8.8 cm. (3.46").

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

Thickness of walls—At A, 18 mm.

Thickness of base—23 mm.

Width of driving band—5 mm.*

Distinctive markings—

* See Remarks opposite.

9.5 cm. German H.E. Shell for French 95 mm. Gun.

3.2 calibres long ; 2.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
French 95 mm. gun, 1888 pattern (<i>franz. 95 mm. K.</i>) (rifling, 28 grooves)	<i>Gr. Z. 14</i>	yards. —	yards. —

Material—Steel.

Weight—

Shell complete, 11.8 kg. (26.0 lbs.).

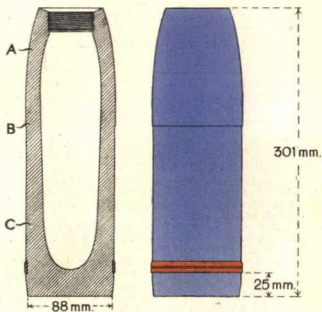
Bursting charge, 0.80 kg. (1.76 lbs.). Amatol.

Employment—

Remarks—The interesting feature in the design of this shell is the tapered base.

9.5 cm. Gr. for French Gun.

Calibre, 9.5 cm. (3.7").

SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 16 mm. ; at B, 15 mm. ; at C, 18 mm.

Thickness of base—28 mm.

Width of driving band—12 mm.

Distinctive markings—

1905 Pattern Light Field Howitzer Universal Shell.

3.3 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(10.5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	H.Z. 05 I.B.	yards. 7,655*	yards. 7,655

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. or amatol.

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

Bullets: 400 10-g. bullets, 45 to the lb.

Employment—*As percussion H.E. shell, with non-delay 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.

As percussion H.E. shell, with delay action: against living targets under overhead cover. 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 in trenches, reserves behind houses, &c.), aeroplanes, especially at long ranges.

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 10-g. bullets, 45 to the lb.).

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 high-explosive shell.

When used as time shrapnel in air, the head flies forward and detonates, the remainder of the shell acting as shrapnel.

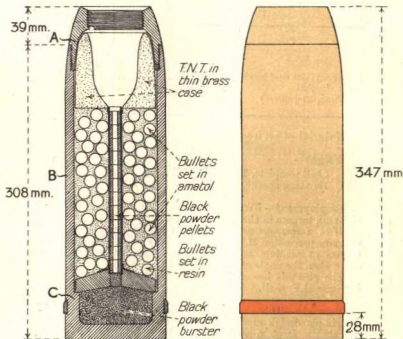
An official document issued by the War Ministry stated that the Universal shell would become obsolete on the 1st July, 1916; it is, however, sometimes met with.

For range table, see Appendix III.

* This fuze is graduated up to 70, corresponding to a range of 7,000 metres or 7,655 yards, which is the maximum range when using Charge No. 8. The usual maximum range is 6,890 yards with Charge No. 7.

F.H. Geschoss 05. Einheits-Geschoss.

Calibre, 10.5 cm. (4.13").



SCALE — $\frac{1}{4}$.

Thickness of walls—At A, 7 mm.; at B, 9 mm.

Thickness of base—17 mm.

Width of driving band—13.5 mm.

1914 Pattern Light Field Howitzer H.E. Shell.

2·8 calibres long ; 2 c.r.h.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
(10·5 cm.) light field howitzer '98/09 (rifling, 32 grooves)				yards.	yards.
	<i>H.Z. 14 Fb.</i>	...	...	—	7,655*
	<i>E.H.Z. 17</i>	...	...	—	7,655*

Material—Cast iron.

Weight—

Shell complete, 15·5 kg.† (34·17 lbs.).

Bursting charge, 0·3 kg.‡ (0·66 lb.). Amatol.

Employment—*With non-delay action percussion fuze:* against all living targets in the open or concealed.

With instantaneous fuze: splinter effect greater than with ordinary percussion H.E. shell. Specially suitable against living targets at medium and long ranges. Blinds will frequently occur when the angle of impact is small.

The effect is less than that of the 1915 pattern light field howitzer H.E. shell.

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 shell. 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 104).

For "smoke producer," *see* page 104. For range table, *see* Appendix II.

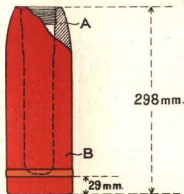
* With charge No. 8 ; the usual maximum range is 6,890 yards with charge No. 7.

† The weight varies considerably.

‡ Formerly 0·4 to 0·6 kg. (0·9 to 1·3 lb.).

H. Gr. 14.

Calibre, 10.5 cm. (4.13").

**SCALE - $\frac{1}{8}$.**

Thickness of walls—At A, 21 mm.; at B, 28 mm.

Thickness of base—33 mm.

Width of driving band—12 mm.

Distinctive markings—The *E.H.Z. 17* instantaneous fuze is painted black.

A white ring, 3 cm. wide, painted round the head indicates an experimental bursting charge, free from nitroglycerine, such as the following:—Resin in the base, astralite in the body, and trinitroanisole in the head. A smoke producer is embedded partly in the resin and partly in the astralite. The total weight of explosive is 0.26 kg. (0.57 lb.). This mixture is much inferior to the regulation amatol (*Fp.* $\frac{60}{40}$).

A vertical black stripe indicates "without smoke producer."

1915 Pattern Light Field Howitzer H.E. Shell.

3·3 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(10·5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	<i>H.Z. 05 Gr.</i> ...	yards. 5,468*	yards. 7,655†
	<i>H.Z. 16...</i> ...	—	7,655†
	<i>E.H.Z. 17</i> ...	—	7,655†
(10·5 cm.) light field howitzer '16 (rifling, 32 grooves)	<i>H.Z. 05 Gr.</i> ...	5,468*	9,241‡
	<i>H.Z. 14 Fb.</i> ...	—	9,241‡
	<i>H.Z. 16...</i> ...	—	9,241‡
(10·5 cm.) light field howitzer, Krupp (rifling, grooves)	<i>E.H.Z. 17</i> ...	—	9,241‡
	<i>Ditto</i> ...	5,468*	9,733§

Material—Cast steel.

Weight—

Shell complete, 15·7 kg. (34·6 lbs.).

Bursting charge, 1·4 kg. (3·1 lbs.). Amatol.

Employment—As for the long pattern light field howitzer H.E. shell (see page 106) but the effect is less.

This shell is also issued, for use only with the '98/'09 light field howitzer, with a reduced bursting charge (0·35 kg. instead of 1·4 kg.) and is then known as **H. Gr. 15 m. ger. Sprgldg.** (*Haubitz-Granate 15 mit geringerer Sprengladung*). It is fuzeed with *H.Z. 14 Fb.*, the maximum range being 7,655 yards. It is painted grey with a yellow head.

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

One shell in each basket (50 per cent.) contains, in addition to the H.E. bursting charge, a "smoke producer" weighing 145 g. and consisting of a cardboard cylinder containing 134 g. of a mixture of red phosphorus, arsenic and paraffin wax.

For range table, see Appendix III.

* Fuzes of older manufacture (*H.Z. 05 Gr. I.B.*) are graduated up to 7,200 metres (7,874 yards).

† With Charge No. 8; the usual maximum range is 6,890 yards with Charge No. 7.

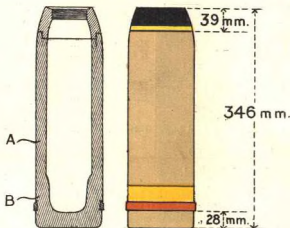
‡ With Charge No. 9; the usual maximum range is 7,054 yards with Charge No. 7.

§ With Charge No. 10; the usual maximum range is 6,452 yards with Charge No. 8.

|| Officially laid down as 1·5 kg. (3·3 lbs.).

H. Gr. 15.

Calibre, 10.5 cm. (4.13").

**SCALE— $\frac{1}{6}$.****Thickness of walls**—At A, 16 mm. ; at B, 22 mm.**Thickness of base**—26 mm.**Width of driving band**—13 mm.**Distinctive markings**—A black ring painted round the head of a shell indicates a bursting charge of amatol ($Fp. \frac{60}{40}$).A yellow band above the driving band indicates an additional exploder of *Grf. 88* (picric acid).

A vertical black stripe indicates "without smoke producer."

Shell have been found with a red band immediately above the driving band.

Long Pattern Light Field Howitzer H.E. Shell.

3.6 calibres long; 2 c.r.h.

Used with			Maximum range.	
Gun.	Fuze.		Time.	Perc'n.
(10.5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	<i>H.Z. 05 Gr.</i> ...	...	yards.	yards.
	<i>H.Z. 16...</i> ...	...	5,468*	7,655†
(10.5 cm.) light field howitzer '16 (rifling, 32 grooves)	<i>H.Z. 05 Gr.</i> ...	...	5,468*	9,186‡
	<i>H.Z. 16...</i> ...	...	—	9,186‡
(10.5 cm.) light field howitzer, Krupp (rifling, grooves)	Ditto	...	5,468*	9,736§

Material—Steel.

Weight—

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

Bursting charge, 2.0 kg. (4.4 lbs.). See p. 107.

Employment—With *non-delay percussion fuze*: against all living targets in the open or concealed.

With *delay action fuze*: (a) *Destructive effect*.—Destruction of trenches, observation posts, machine-gun emplacements, dug-outs.

(b) *Ricochet effect*.—Against all living targets in the open, concealed, or close behind low cover, at ranges up to 3,280 yards, with Charges Nos. 7 and 8, when the ground is suitable.

With *time fuze*: against all living targets, especially when these are close behind cover (batteries, observation posts, fire trenches, communication trenches, reserves behind houses and in woods).

With *instantaneous fuze*: Against living targets and matériel in the open.

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."

This shell is also issued, for use only with the '98/'09 light field howitzer, with a reduced bursting charge (1.5 kg. instead of 2.0 kg.), and is then known as **L.F.H. Gr. m. ger. Sprgldg.** (*Lange Feldhaubitze-Granate mit geringerer Sprengladung*). It is fuzeed with either *H.Z. 14 Fb.* or *E.H.Z. 17*, the maximum range being 7,655 yards. It is then painted grey with a yellow head. The *E.H.Z. 17* fuze is painted black.

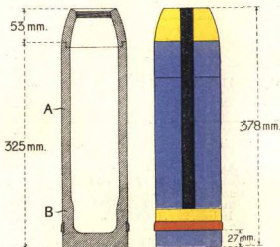
For range table, see Appendix III.

For "smoke producer," see page 104.

* † ‡ § See footnotes on page 104.

L.F.H. Gr.

Calibre, 10.5 cm. (4.13")

SCALE— $\frac{1}{8}$.

Thickness of walls—At A, 12 mm.; at B, 15 mm. (in some specimens, 14 mm. and 17 mm.).

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

Width of driving band—14 mm.

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

A black ring painted round the head of a shell indicates a bursting charge of amatol ($Fp. \frac{60}{40}$).

A dark blue band above the driving band would appear to indicate a filling of either $Di. + Fp. \frac{60}{40}$ or $Di. + An. \frac{60}{40}$, together with an additional picric acid exploder.

A yellow band above the driving band indicates an additional exploder of picric acid (*Grf. ss*).

$Di. \frac{60}{40}$ with a picric acid exploder has also been found.

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

For shell painted grey with yellow head and black fuze, see under "Remarks," on opposite page.

A vertical black stripe indicates "without smoke producer."

Light Field Howitzer Star Shell.

3.3 calibres long ; 0.5 c.r.h.

Used with		Maximum range, time.
Gun.	Fuze.	
(10.5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	<i>Lg. Zdr. S/22</i> ...	yards. 4,740

Material—Steel.

Weight—

Shell complete, 12.5 kg. (27.5 lbs.).

Bursting charge—

In head, 50 g. (1.8 oz.) black powder.

In base, 29 g. (1.0 oz.) " "

Employment—For illuminating targets at night.

Remarks—The flash from the fuze fires the charge in the head which blows off the latter. The flash also passes down the brass tube which is filled with black powder and fires the charge in the base. This charge expels the flare, at the same time lighting the composition.

The flare composition consists of—

Barium nitrate, 48.2 per cent.

Sulphur, 14.5 per cent.

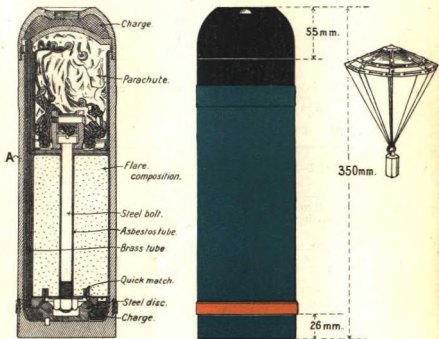
Magnesium, 33.7 per cent.

Paraffin wax, 3.6 per cent.

The range table is calculated for a height of burst of 1,476 feet at all ranges. M.V. = 935 f.s.

F.H. Leuchtgeschoss L/3'3.

Calibre, 10.5 cm. (4.13").



SCALE — $\frac{1}{4}$.

Thickness of walls—At A, 6 mm.

Thickness of base—17 mm.

Width of driving band—14 mm.

Distinctive markings—

Light Field Howitzer Streamline H.E. Shell ("C" Shell).

Complete with fuze, 4.3 calibres long; c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(10.5 cm.) light field howitzer '16 (rifling, 32 grooves)	<i>E.H.Z. 16...</i>	yards. —	yards. 10,499*
(10.5 cm.) light field howitzer, Krupp (rifling, grooves)	" ...	—	11,210†

Material—Steel.

Weight—

Shell complete, 15.5 kg. (34.2 lbs.).

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

Employment—As for the long pattern light field howitzer H.E. shell (*see* page 106), but the effect is less; splinter effect greater than that of other patterns of percussion shell; very suitable for engaging living targets at medium and long ranges. With a small angle of descent, on level or falling ground, the percentage of blinds will be high.

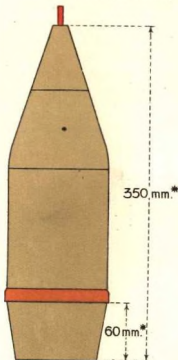
Remarks—

* With charge No. 9, which is the only charge used with this shell. This is the maximum range shown on the range drum; the German ammunition book gives 10,936 yards.

† With charge No. 10, which is apparently the only charge used with this shell.

C-Geschoss der l. F.H.

Calibre, 10.5 cm. (4.13").

SCALE— $\frac{1}{4}$.

The above is merely a rough sketch taken from a captured diagram.

Thickness of walls—18 mm.

Thickness of base— mm.

Width of driving band—15 mm.

Distinctive markings—Painted grey.

* Read 453 mm. and 86 mm.

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

4.2 calibres long; 2.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
10 cm. gun '14, 10 cm. gun '97 ...	<i>Gr. Z. 04</i>	yards. —	yards. 12,085
10 cm. gun '04, 10 cm. gun (rifling of the above guns, 32 grooves.)	"	—	8,968*
			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 in a millboard case).

Employment—*With non-delay action*: Good effect against *matériel* and weak vertical masonry; sufficient effect against living targets on hard ground, in high woods and in villages; also effective against wire entanglements.

With delay action: Good effect against living targets, even on soft ground if the shell ricochet before bursting; with sufficient angle of descent, also effective against breastworks and light cover.

Remarks—For range table, see Appendix V.

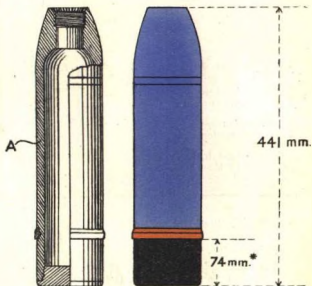
This shell is no longer mentioned in the German Official Ammunition Handbook.

* With reduced charge.

10 cm. Gr. 96.

Fixed ammunition; designation of complete round,
10 cm. Gr. Patr. 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 57.

10 cm. Gun H. E. Shell.

3.25 calibres long; 2.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
10 cm. gun '14, 10 cm. gun '97	<i>Dopp. Z. 92 f. 10 cm. K.</i> {	yards. 8,968 8,968*	yards. 12,085 8,968*
10 cm. gun '04, 10 cm. gun	" }	8,968	11,264
10 cm. gun with overhead shield		9,186	11,811
10 cm. gun in turret			
10 cm. gun, reinforced, in turret		8,530	10,608
10 cm. short gun, in turret (rifling of the above guns, 32 grooves)	"		

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 into a millboard case).

Employment—*With non-delay action*: good effect against *matériel* and weak vertical masonry; sufficient effect against living targets on hard ground, in high woods and in villages; also effective against wire entanglements.

With delay action: good effect on living targets, even on soft ground if the shell ricochet before bursting; with sufficient angle of descent, also effective against breastworks and light cover.

This shell is less effective than the 1915 pattern 10 cm. H.E. shell.

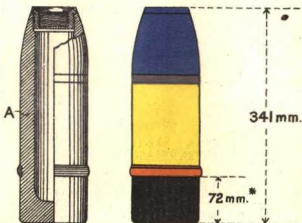
Remarks—For range tables, see Appendix V.

* With reduced charge.

10 cm. Gr.

Fixed ammunition; designation of complete round,
10 cm. Gr. Patr.

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 57.

1906 Pattern 10 cm. Gun H.E. Shell.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
10 cm. coast defence gun (rifling, grooves)	<i>kz. Bd. Z. 10 Kst.K. ...</i>	yards. —	yards. 11,264
10 cm. coast defence gun on wheeled carriage (rifling, grooves)	Ditto	—	At least 11,264

Material—**Weight—**

Shell complete, kg. (lbs.).

Bursting charge, 0.63 kg. (1.4 lbs.).

Employment—*Against floating targets:* Very effective up to 1,531 yards range, and sufficiently effective at all normal ranges against the armour protecting the engines of modern destroyers, even with most unfavourable angles of impact.

Against land targets: Slight effect against living targets, for the shell being pointed, and in addition issued with the fuze set for short delay action, it bursts in the ground; on hard ground, with ricochet action, it is more effective. Sufficient effect against localities.

Remarks—

10 cm. Gr. 06.

Calibre, 10.5 cm. (4.13")

Thickness of walls—

Thickness of base—

Width of driving band—

Distinctive markings—

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

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
10 cm. gun '04, 10 cm. gun ...	<i>K.Z. 16 f. 10 cm. K. H.Z. 14 Vorst. Flickb.</i>	yards. —	yards. 11,264
10 cm. gun '14, 10 cm. gun '07	Ditto	{ —	12,085 8,968*
10 cm. gun with overhead shield	Ditto	—	11,811
10 cm. gun in turret ...			
10 cm. gun, reinforced, in turret			
10 cm. short gun in turret (rifling of the above guns, 32 grooves)	Ditto	—	10,608

Material—**Weight—**

Shell complete, kg. (lbs.).

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

Employment—*With non-delay action:* Good effect against *matériel* and weak vertical masonry; sufficient effect against living targets on hard ground, in high woods and in villages; also effective against wire entanglements.

With delay action: Good effect against living targets, even on soft ground if the shell ricochet before bursting; with sufficient angle of descent, also effective against breastworks and light cover.

The effect is slightly less than that of the 1915 pattern 10 cm. H.E. shell.

Remarks—For anti-aircraft work, 10 cm. guns are mounted on pivot mountings.

For range table, see Appendix V.

* With reduced charge.

10 cm. Gr. 14 A.

Fixed ammunition; designation of complete round,
10 cm. Gr. Patr. 14A.

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.

The shoulder is now greased instead of being painted.

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

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
10 cm. gun '04, 10 cm. gun ...	<i>K.Z. 16 f. 10 cm. K. H.Z. 14 Vorst. Fliehb.</i>	yards. —	yards. 11,264
10 cm. gun '14, 10 cm. gun '97	Ditto	{ —	12,085 8,968*
10 cm. gun with overhead shield	} Ditto	—	11,811
10 cm. gun in turret ...			
10 cm. gun, reinforced, in turret			
10 cm. short gun in turret (riding of the above guns, 32 grooves)	Ditto	—	10,608

Material—**Weight—**

Shell complete, kg. (lbs.).

Bursting charge, 0.75 kg. (1.65 lbs.).

Employment—*With non-delay action:* Good effect against *matériel* and weak vertical masonry; sufficient effect against living targets on hard ground, in high woods and in villages; also effective against wire entanglements.

With delay action: Good effect against living targets, even on soft ground if the shell ricochet before bursting; with sufficient angle of descent, also effective against breastworks and light cover.

The effect is slightly less than that of the 1915 pattern 10 cm. H.E. shell.

Remarks—For range table, see Appendix V.

* With reduced charge.

10 cm. Gr. 14.

Fixed ammunition; designation of complete round,
10 cm. Gr. Patr. 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.

The shoulder is now greased instead of being painted.

1915 Pattern 10 cm. Gun H.E. Shell.

3.9 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
10 cm. gun '04, 10 cm. gun ...	<i>Gr. Z. 04†</i>	yards. —	yards. 11,264
10 cm. gun '14, 10 cm. gun '97	Ditto	{ — —	12,085 8,968*
10 cm. gun with overhead shield 10 cm. gun in turret ... 10 cm. gun, reinforced, in turret (rifling of the above guns, 32 grooves.)	} Ditto	—	11,811

Material—Steel.

Weight—

Shell complete, 18 kg. (39.7 lbs.).

Bursting charge, 1.8 kg. (3.97 lbs.). *Grf. 88* (picric acid stemmed into a millboard case).

Employment—*With non-delay action*: Good effect against *matériel* and weak vertical masonry; sufficient effect against living targets on hard ground, in high woods and in villages; also effective against wire entanglements.

With delay action: Good effect against living targets, even on soft ground if the shell ricochet before bursting; with sufficient angle of descent, also effective against breastworks and light cover.

Remarks—For range table, see Appendix V.

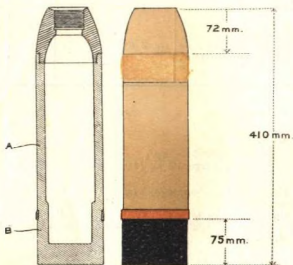
* With reduced charge.

† *Dopp. Z. 15* is also used.

10 cm. Gr. 15.

Fixed ammunition; designation of complete round,
10 cm. Gr. Patr. 15.

Calibre, 10.5 cm. (4.13").



SCALE— $\frac{1}{8}$.

Thickness of walls—At A, 14 mm. ; at B, 17 mm.

Thickness of base—35 mm.

Width of driving band—16 mm.

Distinctive markings—The shoulder is now greased instead of being painted.

1916 Pattern 10 cm. Gun H.E. Shell.

calibres long; c.r.h.

Used with			Maximum range.	
Gun.	Fuze.		Time.	Perc'n.
			yards.	yards.
10 cm. coast defence gun on wheeled carriage (<i>Kst. K. i. R.L.</i>)	<i>Gr. Z. 04</i>	... ..	—	16,295 12,249*

Material—**Weight—**

Shell complete, kg. (lbs.).

Bursting charge, 1·8 kg. (4·0 lbs.). *Fp. 02* (T.N.T.).**Employment—***Against land targets:* same as for 10 cm. *Gr. 15* (see page 128).*Against floating targets:* Effective against light upper works and personnel not under cover; unsuitable for piercing armoured decks, &c.**Remarks—**

* With reduced charge.

10 cm. Gr. 16.

Calibre, 10.5 cm. (4.13").

Thickness of walls—

Thickness of base—

Width of driving bands--

Distinctive markings—

12 cm. German H.E. Shell for French 120 mm. Long Gun.

2.4 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
French 120 mm. long gun (<i>franz. lg. 120 mm. K.</i>)	<i>Gr. Z. 14</i> ...		
(rifling, 36 grooves) ...	<i>Gr. Z 14 n/A.</i> ...	—	

Material—Steel.

Weight—

Shell complete, 16.54 kg. (36.4 lbs.).

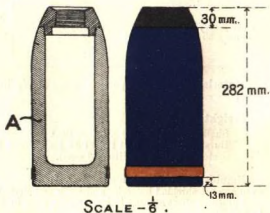
Bursting charge, 1.25 kg. (2.75 lbs.). *Fp.* $\frac{60}{40}$ (amatol).

Employment—

Remarks—Some specimens contain a smoke producer.

12 cm. Gr. for French Gun.

Calibre, 12.0 cm. (4.7").



Thickness of walls—At A, 20 mm.

Thickness of base—32 mm.

Width of driving band—17 mm.

Distinctive markings—

1833 a/A. Pattern 12 cm. Gun H.E. Shell.

2.3 calibres long ; 1.5 c.r.h.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
12 cm. heavy gun (rifling, 30 grooves)	...	<i>Dopp. Z. 88</i>	... ..	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 into a millboard case).

Employment—Direct hits are effective against *matériel*, and even against shielded batteries and weak and shattered masonry.

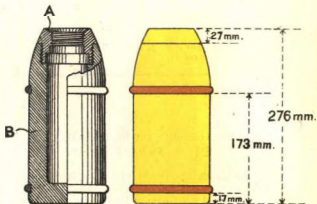
Sufficient effect against living targets, even in high woods and in buildings.

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— $\frac{1}{8}$.

Thickness of walls—At A, 15 mm.*; at B, 27 mm.*

Thickness of base—30 mm.*

Width of driving bands—Upper band, 10 mm.; lower, 13 mm.

Distinctive markings—

* Measurement approximate only, *see* footnote on page 57.

1914 A. Pattern 12 cm. Gun H.E. Shell.

2·3 calibres long; 1·5 c.r.h.

Used with			Maximum range.	
Gun.		Fuze.	Time.	Pere'n.
12 cm. heavy gun ... (rifling, 30 grooves)	...	H.Z. 14 Vorst....	yards. —	yards. 7,984

Material—Cast steel.

Weight—

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

Bursting charge, 0·9 kg. (2·0 lbs.). Amatol.

Employment—Direct hits are effective against *materiel*, and even against shielded batteries and weak and shattered masonry.

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

Remarks—The 12 cm. Gr. 14 differs from the 12 cm. Gr. 14 A in the following particulars :—

Colour—Grey.

Length—233 mm.

Bursting charge—1·4 kg. (3·1 lbs.).

Fuze—Gr. Z. 14, Gr. Z. 14 n/A., or Dopp. Z. 92.

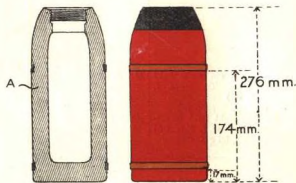
Thickness of walls—20 mm.

The shell has a screwed head.

For range table, see Appendix VI.

12 cm. Gr. 14 A.

Calibre, 12.03 cm. (4.73").

SCALE— $\frac{1}{6}$.

Thickness of walls—At A, 25 mm.

Thickness of base—31 mm.

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

Distinctive markings—A black ring painted round the head of a shell indicates a bursting charge of amatol ($Fp. \frac{60}{40}$).

12 cm. German H.E. Shell for Russian Light Field Howitzer.

2.3 calibres long; 2 c.r.h.

Gun.	Fuze.	Maximum range.	
		Time.	Perc'n.
		yards.	yards.
Russian 12 cm. light field howitzer '04 (<i>russ. l. F.H. 04</i>) (rifling, grooves)	<i>Gr. Z. 14</i>		
Russian light field howitzer '09 (<i>russ. l. F.H. 09</i>) (rifling, 36 grooves)	<i>Ditto</i>		

Material—Steel.

Weight—

Shell complete, 17.0 kg. (37.5 lbs.).

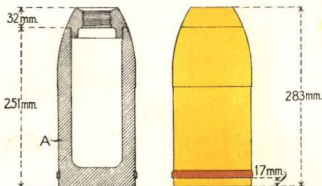
Bursting charge, 1.4 kg. (3.08 lbs.). Amatol.

Employment—

Remarks—These shell contain, in addition to the bursting charge, a smoke producer, in the form of a cardboard cylinder weighing 155 g., and filled with a mixture containing arsenic and phosphorus.

12 cm. Gr. for Russian Light Field Howitzer.

Calibre, 12·19 cm. (4·8").



SCALE— $\frac{1}{8}$.

Thickness of walls—At A, 21 mm.

Thickness of base—31 mm.

Width of driving band—12 mm.

Distinctive markings—On the shoulder is stencilled in black ϕ 12·19 (the calibre).

13 cm. Gun H.E. Shell.

4.8 calibres long ; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Elev'n.
13 cm. gun ... (rifling, 36 grooves)	<i>lg. Bd. Z. 10*</i> ...	yards. —	yards. 15,748

Material—Steel.

Weight—

Shell complete, 40 kg. (88.2 lbs.).

Bursting charge, 3.5 kg. (7.7 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 and to penetrate concrete escarp walls and earthworks.

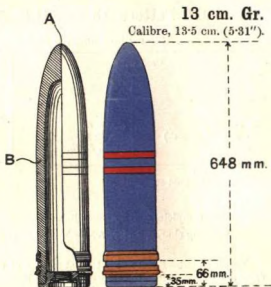
With non-delay action: good effect against living targets, even in high woods and localities, against *matériel*, earthworks, strong vertical masonry, and light concrete works.

With delay action: good effect, especially with double delay action against strong masonry, concrete escarp walls and earthworks.

Remarks—A variation of this shell has been found, the length of which is 565 mm. and thickness of walls 10 mm. It is filled with incendiary material (probably thermite and metallic sodium) and is fitted with a fuze marked *Brd. Gesch. lg. Bd. Z. 10*.

For range table, see Appendix VII.

* Has superseded *Bd. Z. 06*.



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—Two red rings painted round the cylindrical portion denote an increased thickness of walls.

Shell of less recent manufacture do not have red rings round the cylindrical portion.

1914 Pattern 13 cm. H.E. Shell.

3·8 calibres long; 6 c.r.h.

Used with				Maximum range.	
Gun.		Fuze.		Time.	Perc'n.
13 cm. gun (rifling, 36 grooves)		<i>Gr. Z. 04</i> <i>Gr. Z. 14.</i> <i>Dopp. Z. 15.</i>		yards. —	yards 15,311

Material—Cast steel.**Weight**—

Shell complete, 40·5 kg. (89·3 lbs.).

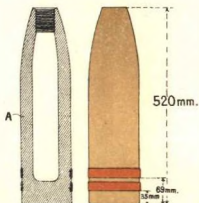
Bursting charge, 2·5 kg. (5·5 lbs.). *Fp. 02* (T.N.T.) or *Fp.* $\frac{60}{40}$.

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").

SCALE — $\frac{1}{10}$.

Thickness of walls—At A, 31 mm.

Thickness of base—60 mm.

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

Distinctive markings—

1880 Pattern 15 cm. Common Shell.

2.4 calibres long; 1 c.r.h.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
15 cm. gun (<i>Ringkanone</i>) (rifling, 24 grooves)	Gr. Z. 82	...	...	yards. —	yards. 8,312
15 cm. gun (<i>Lange Ringkanone</i>) (rifling, 24 grooves)	"	...	...	—	8,749

Material—Cast iron.**Weight**—

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

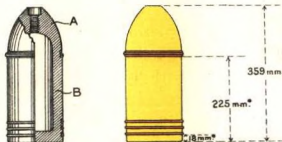
Bursting charge, 1.9 kg. (4.2 lbs.). . Black powder.

Employment—Sufficient effect against living targets, even in high woods or localities, against *matériel*, shielded guns, and light cover.

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

15 cm. Gr. 80 (P.).

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—Shell of less recent manufacture are painted red with yellow head.

* Measurement approximate only, *see* footnote on page 57.

15 cm. Incendiary Shell "C."

2.4 calibres long; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
(15 cm.) heavy field howitzer (rifling, 36 grooves)	<i>Gr. Z. 82</i> ...	—	6,616
(15 cm.) heavy field howitzer '02 (rifling, 36 grooves)	" ...	—	7,109
(15 cm.) heavy field howitzer '13 (rifling, 36 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.

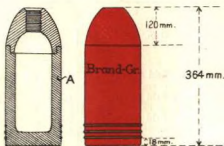
Remarks—At the top of the cylindrical portion is a thin metal disc, which is kept in place by the head of the shell being screwed down. Through the centre of this disc runs a brass tube, 32.5 mm. in diameter, containing black powder and reaching nearly to the base of the shell.

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. C.

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.

1883 Pattern 15 cm. H.E. Shell.

3.7 calibres long ; 1.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
(15 cm.) heavy field howitzer ... (rifling, 36 grooves)	<i>Gr. Z. 04</i> ...	—	6,616
(15 cm.) heavy field howitzer '02 (rifling, 36 grooves)	<i>Gr. Z. 96/04</i> ...	—	8,147
(15 cm.) heavy field howitzer '13 (rifling, 36 grooves)	Ditto ...	—	9,295

Material—Steel.

Weight—

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

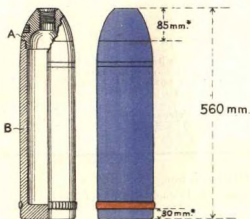
Bursting charge, 5.89 kg. (13 lbs.). *Grf. 88* (cast picric acid).

Employment—Effective against targets capable of offering resistance, especially overhead cover, on account of the large bursting charge.

The characteristics of this shell are generally similar to those of the 1896 pattern 15 cm. shell (*see* p. 156). The burster being smaller (13 lbs. against 16 lbs.), the effect is less.

Remarks—For range tables of heavy field howitzers '02 and '13, *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 57.

1888 Pattern 15 cm. H.E. Shell.

2·8 calibres long; 1·5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
15 cm. long gun	<i>Dopp. Z. 92</i> ...	—	10,936
15 cm. howitzer in turret	<i>Gr. Z. 82</i> (<i>Kp.</i>)*	—	7,874
(15 cm.) heavy field howitzer ...	<i>Ditto</i> ...	—	6,616
(15 cm.) heavy field howitzer '02	<i>Ditto</i> ...	—	8,147
(15 cm.) heavy field howitzer '13	<i>Ditto</i> ...	—	8,147
(rifling of each of the above, 36 grooves)			
15 cm. heavy coast defence howitzer (rifling, grooves)	<i>Ditto</i> ...	—	6,616

Material—Pig iron.

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

Bursting charge, 1·5 kg. (3·3 lbs.). *Grf. 88* (cast picric acid in millboard case).

Employment—*With 15 cm. long gun.*

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*.

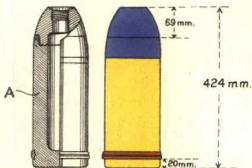
With heavy field howitzers: Effective against living targets in the open or under cover, even in high woods and localities, against *matériel*, shielded batteries, overhead cover in field defences, wire entanglements, and light masonry.

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*.

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

* *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—

1896 Pattern 15 cm. H.E. Shell.

3.9 calibres long; 2.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
15 cm. long gun	<i>Gr. Z. 04</i>	—	10,936
	<i>Gr. Z. 96/04</i>		
(15 cm.) heavy field howitzer ...	Ditto	—	6,616
(15 cm.) heavy field howitzer '02 ...	Ditto	—	8,147
(15 cm.) heavy field howitzer '13 ...	Ditto	—	9,096
(rifling of all of the above, 36 grooves)			

Material—Steel.

Weight—

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

Bursting charge, 7.3 kg. (16.1 lbs.). *Grf. 88* (cast picric acid stemmed into a millboard case).

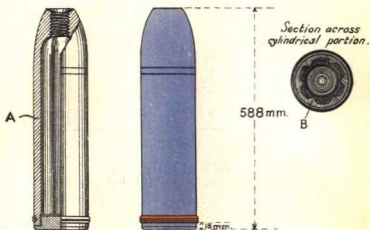
Employment—*With the 15 cm. long gun:* against overhead cover, superior to the 1912 and 1912 n/A. patterns, but the splinter effect is less.

With the heavy field howitzers: very effective against targets offering resistance, especially overhead cover, on account of the large bursting charge; against living targets less effective than the 1912 and 1912 n/A. pattern (*see* pages 168 and 170).

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

15 cm. Gr. 96.

Calibre, 14.97 cm. (5.89").

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

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.

3·8 calibres long ; 7·5 c.r.h. (approx.)*

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
15 cm. gun with overhead shield (<i>i.S.L.</i>) (rifling, 44 grooves?)	<i>Gr. Z. 04</i>	...	...	yards. —	yards. 17,060
15 cm. experimental gun on wheeled carriage (<i>i.R.L.</i>) (rifling, 48 grooves?)	Ditto	...	...	—	18,482

Material—Steel.

Weight—

Shell complete, 50·5 kg. (111·3 lbs.).

Bursting charge, 3·68 kg.† (8·1 lbs.). *Fp. 02* (cast T.N.T. in

millboard case) or *Di.* $\frac{65}{35} + Fp.$ $\frac{60}{40}$.

Employment— *With non-delay action:* Good effect against living targets in the open, even in high woods and in localities; against *matériel*, shielded batteries, wire entanglements, weak masonry, and light cover. Sufficient splinter effect even at the longest ranges.

With delay action: Effective against strong masonry; only effective against overhead cover when the angle of descent is sufficient.

Ricochet action increases the effect against living targets both in the open and behind cover.

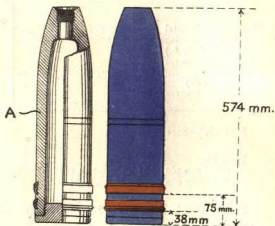
Remarks—

* Not a circular curve.

† In one case (*einteilig*); only 3·27 kg. (7·2 lbs.), when in two separate millboard cases.

15 cm. Gr. 03.

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 27 mm.

Thickness of base—52 mm.

Width of driving bands—23 mm

Distinctive markings—

1903 Pattern 15 cm. H.E. Shell with False Cap.

4.7 calibres long; 7.5 c.r.h.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
15 cm. experimental gun on wheeled carriage (Vers. K. & R. L.) (rifling, 48 grooves ?)	Gr. Z. 04	...	...	yards. —	yards. 21,107
15 cm. gun '16 ... (15 cm. K. 16) (rifling, 48 grooves ?)	Ditto	...	...	—	24,934

Material—Steel.

Weight—

Shell complete, 51 kg. approx. (112.4 lbs.).

Bursting charge, 3.68* kg. (8.11 lbs.).

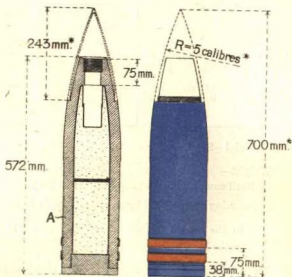
Employment—Same as for 15 cm. Gr. 03 (see page 158).

Remarks—

* See † on page 158.

15 cm. Gr. 03 (Haube).

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 27 mm.

Thickness of base—52 mm.

Width of driving bands—23 mm.

Distinctive markings—

* This dimension should be 7.5 calibres approx.

2 Pattern 15 cm. H.E. Shell with False Cap.

5.1 calibres long; 10 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. experimental gun on wheeled carriage (<i>Vers. K.i.R.L.</i>)	<i>Gr. Z. 04</i>	yards. —	yards. 21,107
15 cm. gun '16 (15 cm. <i>K. 16</i>) (rifling of both guns, 48 grooves?)	Ditto	—	24,934

Material—Steel.

Weight—

Shell complete, 51.5 kg. approx. (113.5 lbs.).

Bursting charge, 4.56 kg. approx. (10.0 lbs.). 0.42 kg. *Fp.* $\frac{60}{40}$

in the head, 1 kg. *Di.* in the body and 3.14 kg. *Di.* $\frac{60}{40}$
in the base.

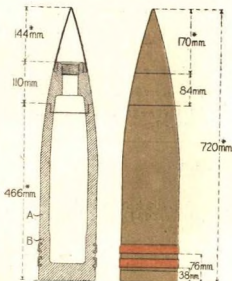
Employment—At long ranges; against traffic centres, such as railway stations; against towns, villages and billets.

Remarks—The false cap is welded in six places to a collar screwed on to the head of the shell. The driving bands are made with a reduced section in the centre, in order to economize copper.

In the bottom of the shell is a smoke producer weighing 0.3 kg. (0.66 lb.).

15 cm. Gr. (?) (Haube).

Calibre, 14.97 cm. (5.89").

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

Thickness of walls—At A, 24 mm. ; at B, 27 mm.

Thickness of base—45 mm.

Width of driving bands—23 mm.

Distinctive markings—

* Correction.—For the dimensions marked with an asterisk,
 720 mm., 466 mm., 170 mm., 144 mm., read :—
 762 mm., 512 mm., 166 mm., 140 mm.

1904 Pattern 15 cm. H. E. Shell.

3.3 calibres long ; 2 c.r.h.

Used with			Maximum range.	
Gun.	Fuze.		Time.	Perc'n.
(15 cm.) heavy field howitzer ...	<i>Gr. Z. 04</i> ...		yards.	yards.
	<i>Gr. Z. 96/04</i>		—	6,616
(15 cm.) heavy field howitzer '02 ...	Ditto ...		—	8,147
(15 cm.) heavy field howitzer '13 ... (rifling of the above, 36 grooves)	Ditto ...		—	9,296

Material—Steel.

Weight—

Shell complete, 40.5 kg. (89.3 lbs.).

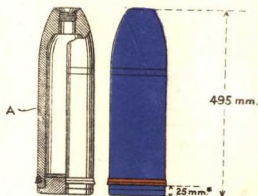
Bursting charge, 4.73 kg. (10.4 lbs.). *Fp. 02* (cast T.N.T. in a zinc casing).*

Employment—The effect is similar to that of the 1912 and 1912 n/A. patterns, but is slightly less (*see* pages 168 and 170).

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

* Shell 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 57.

1906 Pattern 15 cm. H.E. Shell.

4.1 calibres long; 5 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. gun on coast defence mounting 07 (rifling, 44 grooves?)	<i>lg. Bd. Z. 10*</i>	yards. —	yards. 8,530
15 cm. gun with overhead shield (i.S.L.) (rifling, 44 grooves?)	Ditto ...	—	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. in 2 millboard cases).

Employment—*Principal object* (with the 15 cm. coast defence gun): to engage living targets and thinly armoured vessels, defence of booms and mine-fields against torpedo attacks 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.

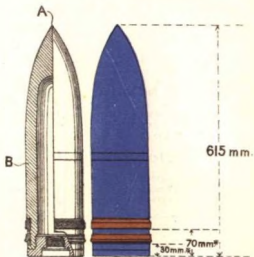
With delay action: it is used in bombardments and against stout masonry.

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 57.

1912 Pattern 15 cm. H.E. Shell.

3.7 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
15 cm. naval gun L/30 (rifling, grooves)	<i>Gr. Z. 04</i>	—	13,233(?)
15 cm. long gun	<i>Ditto</i>	—	10,936
(15 cm.) heavy field howitzer	<i>Gr. Z. 04</i>	6,616	6,616
	<i>Dopp. Z. 15</i>		
(15 cm.) heavy field howitzer '02...	<i>Ditto</i>	8,147	8,147
(15 cm.) heavy field howitzer '13...	<i>Ditto</i>	8,968	9,296
(rifling of the above 4 guns, 36 grooves)			
(15 cm.) long heavy field howitzer '13	<i>Ditto</i>	9,296	9,296
(rifling, 32 grooves)			
15 cm. (6") Russian long gun '04	<i>Ditto</i>	—	13,124
(rifling, 48 grooves)			

Weight—

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

Bursting charge, 6.1 kg. (13.4 lbs.) (3.9 kg. trinitro-anisole and 3.2 kg. dinitrobenzene).*

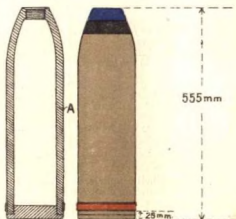
Employment—Same as for 15 cm. *Gr. 12 n/A.* (see page 170), omitting the para. referring to instantaneous fuze.

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

* Formerly 6 kg. (13.2 lbs.) *Grf. 88* (picric acid), stemmed into a millboard case.

15 cm. Gr. 12.

Calibre, 14.97 cm. (5.89").

SCALE $-\frac{1}{70}$.

Thickness of walls—At A, 19 mm.

Thickness of base—34 mm.

Width of driving band—15 mm.

Distinctive markings—A blue ring painted round the head of a shell above a black ring indicates a bursting charge consisting partly of dinitrobenzene and partly of amatol ($Fp. \frac{60}{40}$) or of $An. \frac{60}{40}$.

A black "R" painted on the base or shoulder indicates a smoke producer.

1912 n/A. Pattern 15 cm. H.E. Shell.

3.65 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
15 cm. naval gun L/30	<i>Gr. Z. 04</i>	—	13,233(?)
(rifling, grooves)			
15 cm. long gun	Ditto	—	10,936
(15 cm.) heavy field howitzer ...	<i>Gr. Z. 04</i>	6,616	6,616
	<i>Dopp. Z. 15</i>		
(15 cm.) heavy field howitzer '02	Ditto	8,147	8,147
(15 cm.) heavy field howitzer '13	Ditto	8,968	9,296
(rifling of the above 4 guns, 36 grooves)			
(15 cm.) long heavy field howitzer	Ditto	9,296	9,296
(rifling, 32 grooves)			

Material—Steel.

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

Bursting charge, 6.1 kg.* (13.4 lbs.).

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 non-delay fuze: good effect at living targets behind or under cover, even in high woods and localities; against *matériel*, especially shielded guns; against strong field fortifications, wire entanglements, solid masonry, concrete walls up to 3 ft. 3 in. thick, and light splinter-proof armour.

Sufficient effect against dug-outs that are not concreted, and concreted cover up to 20 inches thick.

With delay fuze: 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. Effective against cellars. Inappreciable effect against concrete.

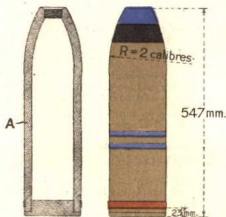
With time fuze: When burst low down, devastating effect on living targets either in the open or behind cover. Moral effect, considerable.

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

* Shown actually to consist of an additional picric acid exploder weighing 0.06 kg. (0.13 lb.), 1.9 kg. $An. \frac{60}{40}$, or $Fp. \frac{60}{40}$ in the head, and 4 kg. (8.8 lbs.) dinitrobenzene in the body of the shell.

15 cm. Gr. 12 n/A.

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.**Thickness of walls**—At A, 19 mm.**Thickness of base**—41 mm.**Width of driving band**—15 mm.

Distinctive markings—This shell is a variation of the 15 cm. Gr. 12, being 8 mm. shorter, with a base 7 mm. thicker. It is distinguished by two light blue rings painted round the cylindrical portion.

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

2·83 calibres long; 1 c.r.h.

Used with			Maximum range.	
Gun	Fuze.		Time.	Perc'n.
15 cm. naval gun L/30	<i>Gr. Z. 04</i> ...		yards.	yards.
(rifling. grooves) .	<i>Gr. Z. 96/04</i> ...		—	13,233(7)
15 cm. long gun	<i>Gr. Z. 04</i> ...	{	—	10,936
	<i>Gr. Z. 14</i> ...			
	<i>Gr. Zdg. 88*</i> ...			
(15 cm.) heavy field howitzer ...	<i>Gr. Z. 96/04</i> ...	{	—	9,296
(15 cm.) heavy field howitzer '02 ...	<i>Gr. Z. 04</i> ...			
(15 cm.) heavy field howitzer '13 ...	<i>Gr. Z. 14</i> ...			
15 cm. howitzer in turret ...	<i>Dopp. Z. 92</i> ..		7,218	7,874
(rifling of all of the above, 36 grooves)				

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—Same as for 15 cm. *Gr. 14*. It is less effective than the latter on account of its small burster.**Remarks**—The *Gr. Z. 14* fuze has probably been replaced by the *Gr. Z. 14 n/A.*, and the latter will probably be superseded in time by the instantaneous fuze *Gr. Z. 17*.

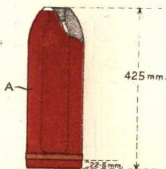
This shell when used with an incendiary filling is probably the shell known as 15 cm. *Brand-Gr. B.*, which is marked on the head with a small black B to distinguish it from the H.E. shell. Its maximum range is 8,147, 8,147 and 6,616 yards with the 3 above-mentioned types of heavy field howitzer, respectively. The inflammable material is similar to that contained in the 15 cm. *Brand-Gr. C.* (see page 150). 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 IX, X and XI) should be employed.

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

† Officially laid down as 1·5 kg. (3·3 lbs.).

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 ring painted round the head of a shell indicates a bursting charge of amatol ($Fp. \frac{60}{40}$).

A blue ring painted round the head of a shell indicates a bursting charge of dinitrobenzene and either T.N.T. or trinitroanisole.

1914 Pattern 15 cm. H.E. Shell.

2.83 calibres long; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
15 cm. naval gun L/30 ... (rifling, grooves)	<i>Gr. Z. 14</i> ...	—	13,233(?)
15 cm. long gun ... (rifling, 36 grooves)	<i>Gr. Z. 96/04</i> ... <i>Gr. Z. 04</i> ... <i>Gr. Z. 14</i> ... <i>Dopp. Z. 92</i> ...	10,936	10,936
15 cm. Belgian gun '90, on wheeled carriage	<i>Gr. Z. 04</i> ...	—	at least 10,335
15 cm. (6") Russian long gun '04 (48 grooves)	<i>Gr. Z. 04</i> ...	—	13,124
(15 cm.) heavy field howitzer	<i>Gr. Zdg. 88*</i> ...	6,452	6,616
(15 cm.) heavy field howitzer '02	<i>Gr. Z. 96/04</i> ... <i>Gr. Z. 04</i> ...	8,147	8,147
(15 cm.) heavy field howitzer '13	<i>Gr. Z. 14</i> ... <i>Gr. Z. 14 n/A</i> ... <i>Dopp. Z. 92 lg. Brlg.</i>	9,296	9,296
(rifling of the above three howitzers, 36 grooves)			
(15 cm.) long heavy field howitzer '13	<i>Gr. Z. 14</i> ... <i>Dopp. Z. 92 lg. Brlg.</i>	9,296	9,296
(rifling, 32 grooves)			
15 cm. howitzer in turret (rifling, 36 grooves)	<i>Dopp. Z. 92</i> ...	7,218	7,874
15 cm. (6") Russian howitzer	<i>Gr. Z. 04</i> ...	—	—

Material—Cast steel.**Weight**—

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

Bursting charge, 2.3 kg. (5.1 lbs.). Amatol.

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.

With instantaneous fuze: against living targets and *matériel* in the open.

The radius of action of each projectile is less than that of the 1912 *n/A*. pattern 15 cm. shell (see page 170). Against overhead cover the 1914 pattern 15 cm. shell is more effective than the 1914 A pattern (see page 172).

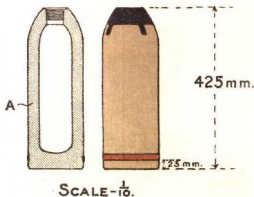
Remarks—The *Gr. Z. 14* fuze has probably been replaced by the *Gr. Z. 14 n/A*, and the latter will probably be superseded in time by the instantaneous fuze *Gr. Z. 17*.

The range tables of the 1888 pattern 15 cm. shell (see Appendices IX, X, XI and XII) should be employed.

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

15 cm. Gr. 14.

Calibre, 14.97 cm. (5.89").



Thickness of walls—At A, 30 mm.

Thickness of base—44 mm.

Width of driving band—15 mm.

Distinctive markings—A black ring painted round the head of a shell indicates a bursting charge of amatol (*Exp.* $\frac{60}{40}$).

A blue ring painted round the head indicates a bursting charge of dinitrobenzene and either T.N.T. or trinitroanisole.

The 4 vertical black stripes denote that the fuze hole will take a *Dopp. Z. 92* fuze.

Yellow colouring, instead of grey, indicates a shell for use with captured Russian guns.

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

A black "R," painted on the base or shoulder, indicates a smoke producer.

This shell, when used with captured Russian 15.24 cm. (6") guns, is fitted with a thicker driving band to compensate for the difference in calibre (2.7 mm. or 0.1 inch), and is coloured dark yellow with a black head and " ϕ 15, 24" stencilled on the shoulder.

1914 Pattern 15 cm. H.E. Shell with False Cap.

4.5 calibres long ; 7 c.r.h. (?)

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
(15 cm.) long heavy field howitzer '13 (rifling, 32 grooves)	<i>Gr. Z. 14 n/A...</i> <i>Gr. Z. 17</i>	...		yards.	yards.
15 cm. long gun ... (rifling, 36 grooves)	Ditto	...	...	—	over. 9,296
15 cm. Belgian gun ...	Ditto	...	..	—	
15 cm. Belgian heavy gun (rifling of the above 2 guns, either 36 or 40 grooves)	Ditto	...	...	—	

Material—Steel.

Weight—

Shell complete, 43.5 kg. (95.9 lbs.).

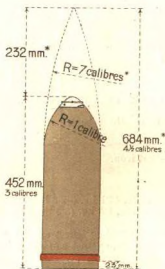
Bursting charge, 2.3 kg. (5.1 lbs.).

Employment—Same as for 15 cm. *Gr. 14* (see page 174) but at longer ranges.

Remarks—

15 cm. Gr. 14 (Haube).

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 30 mm.

Thickness of base—44 mm.

Width of driving band—15 mm.

Distinctive markings—

* Dimensions approximate only.

1914 A Pattern 15 cm. H.E. Shell with Forward Driving Band.

2.83 calibres long; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. gun with chase rings (<i>Ringkanone</i>)	<i>Gr. Zdg. 88*</i>	yards.	yards.
	<i>Gr. Z. 96/04 ...</i>	—	8,640
	<i>Gr. Z. 04 ...</i>		
	<i>Gr. Z. 14 ...</i>		
15 cm. long gun with chase rings (<i>lange Ringkanone</i>) (rifling of both the above, 24 grooves)	<i>Gr. Z. 14n/A.</i> Ditto ...	—	8,749

Material—Cast iron.

Weight—

Shell complete, 42.1 kg. (92.8 lbs.).

Bursting charge, 1.5 kg. (3.3 lbs.). Amatol.

Employment—Sufficient effect against living targets, even in high woods or localities, against *matériel*, shielded guns, and light cover.

Remarks—A variation of this shell has been found on which there are only two lower driving bands (each 4 mm. wide) instead of three; the upper band is 17 mm. wide and 206 mm. above the base.

There is also a 1914 pattern 15 cm. H.E. shell with forward driving band (*15 cm. Gr. 14 m.v.F.*), more effective than the 1914A pattern, which differs from the latter in the following particulars:—

Colour—Grey.

Bursting charge—2.3 kg. (5.1 lbs.).

Fuze—*Gr. Z. 14 n/A.* and *Dopp. Z. 92* (in addition to those given above).

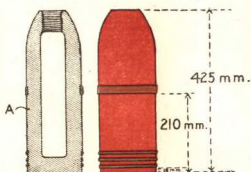
Thickness of walls—

For range table for all these shell, with 15 cm. gun with chase rings, see Appendix VIII.

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

15 cm. Gr. 14 A m.v.F.

Calibre, 14.97 cm. (5.89").

SCALE $\frac{1}{10}$

Thickness of walls—At A, 40 mm.

Thickness of base—42.5 mm.

Width of driving bands—Upper band, 20 mm.; lower bands 4.5 mm., and 11.5 mm. apart.

Distinctive markings—

20.3 cm. German H.E. Shell for captured Russian 20.3 cm. Howitzer.

2.8 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
Russian 20.3 cm. (8") howitzer (<i>russ.</i> 20 cm. H. 77 n. 92) (rifling, 46 grooves)	<i>Gr. Z. 04</i>	yards.	yards.
	<i>Gr. Z. 04/14</i>	—	9,515

Material—Cast iron.

Weight—

Shell complete, 88.7 kg. (195.6 lbs.).

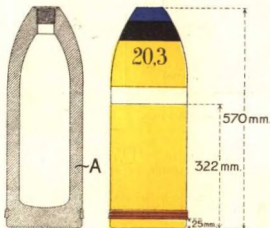
Bursting charge, kg. (lbs.).

Employment—

Remarks—For range table, see Appendix XX.

Deutsche 20·3 cm. Gr. für russ. Haubitze.

Calibre, 20·3 cm. (8").

SCALE — $\frac{1}{10}$.

Thickness of walls—At A, 32 mm.

Thickness of base—50 mm.

Width of driving band—21 mm.

Distinctive markings—A blue ring painted round the head of a shell above a black ring indicates a bursting charge consisting partly of dinitrobenzene and partly of amatol ($Fp. \frac{60}{40}$), or of $An. \frac{60}{40}$. On the shoulder is stencilled in black either “ ϕ 20,3” or “20,3” (the calibre).

1880 Pattern 21 cm. Common Shell.

2·5 calibres long; 1·5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
21 cm. howitzer in turret (rifling, 30 grooves)	<i>Gr. Z. 82 (Kp.)</i> ...	yards. —	yards. 8,749

Material—Cast iron.

Weight—

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

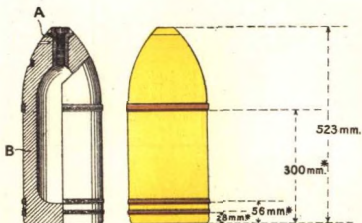
Bursting charge, 4·45 kg. (9·8 lbs.). Black powder.

Employment—Sufficient effect against living targets (secondary effect), *matériel*, field wire entanglements and masonry.

Remarks—

21 cm. Gr. 80. (P.).

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—Shell of less recent manufacture are painted red with yellow head.

* Measurement approximate only, see footnote on page 57.

1883 Pattern 21 cm. H.E. Shell.

3.9 calibres long ; 1.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Pero'n.
		yards.	yards.
21 cm. mortar* (rifling, 64 grooves)	<i>Gr. Z. 04.</i> ...	—	7,327
	<i>Gr. Z. 96/04</i>		
	<i>Gr. Z. 96</i>		
Mortar* (rifling, 64 grooves)	Ditto ...	—	9,733
21 cm. bronze mortar (rifling, 30 grooves)	Ditto ...	—	7,000(?)

Material—Steel.**Weight**—

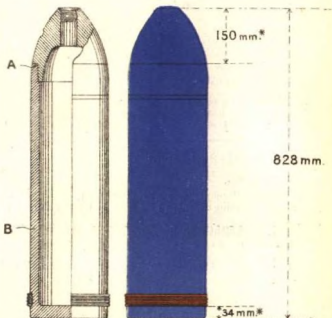
Shell complete, 119 kg. (262.3 lbs.).

Bursting charge, 17.39 kg. (38.3 lbs.). *Grf. 88* (cast picric acid in a millboard case).**Employment**—**Remarks**—

This shell no longer figures in the official German Ammunition Book.

* 21 cm. Mortar is the older pattern mortar introduced in 1902: a later pattern, introduced in 1910 is called Mortar (*Mörser*) without specifying the calibre.

21 cm. Gr. 83.
Calibre, 21.1 cm. (8.3").



SCALE — $\frac{1}{10}$.

Thickness of walls—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 57.

1888 Pattern 21 cm. H.E. Shell.

2·4 calibres long ; 2 c.r.h.

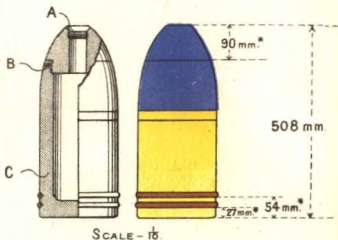
Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
21 cm. mortar* (rifling, 64 grooves)	<i>Gr. Z. 04</i> <i>Gr. Z. 96/04</i>	—	8,968
Mortar* (rifling, 64 grooves)	Ditto	—	9,952
21 cm. bronze mortar (rifling, 30 grooves)	Ditto	—	8,530

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**—Similar to that of the 1914A pattern (*see* page 198).**Remarks**—For range tables, *see* Appendices XIV and XVI.* *See* footnote on page 188.

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 57.

1896 Pattern 21 cm. H.E. Shell.

4.1 calibres long ; 2 c.r.h. ; base fuze.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
				yards.	yards.
21 cm. mortar* ...	<i>Bd. Z. 06</i> ...			—	7,874
(rifling, 64 grooves)					
Mortar * ...	<i>lg. Bd. Z. 10</i> ...			—	10,280
(rifling, 64 grooves)					

Material—Steel.

Weight—

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

Bursting charge, 16.93 kg.† (37.3 lbs.). *Fp. 02* or *Grf. 88* (cast T.N.T. or picric acid in 2 millboard cases).

Employment—Same as for 21 cm. *Gr. 96 n/A.* (see page 194).

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 194.

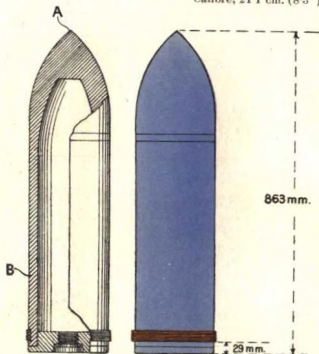
The 21 cm. *Gr. 96* is fired from the 21 cm. mortar and the 21 cm. *Gr. 96 (umg.)* from the "mortar."

* See footnote on page 188.

† Officially laid down as 17.47 kg. (38.5 lbs.) for the 21 cm. *Gr. 96 (umg.)*.

21 cm. Gr. 96.

Calibre, 21.1 cm. (8.3").

**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 57.
(N 13641)

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

4 calibres long; 2 c.r.h.; base fuze.

Used with			Maximum range.	
Gun.		Fuze.	Time.	Perc'n.
			yards.	yards.
21 cm. mortar* ...	...	kz. Bd. Z. 10 ...	—	7,874
(rifling, 64 grooves)				
"Mortar" (21 cm.) ...	...	" ...	—	10,280
(rifling, 64 grooves)				
Long mortar (21 cm.) ...	...	" ...	—	11,155
(rifling, grooves)				

Material—Steel.

Weight—

Shell complete, 120 kg. (264.5 lbs.).

Bursting charge, 17.47 kg.+ (38.5 lbs.). *Fp. 02* (cast T.N.T. in 2 red millboard containers).

Employment—*With non-delay 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. Satisfactory effect can only be obtained with a large expenditure of ammunition.

Against stronger cover the effect is insufficient, but secondary effects can be obtained.

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. Small effect against very thick concrete structures, off which the projectile ricochets, even when fired at maximum angles of elevation. No effect against armour.

Remarks—An order, dated 9.5.18, states that in order to economize explosives this shell will be issued with an ammonium nitrate filling, designated "*Sprengstoff Nr. 26*."

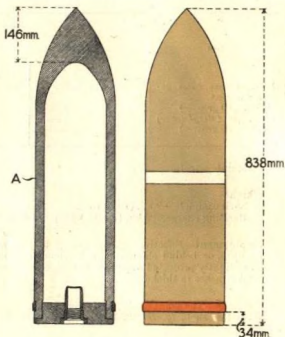
For range tables, see Appendices XIII and XV.

* "21 cm. Mortar" is the oldest pattern mortar introduced in 1902; a later pattern introduced in 1910, is called "Mortar" (*Mörser*) without specifying the calibre. The latest pattern is called "Long mortar" (*langer Mörser*).

+ Officially laid down as 18.32 kg. (40.38 lbs.).

21 cm. Gr. 96 n/A.

Calibre, 21.1 cm. (8.3").

SCALE — $\frac{1}{10}$

Thickness of walls—At A, 22 mm.

Thickness of base—55 mm.

Width of driving band—24 mm.

Distinctive markings—A white ring round the cylindrical portion denotes that the bursting charge is set in magnesium cement.

1906 Pattern 21 cm. H.E. Shell.

2.4 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
21 cm. bronze coast defence mortar (rifling, 30 grooves)	<i>lg. Bd. Z. 10*</i> ...	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.).

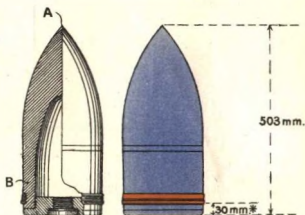
Employment—Effective against living targets and *matériel* in the open, or behind shields or light armour; against non-protected or lightly protected upper works and nickel-steel decks up to about 2 inches in thickness.

Remarks—The point of the shell is hardened.

With this shell, *lg. Bd. Z. 10* is only used set for non-delay action.

* 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 57.
 (n 13641)

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

2·4 calibres long ; 1·5 c.r.h.

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

Material—Cast iron.

Weight—

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

Bursting charge, 6·3 kg. (13·9 lbs.).

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

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

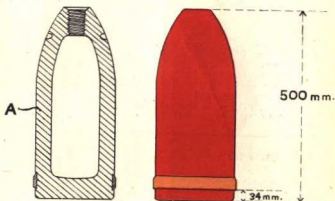
The effect is inferior to that of the 1914 pattern shell.

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

* *See footnote on p. 188.*

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—

1914 Pattern 21 cm. H.E. Shell.

2.4 calibres long; 1.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
21 cm. mortar* (rifling, 64 grooves)	<i>Gr. Z. 04</i> <i>Gr. Z. 04/14</i>	yards.	yards.
"Mortar" (21 cm.)... .. (rifling, 64 grooves)	Ditto	—	8,968
"Long mortar" (21 cm.) (rifling, grooves)	Ditto	—	9,952
21 cm. Belgian howitzer '89 (rifling, 48 grooves)	Ditto	—	10,280

Material—Steel.

Weight—

Shell complete, 83.7 kg. (184.5 lbs.).

Bursting charge, 7.7 kg. (17.0 lbs.).

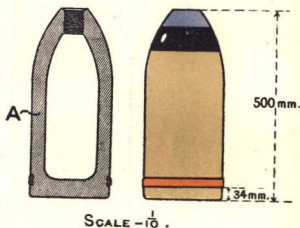
Employment—*With non-delay action* (at low angles of elevation): good effect against living targets (secondary effect), *matériel*, field wire entanglements, light cover and stout masonry.

With delay action (at high angles of elevation): 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. 194.

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



Thickness of walls—At A, 35 mm.

Thickness of base—47 mm.

Width of driving band—23 mm.

Distinctive markings—A blue ring painted round the head of a shell above a black ring indicates a bursting charge consisting partly of dinitrobenzene and partly of amatol ($Fp. \frac{60}{40}$) or of $An. \frac{60}{40}$.

A black "R" painted on the base or shoulder indicates a smoke producer.

1917 Pattern 21 cm. H.E. Shell.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.

Material—

Weight—

Employment—

Remarks—Issued with an ammonium nitrate filling known as
"Sprengstoff Nr. 26."

21 cm. Gr. 17.

Calibre, 21.1 cm. (8.3")

Thickness of walls—

Thickness of base—

Width of driving bands—

Distinctive markings—

1906 Pattern 28 cm. H.E. Shell.

3·5 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
28 cm. coast defence howitzer (rifling, grooves)	<i>lg. Bd. Z. 10*</i> ...	yards.	yards.
	<i>kz. Bd. Z. 10*</i> ...	—	12,467
		—	12,467

Material—Steel.

Weight—

Shell complete, 350 kg. (771·6 lbs.).

Bursting charge, 11·38 kg.† (25·1 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.

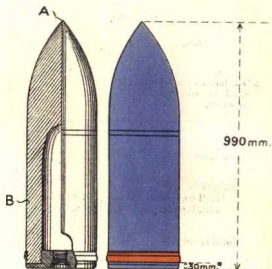
Remarks—In addition to the 28 cm. *Gr. 06*, there is a 28 cm. *Lggr.* (28 cm. *Langgranate*) or long shell, of which the following details are available: It has a maximum range of 10,608 yards, and should be employed at ranges below 4,375 yards in preference to 28 cm. *Gr. 06*. It has a considerably larger bursting charge than 28 cm. *Gr. 06*, viz., 29·4 kg. (64·8 lbs.).

* Shell 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*.

† Prior to 1911, 10·01 kg. (22·0 lbs.). *Fp. 02*.

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 57.

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

3.6 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
28 cm. howitzer on wheeled carriage (rifling, grooves).	<i>kz. Bd. Z. 10 ...</i>	yards. —	yards. 12,030

Material—Steel.**Weight**—

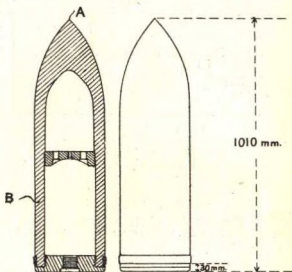
Shell complete, 338 kg. (745.2 lbs.).

Bursting charge, 52 kg. (114.6 lbs.)

Employment—**Remarks**—

28 cm. Gr. (12 ?).

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



SCALE— $\frac{1}{15}$.

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 30·5 cm. H.E. Shell.

3·4 calibres long; 1·5 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
30·5 cm. heavy coast defence howitzer '96 (?)	<i>kz. Bd. Z. 10</i>	yards. —	yards. 9,624
30·5 cm. heavy coast defence howitzer '09 (?) (rifling, 88 grooves) (?)	"	—	13,014

Material—Steel.

Weight—Shell complete, 333 kg. (734 lbs.).

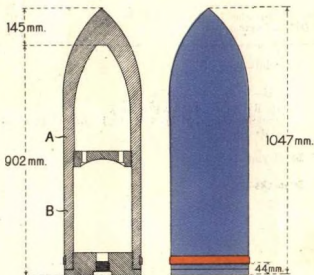
Bursting charge, 36 kg. approx. (79·4 lbs.) in cotton bags.

Employment—

Remarks—The diaphragm is pierced by 4 holes; these are filled with H.E., which transmits the detonation from the lower to the upper charge.

30.5 cm. Gr. (?).

Calibre, 30.5 cm. (12").



SCALE— $\frac{1}{15}$.

Thickness of walls—At A, 39 mm. ; at B, 35 mm.

Base plug—Diameter, 300 mm. ; thickness, 90 mm.

Width of driving band—30 mm.

Distinctive markings—

30.5 cm. Austrian H.E. Shell.

3.6 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
30.5 cm. Austrian howitzer (rifling, 68 grooves)	Z.F.M. 9* ...	yards. —	yards. 13,998

Material—Steel.

Weight—

Shell complete, 383 kg. (844 lbs.).

Bursting charge, 37 kg. (81.6 lbs.). *Ekrasit* (a nitrate of cresol).

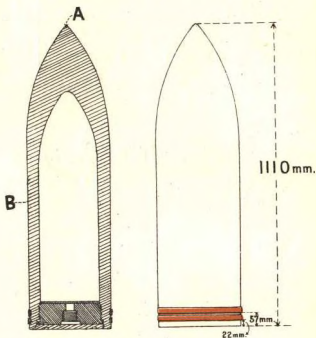
Employment—

Remarks—

* *Zünder-Vorrichtung Muster 9* (1909 pattern fuze).

30.5 cm. Gr. (Austrian).

Calibre, 30.5 cm. (12.0").

SCALE — $\frac{1}{15}$.

Thickness of walls—At A, 240 mm ; at B, 44 mm.

Base plug—Diameter, 242 mm. ; thickness, 72 mm.

Base plate—Diameter, 252 mm. ; thickness, 15 mm.

Width of driving bands—Upper band, 28 mm. ; lower, 22 mm.

Distinctive markings—

42 cm. H.E. Shell (with diaphragm).

3.7 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
42 cm. mortar (rifling, 120 grooves)	<i>kz. Bd. Z. 10</i> ...	yards. —	yards. 15,530(?)

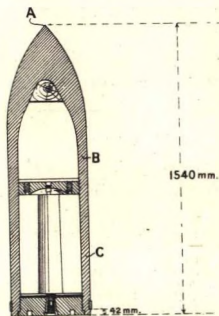
Material—Steel.**Weight**—

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**—

42 cm. Gr.

Calibre, 42 cm. (16.54").



SCALE - 20.

Thickness of walls—At A, 300 mm.; at B, 52 mm.; at C, 48 mm.

Base plug—Diameter, 370 mm.; thickness, 100 mm.

Width of driving band—50 mm.

Distinctive markings—

42 cm. H.E. Shell (without diaphragm).

3.6 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
42 cm. mortar (rifling, 120 grooves)	<i>kz. Bd. Z. 10...</i>	yards. —	yards. 15,530(?)

Material—Steel.

Weight—

Shell complete, 796 kg. (1,755 lbs.).

Bursting charge, 137.6 kg. (303.2 lbs.). *Fp. 02* (cast T.N.T.).

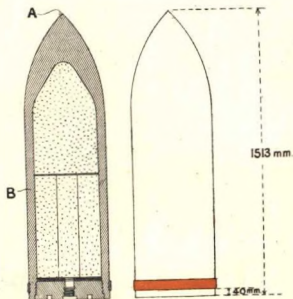
Employment—Principally employed against permanent fortifications, but is also used for bombarding towns and field defences.

Remarks—This shell is of more recent pattern than the shell described on pages 214 and 215.

The two shells are practically identical in appearance, but in that of the later pattern, the thickness of the walls has been reduced and the wooden plug and steel diaphragm discarded. This has reduced the total weight, while allowing of a larger bursting charge. The latter is in two portions, the upper of which is cast directly into the shell, while the lower is contained in a cotton wrapper and is cast with a central core, in two operations.

42 cm. Gr.

Calibre, 42 cm. (16.54").

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

Thickness of walls—At A, 258 mm.; at B, 42 mm.

Base plug—Diameter, 372 mm.; thickness, 90 mm.

Width of driving band—50 mm.

Distinctive markings—

Converted 1896 Pattern 7.7 cm. Field Gun Shrapnel.

3.3 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Pere'n.
(7.7 cm.) field gun 96 n/A.	<i>Dopp. Z. 96 n/A.</i>	yards.	yards.
(7.7 cm.) field gun '16	...	7,655*	9,186
(rifling of both guns, 32 grooves)	"	6,562†	6,562‡

Material—Steel.

Weight—

Shell complete, 6.82 kg. (15.04 lbs.).

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

Bullets—300 10-g. lead bullets, 45 to the lb., set in resin, black powder and paraffin wax, or 220 steel bullets set in pitch.

Employment—*As time shrapnel*: against all living targets, except such as are close behind cover. Repulse of attacks at close quarters (case shot effect). Bombardment of rearward communications and flanking fire.

As percussion shrapnel: bombardment of villages, houses, woods, and observation posts in haystacks, &c., when incendiary effect is required.

Remarks—The original 7.7 cm. shrapnel was known as the '96 pattern, *F. Schr. 96*. The shrapnel case was made in one piece and was fitted with a small adapter ring. The modern pattern, known as the converted '96 pattern, *F. Schr. 96 (umg.)*, is fitted with a screwed head (*see plate*).

For range table, *see* Appendices I, II and IIA.

* Fuzes graduated up to 7,150 metres (7,820 yards) have been found.

† Fuzes are graduated up to 7,000 metres (7,655 yards).

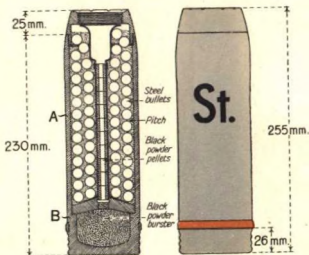
‡ Maximum range with charge No. 1; charge No. 2 is not used with shrapnel.

F. Schr. 96 (umg.).

Fixed ammunition for 96 n/A. field gun; designation of a complete round, *F. Schr. Patr. 96 (umg.)*.

Separate ammunition for '16 field gun.

Calibre, 7.7 cm. (3.0").



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—Shrapnel marked with "St." contain steel bullets.

1882 Pattern 9 cm. Gun Shrapnel.

2·3 calibres long; 1 c.r.h.

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

Material—Cast iron.

Weight—

Shell complete, 8·1 kg. (17·8 lbs.).

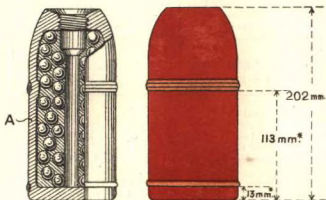
Bursting charge, 0·0225 kg. (0·05 lb.). Black powder.

Bullets—262 13-g. lead bullets, 35 to the lb., set in sulphur.

Employment—

Remarks—An obsolete shrapnel, which no longer figures in the German Ammunition Book.

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 57.

1891 Pattern 9 cm. Gun Shrapnel.

2·2 calibres long ; 1·5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
9 cm. gun '73/'88 ... (rifling, 24 grooves)	<i>Dopp. Z. 91</i> ...	yards. 4,921	yards. 7,109

Material—Steel.

Weight—

Shell complete, 7·5 kg. (16·5 lbs.).

Bursting charge, 0·045 kg. (0·01 lb.). Black powder.

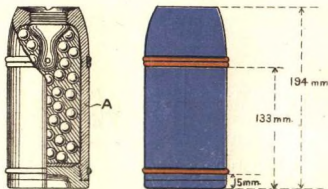
Bullets—285 11·1-g. lead bullets, 41 to the lb., in a copper container. The bullets are set in black powder.

Employment—Sufficient effect at living targets in the open.

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

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 indicate 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.

9.5 cm. German Shrapnel for French 95 mm. Gun.

3 calibres long ; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
French 95 mm. gun (<i>franz.</i> 95 mm. <i>K.</i>) (rifling, 28 grooves)	<i>Dopp. Z. 92 f.</i> <i>10 cm. K.</i>	yards.	yards.

Material—Steel.

Weight—

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

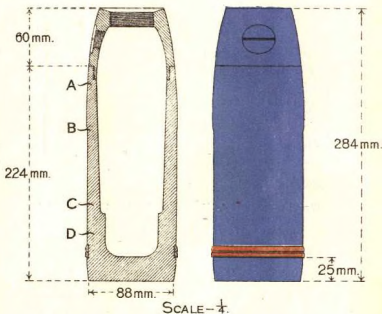
Bullets— 11.1-g. steel bullets, 41 to the lb.

Employment—

Remarks—The interesting feature in the design of this shell is the tapered base.

9.5 cm. Schr. for French Gun.

Calibre, 9.5 cm. (3.7").



Thickness of walls—At A, 9 mm.; at B, 11 mm.; at C, 14 mm.; at D, 19 mm.

Thickness of base—25 mm.

Width of driving band— mm.

Distinctive markings—

1916 Pattern Light Field Howitzer Shrapnel.

3.1 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(10.5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	<i>H.Z. 05 Schr. ...</i>	yards. 7,655	yards. 7,655*
(10.5 cm.) light field howitzer '16 (rifling, 32 grooves)	"	7,655	9,186†
(10.5 cm.) light field howitzer, Krupp (rifling, grooves)	"	7,655	9,733‡

Material—Steel.

Weight—

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

Bursting charge, 0.17 kg. (0.37 lb.).

Bullets—450 11-g. steel bullets, 41 to the lb., set in pitch.

Employment—*As time shrapnel*: against all living targets except such as are close behind cover. Repulse of attacks at close quarters (case shot effect). Bombardment of rearward communications (flanking fire).

As percussion shrapnel: bombardment of villages, houses, woods, and observation posts in haystacks, &c., when incendiary effect is required.

The effect is greater than that of the 1896 pattern field gun shrapnel.

Remarks—For range table, see Appendix III.

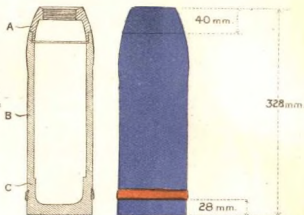
* With Charge No. 8: the usual maximum range is 6,890 yards with Charge No. 7.

† With Charge No. 9: the usual maximum range is 6,999 yards with Charge No. 7.

‡ With Charge No. 10: the usual maximum range is 6,452 yards with Charge No. 8.

F.H. Schr. 16.

Calibre, 10.5 cm. (4.13").

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

Thickness of walls—At A, 8 mm. ; at B, 10 mm. ; at C, 16 mm.

Thickness of base—16 mm.

Width of driving band—12 mm.

Distinctive markings—A black band or the letters "St." stencilled in black indicate steel bullets.

1896 Pattern 10 cm. Gun Shrapnel.

3.1 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
10 cm. gun '04, 10 cm. gun	<i>Dopp. Z. 92 f. 10 cm. K.</i>	9,296	12,085
	<i>Dopp. Z. 92 K. 15 ...</i>		
	<i>Dopp. Z. 92 lg. Brlg. ...</i>	12,085	12,085
10 cm. gun '14, 10 cm. gun '97	<i>Dopp. Z. 92 f. 10 cm. K.</i>	9,077	11,264
	<i>Dopp. Z. 92 K. 15 ...</i>		
	<i>Dopp. Z. 92 lg. Brlg. ...</i>	11,264	11,264
10 cm. gun with overhead shield			
10 cm. gun in turret ...	<i>Dopp. Z. 92 f. 10 cm. K.</i>	9,296	11,811
10 cm. gun, reinforced, in turret	<i>Dopp. Z. 92 K. 15 ...</i>		
10 cm. short gun in turret (rifling of the above guns, 32 grooves)	<i>Dopp. Z. 92 f. 10 cm. K.</i>	8,640	10,608
	<i>Dopp. Z. 92 K. 15 ...</i>		

Material—Steel.

Weight—

Shell complete, 16.0 kg. (35.3 lbs.).

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

Bullets—506 11.5-g. steel bullets, 40 to the lb., set in pitch.

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 original pattern weighs 17.9 kg. (39.5 lbs.), and contains 680 11.1-g. bullets, 41 to the lb. The bullets are of a lead-antimony alloy. 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").

Thickness of walls—At A, 6 mm. ; at B, 9 mm. ; at C, 12 mm. ; at D, 16 mm.

Thickness of base—17 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. In specimens found recently this red ring is 50 mm. wide and is situated immediately above the driving band.

A red head denotes that the shrapnel contains short lengths of chain for use against aerial targets.

A black ring round the cylindrical portion denotes steel bullets set in pitch.

The shoulder is greased instead of being painted.

12 cm. German Shrapnel for French 120 mm. Long Gun.

2.5 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
French 120 mm. long gun (<i>franz.</i> <i>lg. 120 mm. K.</i>) (rifling, 36 grooves)	<i>Dopp. Z. 92 K. 15</i> <i>Dopp. Z. 92 f. 10</i> <i>cm. K.</i>	yards.	yards.

Material—Steel.

Weight—

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

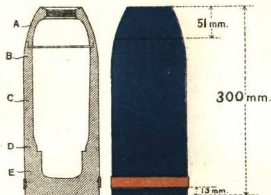
Bullets—

Employment—

Remarks—

12 cm. Schr. for French Gun.

Calibre, 12.0 cm. (4.7").



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

Thickness of walls—

- At A, 8 mm.
- At B, 9 mm.
- At C, 14 mm.
- At D, 19 mm.
- At E, 26 mm.

Thickness of base—27 mm.

Width of driving band—17 mm.

Distinctive markings—

1880/1892 Pattern 12 cm. Gun Shrapnel.

2·2 calibres long ; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
12 cm. heavy gun... (rifling, 30 grooves)	<i>Dopp. Z. 92</i> ...	yards. 7,218	yards. 7,983

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. lead bullets, 35 to the lb., set in sulphur.

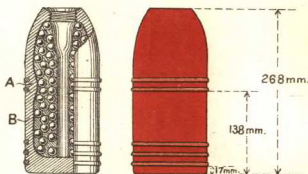
Employment—Good effect against living targets in the open or insufficiently covered, silhouetted targets and captive balloons.

Remarks—A variation of this shrapnel, manufactured in 1916, has been found with 4 driving bands instead of 5. Of the 3 bands near the base shown in the plate opposite, the upper one is omitted.

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. (11 mm. apart).

Distinctive markings—

1915 Pattern 12 cm. Shrapnel.

2.5 calibres long; 2 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
12 cm. heavy gun ... (rifling, 30 grooves)	<i>Dopp. Z 92</i> ...	yards. 7,218	yards. 7,983

Material—Steel.

Weight—

Shell complete, 20.16 kg. (44.4 lbs.).
Bursting charge,

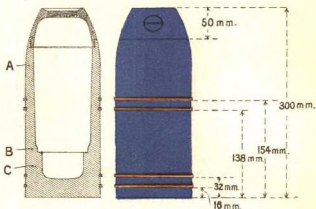
Bullets—

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

Remarks—

For range table, see Appendix VI.

12 cm. Schr. 15.
Calibre, 12.03 cm. (4.73")



SCALE— $\frac{1}{6}$.

Thickness of walls—At A, 10 mm.; at B, 19 mm.; at C, 27 mm.

Thickness of base—28 mm.

Width of driving bands—4.5 mm.

Distinctive markings—

13 cm. Gun Shrapnel.

3.5 calibres long; 6 c.r.h.*

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
13 cm. gun ... (rifling, 36 grooves)	<i>Dopp. Z. 92 f. 10 cm. K.</i> <i>Dopp. Z. 92 K. 15</i> <i>Dopp. Z. 92 lg. Brlg. ...</i>	yards.	yards.
		10,936	15,311
		15,311	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—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.

Indifferent incendiary effect when fired as percussion shrapnel.

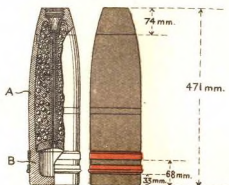
Remarks—The space between the bullets is filled up near the base of the shell with molten resin, in the centre part with black powder, and in the upper part with a mixture of resin and paraffin wax.

For range table, see Appendix VII.

* 3 c.r.h. head, 6 c.r.h. shoulder.

13 cm. Schr.

Calibre, 13.5 cm. (5.31").

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

Thickness of walls—At A, 16 mm. ; at B, 28 mm.

Thickness of base—23 mm.

Width of driving bands—24 mm.

Distinctive markings—One red ring round the cylindrical portion indicates that the bullets are set in resin, while two red rings indicate bullets set in resin and increased thickness of walls.

1880/1892 Pattern 15 cm. Shrapnel.

2·3 calibres long; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Pere'n.
15 cm. gun (<i>lange Ringkanone</i>) (rifling, 24 grooves)	<i>Dopp. Z. 92</i>	yards. 7,655	yards. 7,655
15 cm. gun (<i>Ringkanone</i>) (rifling, 24 grooves)	"	7,546	7,546

Material—Cast iron.**Weight**—

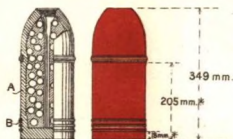
Shell complete, 39·6 kg. (87·3 lbs.)

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

Bullets—633 28-g. bullets, 16 to the lb., set in sulphur.**Employment**—Good effect against living targets in the open or insufficiently covered, and against captive balloons.**Remarks**—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, 19 mm. ; lower bands, 4 mm.* (12 mm. apart).

Distinctive markings—

* Measurement approximate only, *see* footnote on page 57.

1892 Pattern 15 cm. Shrapnel.

2·6 calibres long; 1·5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. long gun ... (rifling, 36 grooves)	... <i>Dopp. Z. 92</i> ...	yards. 8,968	yards. 10,936

Material—Steel.

Weight—

Shell complete, 41·2 kg. (90·8 lbs.).

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

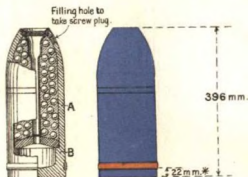
Bullets—1,320 11·1-g. lead bullets, 41 to the lb., set in resin.

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

Remarks—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 57.

1903 Pattern 15 cm. Shrapnel.

3·4 calibres long; 6 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. gun with over-head shield (i.S.L.) (rifling, 44 grooves?)	<i>Dopp. Z. 92 f. 10 cm. K.</i>	yards.	yards.
	<i>Dopp. Z. 92 K. 15</i>	10,718	17,060
	<i>Dopp. Z. 92 lg. Brlg. ...</i>	16,186	17,060
15 cm. gun on coast defence mounting '07 (rifling, 44 grooves?)	<i>Dopp. Z. 92 f. 10 cm. K.</i>	8,530	8,530
	<i>Dopp. Z. 92 K. 15</i>		

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. set in resin.

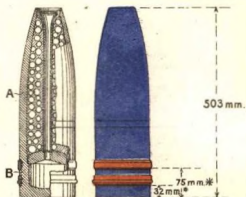
Employment—Good effect against living targets in the open or insufficiently covered, against detraining stations and parks, and to prevent the enemy deploying and forming up.

Suitable also for firing at captive balloons at long ranges.

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

Remarks—There is a variation of this shell called *15 cm. Schr. 03 (ung.)* 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—

* Measurement approximate only, see footnote on page 57.

(?) Pattern 15 cm. Shrapnel with False Cap.

4.8 calibres long ; 9 c.r.h.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
15 cm. experimental gun on wheeled carriage (<i>Vers. K.J.R.L.</i>) (rifling, 48 grooves ?)	<i>Dopp. Z. 16</i>	...	...	yards. at least 18,592	yards.
15 cm. gun '16 (?) (rifling, 48 grooves ?)	Ditto	...	...	at least 18,592	

Material—Steel.**Weight**—

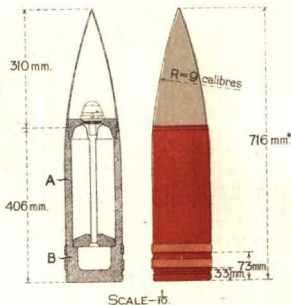
Shell complete, 51.4 kg. approx. (113.3 lbs.).

Bursting charge, 0.545 kg. approx. (1.2 lbs.).

Bullets— 11.1-g. lead bullets, 41 to the lb.**Employment**—Against living targets in the open or under light cover ; against kite balloons. Against shielded batteries, it is effective only in connection with enfilade fire.**Remarks**—

15 cm. Schr. (Haube) (?).

Calibre, 14.97 cm. (5.89").



Thickness of walls—At A, 20 mm. ; at B, 30 mm

Thickness of base—35 mm.

Width of driving bands—25 mm.

Distinctive markings—Possibly the point is painted black.

1903 (gr.)* Pattern 15 cm. Shrapnel.

3.3 calibres long ; 7.6 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. gun with overhead shield (i.S.L.) (rifling, 44 grooves f)	<i>Dopp. Z. 16</i> ...	yards. about 17,060	yards.
	<i>Dopp. Z. 92 lg. Brlg.</i> ...	16,186	17,060
	<i>Dopp. Z. 92 f. 10 cm. K.</i> ...	10,718	17,060
	<i>Dopp. Z. 92 K. 15</i> ...	about 18,600	
15 cm. experimental gun on wheeled carriage (i.R.L.) (rifling, 48 grooves f)	<i>Dopp. Z. 16</i> ...	16,404	18,592
	<i>Dopp. Z. 92 lg. Brlg.</i> ...	12,249	18,592
	<i>Dopp. Z. 92 f. 10 cm. K.</i> ...		
	<i>Dopp. Z. 92 K. 15.</i> ...		
15 cm. gun on coast defence mounting '07 (rifling, 44 grooves f)	<i>Dopp. Z. 92 f. 10 cm. K.</i> ...	8,530	8,530
	<i>Dopp. Z. 92 K. 15</i> ...		

Material—Steel.

Weight—

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

Bullets— g. bullets, to the lb., set in resin.

Employment—Good effect against living targets in the open or under light cover.

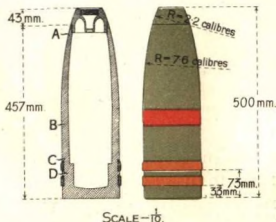
Against shielded batteries, it is effective only in connection with enfilade fire.

Remarks—

* (gr.) probably = *gran* or *grey*.

15 cm. Schr. 03 (gr.).

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 9 mm.; at B, 19 mm.; at C, 20 mm.
at D, 30 mm.

Thickness of base—25 mm.

Width of driving bands—25 mm.

Distinctive markings—The red ring round the centre of the cylindrical portion indicates that the bullets are set in resin.

1907 Pattern 15 cm. Shrapnel.

2·6 calibres long ; 1 c.r.h.

Used with		Maximum range.	
Gon.	Fuze.	Time.	Perc'n.
15 cm. long gun ... (rifling, 36 grooves)	<i>Dopp. Z. 92</i> ...	yards. 8,968	yards. 10,936

Material—Steel.**Weight**—

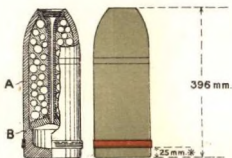
Shell complete, 41·2 kg. (90·8 lbs.).

Bursting charge, 0·47 kg. (1·0 lb.). Black powder.

Bullets—1,600 11·1-g. lead bullets, 41 to the lb., set in resin.**Employment**—Good effect against living targets in the open or insufficiently covered, silhouetted targets and captive balloons.**Remarks**—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 57.
(B 13641)

1915 Pattern 15 cm. Shrapnel.

2.4 calibres long ; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
5 cm. long gun ... (rifling, 36 grooves)	<i>Dopp. Z. 92</i> ...	yards. 8,968	yards. 10,936
	<i>Dopp. Z. 92 n.F.</i> ...	10,936(?)	10,936(?)

Material—Steel.

Weight—

Shell complete, 39.6 kg. (87.3 lbs.).

Bursting charge, kg. (lbs.).

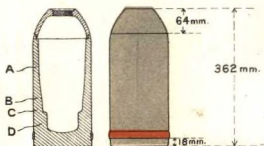
Bullets— 25-g. bullets, 18 to the lb.

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

Remarks—For range table, see Appendix IX.

15 cm. Schr. 15.

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—

1915 Pattern 15 cm. Shrapnel with Forward Driving Band.

2.3 calibres long; 1 c.r.h.

Used with				Maximum range.	
Gun.	Fuze.			Time.	Perc'n.
				yards.	yards.
15 cm. gun (<i>Ringkanone</i>)... (rifling, 24 grooves)	<i>Dopp. Z. 92</i>	...	...	7,546	7,546
15 cm. gun (<i>lange Ringkanone</i>) (rifling, 24 grooves)	"	...	...	7,929	7,929

Material—Body, cast steel; head, forged steel.

Weight—

Shell complete, 39.6 kg. (87.3 lbs.).

Bursting charge, kg. (lbs.).

Bullets— g. bullets, to the lb.

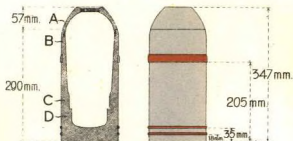
Employment—

Remarks—A variation of this shrapnel has been found on which there are three lower driving bands instead of two.

For range table, see Appendix VIII.

15 cm. Schr. 15 m.v.F.

Calibre, 14.97 cm. (5.89").

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 7.5 mm. ; at B, 10 mm. ; at C, 23 mm. ; at D, 28 mm.

Thickness of base—36 mm.

Width of driving bands—Upper band, 19 mm. ; lower bands 4.5 mm.

Distinctive markings—A black ring round the cylindrical portion denotes that the bullets are made of steel.

1889 Pattern 21 cm. Shrapnel.

2 calibres long; 1 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
21 cm. howitzer in turret... (rifling, 30 grooves) -	... <i>Dopp. Z. 92</i> ...	yards. 5,960	yards. 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., set in resin.

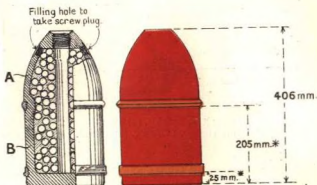
Employment—Good effect against living targets in the open or insufficiently covered.

Remarks—

* 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 57.

1904 Pattern 21 cm. Shrapnel.

2.5 calibres long ; 1.5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
21 cm. gun (<i>Ringkanone</i>) (rifling, 30 grooves)	<i>Dopp. Z. 92</i>	yards. 7,655	yards. 7,655

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.

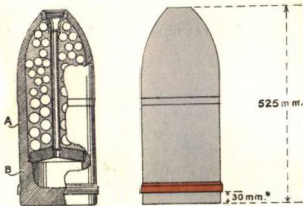
The bullets are set in resin.

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

Remarks—Hard nickel steel plates, 0.47-in. thick, are penetrated by the 150-g. (5½-oz.) steel bullets up to a range of 5,468 yards and at a distance of 33 yards from the point of burst.

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 57.

GERMAN NAVAL SHELL USED IN LAND WARFARE.

The following reasons have led to the inclusion of details of German naval shell :—

1. The coast defences of Belgium include German naval guns of all calibres, many of which fire landwards.
2. In certain sectors of the Flanders front, naval pom-poms and boat guns are used as trench artillery.
3. Long range naval guns on wheeled carriages, platform mountings and railway mountings are continually being located all along the British Front. The calibres most in evidence are 15 cm. (5·9 in.) and 24 cm. (9·45 in.). These guns are usually employed for harassing fire with H.E. shell, but the use of 24 cm. shrapnel against kite balloons has been a noticeable feature of the past year.

Nature and marking.—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>Pz-Granate</i> ...	Blue, with yellow head.	All modern guns of 15 cm. and upwards.

* 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.

Nature.	German Name.	Colour.	Used with
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.
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.
Shrapnel with false cap	<i>Hauben-Schrapnel</i> (?)	Blue, or red with grey cap and black nose	24 cm. gun.

Designation.—The designation of a naval shell gives in abbreviated form its calibre, nature and total length in calibres together with the type of the fuze employed with it. If the shell is fitted with a false cap, the word *Haube* (cap) is added.

Example:

15 cm. Spgr. L/3·6 (Dz.) = 15 cm. *Sprenggranate Länge*/3·6 (*Doppelzünder*), i.e., 15 cm. (5·89 in.) H.E. shell, 3·6 calibres long, fitted for a time and percussion fuze.

15 cm. Spgr. L/5 (Dz.) (*Haube*) indicates the same shell fitted with a false cap (*Haube*), which makes its total length 5 calibres.

Rifling.—The number of grooves affords an important clue to the identity of a naval shell; for example, 44 grooves on a driving band completely identify the 15 cm. naval gun.

* The heads of these shell 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.

Design.—The older patterns of German naval shell are characterized by thick walls and a fairly small bursting charge. The head is struck with a radius of less than 3 calibres (3 c.r.h.), the total length of the shell being from 2.5 to 3.5 calibres.

In modern German naval shell used in land warfare, the most noticeable features of design are a powerful bursting charge, thinner walls, and a general streamline effect. The head tapers to a point and is usually struck with a radius of 10 calibres (i.e., the head of a 15 cm. or 5.9" shell will be struck with a radius of 1.50 m. or 59"). It is sometimes formed by a false cap. In the latest types, the false cap is welded to an adapter ring which screws on to the shell proper. The base of the shell may also be tapered, but this is unusual. The total length of shell varies from 4 to 5 calibres. It may be mentioned here that the introduction of the streamline shell with false cap is due to the demand for increased maximum range with undiminished accuracy, and for greater range when using a reduced charge.

Bursting charge.—Picric acid (*Grf. 88*) was formerly used, but all modern German naval shell are filled with T.N.T.

The charge consists of one or more slabs of compressed T.N.T. made up in red millboard containers. A white paper label pasted on each container states the designation of the shell, the weight and nature of the bursting charge in the container, and the date and place of filling.

Example:

*Zweiteilige Sprengladung für 28 cm. Spgr.
L/35 m. Bdz.
5.08 kg. Fp. C/02. Rdf. Lief. 67.14.
gefertigt Reinsdorf 1914 III Lief.*

or "Bursting charge in two containers for 28 cm. H.E. shell, length of which is 3.5 calibres (base fuze): 5.08 kg. of *Fullpulver 02* (i.e., T.N.T.): Batch No. 67 manufactured at Reinsdorf in 1914: Made up at Reinsdorf in 1914, Batch No. III."

The interior of the shell is varnished and lined with brown paper. In certain shell of large calibre, the T.N.T. is in bags.

The upper portion of the cavity is filled by a wood block, and a tight fit is ensured by inserting the required number of mill-board or vulcanite discs before screwing in the base plug.

In shell fitted for base fuze, gas-tight joints between fuze and base plug, and between the latter and the walls of the shell, are obtained by means of lead washers. In the case of the *Spgr. m. K.* fuze (base fuze), a copper gas check is used.

Exploder.—The type in general use with H.E. shell is a delay action exploder, consisting of a cartridge of compressed picric acid in a cylindrical tinned brass case. On this case is usually stamped the designation of the exploder.

Example :

Gr. Zdlg. C/98 (Grosse Zündladung Construction 1898 = large 1898 pattern exploder).

A fulminate detonator is embedded in the top of the picric acid. The "delay" (usually 0.05 sec.) is obtained by means of a powder pellet placed above the fulminate.

Fuze.—The fuzes employed differ from those of Army shell and comprise nose, base and internal fuzes. H.E. shell are frequently issued with T. and P. fuze. Clockwork time fuzes of remarkable accuracy have been adopted for 24 cm. and 38 cm. shrapnel. (For naval fuzes used in land warfare, see S. S. 306, "Notes on German Fuzes.")

Gaine.—A steel or brass gaine, which is simply a tube closed at the bottom, is first screwed into the shell (nose, or base plug). This gaine penetrates into a cavity formed in the bursting charge. The exploder is dropped into the gaine and the fuze screwed home after it.

TABLE SHOWING PARTICULARS OF RIFLING OF GERMAN NAVAL GUNS, AND NATURE
OF SHELL EMPLOYED.

Name.	Calibre. cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth. mm.	Width. mm.		
3·7 cm. Gun ... 3·7 cm. Sch. Gr. K.	3·7	—	12	—	—	3·7 cm. Gr. (?) 3·7 cm. Spgr. 3·7 cm. L.S. Gesch.	
6 cm. Boat Gun ...	6·0 (?)	—	24	—	—	6 cm. Spgr. L/3·4 (Dz.)	
8·8 cm. Q.F. Gun L/30 8·8 cm. S.K. L/30	8·8	—	32	0·9	5·6	8·8 cm. Spgr. L/2·6 (Kz.) 8·8 cm. Spgr. L/2·8 (Iz.)	
8·8 cm. Q.F. Gun L/35 8·8 cm. S.K. L/35	8·8	—	—	—	—	8·8 cm. Spgr. L/2·6 (Kz.) 8·8 cm. Spgr. L/2·8 (Iz.)	

8.8 cm. Q.F. Gun L/45 8.8 cm. S.K. L/45	8.8	—	—	—	—	8.8 cm. Spgr. L/3.6 (Kz.) 8.8 cm. Spgr. L/3.8 (Iz.) 8.8 cm. Spgr. L/3.7 (Dz.)
10.5 cm. Q.F. Gun L/35 10.5 cm. S.K. L/35 or s. 10 cm. K.	10.5	6° approx.	32	—	—	10.5 cm. Spgr. L/3.6 (Dz.) 10.5 cm. Spgr. L/3.6 (Kz.)
15 cm. Q.F. Gun ? ... 15 cm. S.K. ?	14.97 approx.	—	40	—	—	15 cm. Üb. Spgr. L/2.9 (Kz.) (?)
15 cm. Gun L/30 ... 15 cm. K. L/30	14.97 approx.	—	44(?)	—	—	15 cm. Spgr. L/3.6 (Dz.) 15 cm. Gr. 12 15 cm. Gr. 12 n/A. 15 cm. Gr. 14
15 cm. Q.F. Gun L/40 15 cm. S.K. L/40 or s. 15 cm. K.	14.97 approx.	7° approx.	44	—	—	15 cm. Spgr. L/3.6 (Dz.) 15 cm. Spgr. L/5 (Dz.) (Haube)
17 cm. Q.F. Gun L/40 17 cm. S.K. L/40	17.2 approx.	5° approx.	52	—	—	17 cm. Spgr. L/3 (Kz.) 17 cm. Spgr. L/4.7 (Haube) (?)
17 cm. Gun on Wheeled Carriage	—	—	—	—	—	
17 cm. K. & R. L.	—	—	—	—	—	
17 cm. Gun on Plat- form Mounting	—	—	—	—	—	
17 cm. K. (Bett. Gesch.)	—	—	—	—	—	
17 cm. Gun on Rail- way Mounting	—	—	—	—	—	
17 cm. K. Eis.						

Name.	Calibre. cm.	Rifling.				Shell.	Shrapnel.
		Pitch.	Grooves.				
			Num- ber.	Depth. mm.	Width. mm.		
21 cm. Q.F. Gun L/45 21 cm. S.K. L/45 or 21 cm. K. 21 cm. Q.F. Gun on Railway Mounting 21 cm. K. Eis.	21.0 approx.	6° approx.	60	—	—	21 cm. Spgr. L/3.1 m. Bdz. (m. Haube) 21 cm. Spgr. L/4.2 m. Bdz.	
	—	—	—	—	—		
24 cm. Q.F. Gun L/40 on Railway Mount- ing 24 cm. S.K. L/40 Eis. 24 cm. Gun on Plat- form Mounting 24 cm. S.K. (Bett. Gesch.)	23.6 approx.	5° approx.	72	—	—	24 cm. Spgr. L/2.8 m. Bdz. (m. Haube) 24 cm. Spgr. L/4.1 m. Bdz.	24 cm. Schr. L/4.2 (Haube) (?)
	—	—	—	—	—		
28 cm. Q.F. Gun (?)	—	—	—	—	—	28 cm. Spgr. L/3.6 m. Bdz. (?) 28 cm. Spgr. L/3.1 m. Bdz. (m. Haube)	

30.5 cm. Q.F. Gun L/50 30.5 cm. S.K. L/50	30.5	—	88	2	—	30.5 cm. Spgr. L/33 m. Bdz. (?)	
35.6 cm. Gun ...	35.6	—	72	—	—	35.6 cm. Spgr. L/? m. Bdz. (m. Haube) (?)	
38 cm. Gun ...	38.1	6° approx.	100	3 approx.	6.3 approx.	38 cm. Spgr. L/3.6 m. Bdz. (m. Haube) (?) 38 cm. Spgr. L/4.1 m. Bdz. (?) 38 cm. Spgr. L/4.1 (Bdz. u. Kz.) m. Haube.	38 cm. Schr. L/3.6 (?)
42 cm. Short Naval Gun on Fixed Mounting* Kz. Mar. Kan. (42 cm.) (in unbeweglicher La- fette)	42.3 approx.	6° approx.	120(?)	2½ approx.	6 approx.	42 cm. Spgr. L/1.7 (m. Haube) (?)	
1914 Pattern 42 cm. Short Naval Gun on Wheeled Car- riage* Kz. Mar. Kan. 14 (42 cm.) M. in Räder- Lafette fahrbar							

* It is uncertain whether the particulars given should refer to these two guns, as they result solely from the measurement of the shell.

3.7 cm. Naval Common Shell.

2.3 calibres long; 2 c.r.h.; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
3.7 cm. trench gun (3.7 cm. <i>Schützen-Graben-Kanone</i>) (rifling, 12 grooves)	Percussion fuze * ...	yards. —	yards. 3,280(?)

Material—Steel.

Weight—

Shell complete, 0.45 kg. (1.0 lb.).

Bursting charge, 0.025 kg. (0.055 lb.) approx. Black powder.

Employment—*Principal object* (with 3.7 cm. trench gun): to stop tanks and to relieve the close-range guns and the rest of the artillery from the task of self-defence; for direct fire against dead ground in front of battery positions. Also used for harassing fire directed against trenches; effective against shields, loophole plates, sandbag revetments, &c., up to 660 yards range.

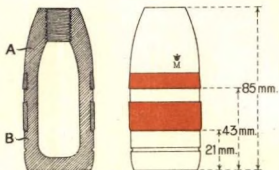
Remarks—According to captured orders, this ammunition can also be fired from the 3.7 cm. revolver gun (*see* page 56).

* The specimen examined bears no marking, but is probably the naval fuze known as *Z. f. 3.7 cm. Spgr.*

3·7 cm. Gr. (P).

Fixed ammunition.

Calibre, 3·7 cm. (1·46").



SCALE— $\frac{1}{2}$.

Thickness of walls—At A, 8·5 mm. ; at B, 7 mm.

Thickness of base—7 mm.

Width of driving bands—Upper band, 6 mm. ; lower, 15 mm.

Distinctive markings—

3·7 cm. Naval H.E. Shell.

2·3 calibres long; 2 c.r.l.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
3·7 cm. trench gun (3·7 cm. Schützen - Graben - Kanone)	Z.f. 3·7 cm. Spgr. ...	—	880*
3·7 cm. revolver gun (3·7 cm. Rev. K.) (rifling of both guns, 12 grooves)	"	—	660

Material—Steel.**Weight**—

Shell complete, 0·45 kg. (1 lb.).

Bursting charge, 0·04 kg. (0·09 lb.). H.E.

Employment—*Principal object* (with 3·7 cm. trench gun): to stop tanks and to relieve the close-range guns and the rest of the artillery from the task of self-defence; for direct fire against dead ground in front of battery positions. Also used for harassing fire directed against trenches; effective against shields, loophole plates, sandbag revetments, &c., up to 660 yards range.

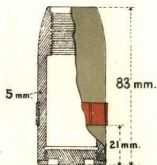
Remarks—Fired in conjunction with tracer shot (*see* page 284).

* Maximum effective range, 660-880 yards.

3.7 cm. Spgr.

Fixed ammunition; designation of complete round,
Spgr. Patr.

Calibre, 3.7 cm. (1.46")



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

Thickness of walls—At A, 5 mm.

Thickness of base—8 mm.

Width of driving band—12 mm.

Distinctive markings—

3·7 cm. Naval Tracer Shot.

2·5 calibres long; 2 c.r.h.; base igniter.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
3·7 cm. trench gun (3·7 cm. <i>Schützen - Graben-Kanone</i>) (rifling, 12 grooves)	—	yards. —	yards. 3,280 (?)
3·7 cm. anti-aircraft gun? (3·7 cm. <i>Flak.</i>)	—	—	

Material—Steel.

Weight—

Shell complete, 0·47 kg. (1·03 lb.).

Tracer composition, 0·039 kg. (0·085 lb.).

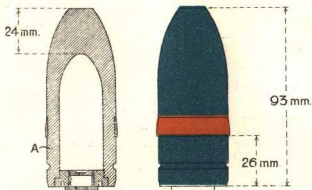
Employment—Probably against low-flying aeroplanes; in conjunction with H.E. shell, against tanks, and to repel assaults at close range (up to 880 yards); also to protect anti-tank and field batteries by sweeping dead ground in front of battery positions. 3·7 cm. guns are not, however, dug in far forward.

Remarks—This tracer shell is filled with a mixture containing barium nitrate, magnesium and shellac, which burns with a green light. It is fired by an igniter of black powder contained in a brass plug which is pressed into the base plug. The latter is made of white metal.

3.7 cm. L.S.Gesch.

Fixed ammunition; designation of complete round, *L.S. Gesch. Patr.*

Calibre, 3.7 cm. (1.46").



SCALE — $\frac{1}{2}$.

Thickness of walls—At A, 6.5 mm.

Base plug—Diameter, 28 mm. ; thickness, 10 mm.

Width of driving band—10 mm.

Distinctive markings—

6 cm. Naval H.E. Shell.

3·4 calibres long ; 1·5 c.r.h. ; time and percussion fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
6 cm. boat gun ... (rifling, 24 grooves)	Time and percussion fuze*	yards.	yards.

Material—Steel.

Weight—

Shell complete, 2·88 kg. (6·34 lbs.).

Bursting charge, 0·13 kg. (0·28 lb.). *Grf. 88* (compressed picric acid in millboard case).

Exploder—Delay action exploder.

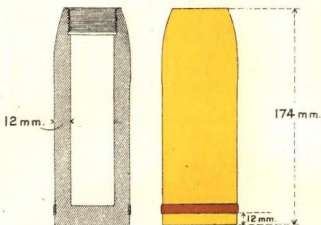
Employment—In trench warfare, against living targets at close quarters and against tanks ; possibly against low-flying aeroplanes.

Remarks—

* The fuze is graduated in seconds from 2 to 43 (lowest and highest figures 4 and 42).

6 cm. Spgr. L/3'4 (Dz.)

Calibre, 6 cm. (2'36") (?).

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

Thickness of walls—12 mm.

Thickness of base—16 mm.

Width of driving band—7 mm.

Distinctive markings—

8.8 cm. Naval H.E. Shell.

2.8 calibres long; 2 c.r.h.; internal fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
8.8 cm. Q.F. gun L/30 (rifling, 32 grooves)	... <i>Granatzünder m.V.</i> ...	yards. —	yards. 9,077
8.8 cm. Q.F. gun L/35 (rifling, . grooves)	... " "	—	Probably about 10,000

Material—Steel.**Weight**—

Shell complete, 7.0 kg. (15.4 lbs.).

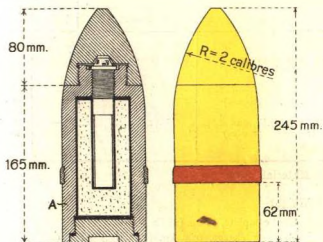
Bursting charge, 0.34 kg. (0.75 lb.). *Fp. 02** (compressed T.N.T. in millboard case).**Exploder**—*kl. Zdlg. C/98* = small 1898 pattern exploder; picric acid in cylindrical tinned brass case.**Employment**—**Remarks**—

* Shell manufactured prior to 1910 are filled with *Grf. 88* (picric acid).

8·8 cm. Spgr. L/2·8 (Iz.).

Fixed ammunition; designation of complete round, *leichte*
8·8 cm. Spgr. Patr. (Iz.)

Calibre, 8·8 cm. (3·46").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 15 mm.

Base plug—Diameter, 67 mm. ; thickness, 25 mm.

Width of driving band—20 mm.

Distinctive markings—

8.8 cm. Naval H.E. Shell.

3.6 calibres long; 2 c.r.h.; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
8.8 cm. Q.F. gun L/30 (rifling, 32 grooves)	<i>Granatzünder C/89</i> ...	yards. —	yards. 9,077*
8.8 cm. Q.F. gun L/35 (rifling, grooves)	„ ...	—	probably over 10,000
8.8 cm. Q.F. gun L/45 (rifling, grooves)	„ ...	—	probably over 10,000

Material—Steel.**Weight**—

Shell complete, 10 kg. (22 lbs.).

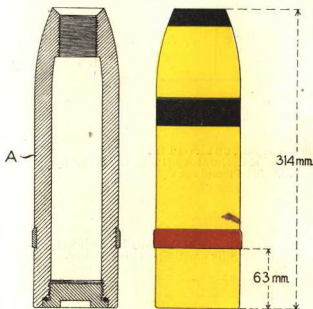
Bursting charge, 0.56 kg. (1.23 lbs.). *Fp. 02* (T.N.T. in millboard case).**Exploder**—*kl. Zdlg. C/98*=small 1898 pattern exploder; picric acid in cylindrical tinned brass case.**Employment**—**Remarks**—

* Corresponding apparently to the maximum angle of elevation of 15° allowed by the mounting for torpedo boats.

8.8 cm. Spgr. L/3.6 (Kz.)

Fixed ammunition; designation of complete round, *schwere*
8.8 cm. Spgr. Patr. (Kz.).

Calibre, 8.8 cm. (3.46").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 17 mm.

Base plug—Diameter, 67 mm. ; thickness, 25 mm.

Width of driving band—20 mm.

Distinctive markings—A black nose indicates a filled shell.

8·8 cm. Naval H.E. Shell.

3·7 calibres long*; 2 c r.h.; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Pere'n.
8·8 cm. Q.F. gun L/45 (rifling, grooves)	<i>Dopp. Z. S/26...</i> ...	yards. —	yards. probably over 10,000

Material—Steel.

Weight—

Shell complete, 9·6 kg. (21·1 lbs.).

Bursting charge, 0·51 kg. (1·1 lbs.). *Fp. 02* (compressed
T.N.T. in millboard case).

Exploder—

Employment—

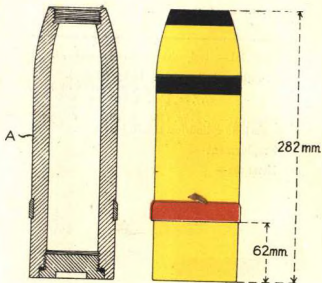
Remarks—In the bottom of the cavity is a cardboard cylinder, 64 g. in weight, filled with a smoke-producing mixture.

* Complete with fuze.

8·8 cm. Spgr. L/3·7 (Dz.).

Fixed ammunition; designation of complete round, *schwere*
8·8 cm. Spgr. Patr. (Dz.).

Calibre, 8·8 cm. (3·46").



SCALE.— $\frac{1}{4}$.

Thickness of walls—At A, 17 mm.

Base plug—Diameter, 67 mm.; thickness, 25 mm.

Width of driving band—20 mm.

Distinctive markings—A black nose indicates a filled shell.

8'8 cm. Naval H.E. Shell.

3'8 calibres long ; 2 c.r.h. ; internal fuze.

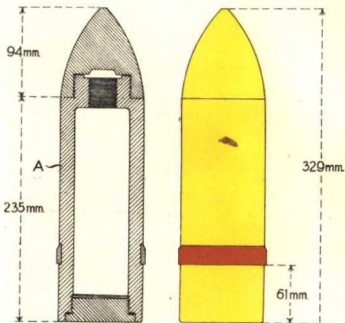
Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
8'8 cm. Q.F. gun L/45 ... (rifling, grooves)	<i>Granatzünder m. F.</i>	yards. —	yards. Probably over 10,000

Material.—Steel, with hardened steel head.**Weight**—Shell complete, 10 kg. (22 lbs.).Bursting charge, 0'64 kg. (1'4 lbs.). *Fp. 02*, T.N.T., or
Grf. 88, picric acid, compressed in millboard case.**Exploder**—*kl. Zdlg. C/98*—small 1898 pattern exploder ; picric
acid in cylindrical tinned brass case.**Employment**—**Remarks**—

8.8 cm. Spgr. L/3.8 (Iz.).

Fixed ammunition; designation of complete round, *schwere*
8.8 cm. Spgr. Patr. (Iz.).

Calibre, 8.8 cm. (3.46").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 15 mm.

Base plug—Diameter, 67 mm.; thickness, 25 mm.

Width of driving band—20 mm.

Distinctive markings—

(B 13841)

K 4

10.5 cm. Naval H.E. Shell.

3.6 calibres long ; 2 c.r.h. ; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
10.5 cm. Q.F. gun L/35* (rifling, 32 grooves)	Percussion fuze† ...	yards. —	yards. 10,389
	or <i>Dopp. Z. S/43</i> ...	10,389	10,389

Material—Forged steel.

Weight—

Shell complete, 17.55 kg. (38.69 lbs.).

Bursting charge, 0.75 kg.† (1.65 lbs.). *Fp. 02* (compressed T.N.T. in millboard case).

Exploder—*Gr. Zdlg. C/98* = large 1898 pattern exploder ; 32 g. picric acid in cylindrical tinned brass case. *Zdlg. C/08* is also used.

Employment—*With delay action percussion fuze* : good effect against living targets, even on soft ground, provided the shell ricochets ; with sufficient angle of descent, effective against earth-works and light cover.

With time fuze : against living targets, both in the open and under cover ; considerably more effective than the *10 cm. Gr. 15* (*see* page 128).

Remarks—The bursting charge of the shell examined was manufactured at Reinsdorf in 1917.

* The naval designation of this gun is *10.5 cm. S.K. L/35* (10.5 cm. Q.F. gun 35 calibres long), although it is known to the Army as *s. 10 cm. K.* (10 cm. heavy gun).

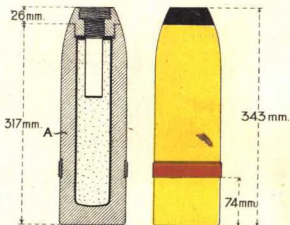
† Designation unknown (*see* S.S. 306, "Notes on German Fuzes," 2nd edition, page 146).

‡ Officially laid down as 0.63 kg. (1.4 lbs.).

10.5 cm. Spgr. L/3.6 (Kz.).

Fixed ammunition; designation of complete round, 10.5 cm. Spgr. Patr. (Kz.).

Calibre, 10.5 cm. (4.13")



SCALE - $\frac{1}{8}$.

Thickness of walls—At A, 23 mm.

Thickness of base—29 mm.

Width of driving band—24 mm.

Distinctive markings—The black nose indicates a filled shell.

15 cm. Naval Practice H.E. Shell.

2.9 calibres long; 2.8 c.r.h.; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. Q.F. naval gun L/1(?) (rifling, 40 grooves)	<i>Kopfzünder für Spreng- granaten*</i>	yards. —	yards.

Material—Steel.

Weight—

Shell complete, 39.5 kg. (87 lbs.).

Blowing charge, 0.116 kg. (0.25 lb.). *Fp. 02* (T.N.T. crystals lightly stemmed into a brass tube). The remaining space in the millboard container is filled with pitch.

Exploder—The exploder was missing from the specimen examined.

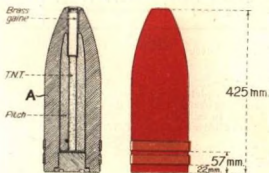
Employment—For practice shoots.

Remarks—The T.N.T. on detonation bursts the shell and scatters the heated pitch, producing a smoke cloud probably sufficient for practice or ranging purposes.

* A naval percussion nose fuze (graze fuze) used with the delay action exploder *Gr. Zdlg. C/98*.

15 cm. Üb. Spgr. L/2'9 (Kz.).

Calibre, 14.97 cm. (5.89") (†).



SCALE—10.

Thickness of walls—At A, 40 mm.

Base plug—Diameter, 94 mm. ; thickness, 50 mm.

Width of driving bands—26 mm.

Distinctive markings—Naval practice H.E. shell are painted red.

15 cm. Naval H.E. Shell with False Cap.

Original shell, 3 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. Q.F. gun L/40 * (rifling, 44 grooves)	<i>Bodenzünder für Sprenggranaten</i>	yards. —	yards. At least 14.500

Material—Steel.

Weight—

Shell complete, 45 kg. approx. (99 lbs.).

Bursting charge, 1.62 (3.6 lbs.). *Grf. 88* (compressed picric acid in millboard case). Shell manufactured since 1913 are filled with *Fp. 02* (T.N.T.).

Exploder—

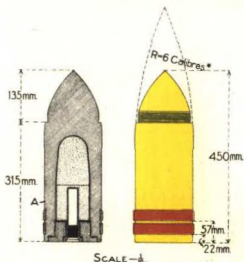
Employment—

Remarks—The false cap is made in one piece and is screwed directly on to the head of the shell which is threaded to receive it (see plate opposite).

* See footnote on page 304.

15 cm. Spgr. L/3 m. Bdz. (m. Haube).

Calibre, 14.97 cm. (5.89") (?).



Thickness of walls—At A, 30 mm.

Base plug—Diameter mm. ; thickness, 53 mm.

Width of driving bands—28 mm.

Distinctive markings—

* Dimension approximate only.

15 cm. Naval H.E. Shell.

3.6 calibres long ; 2.5 c.r.h. ; time and percussion fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
15 cm. gun L/30 (rifling, 44 grooves (?))	<i>Dopp Z.S/43</i> ...		
15 cm. Q.F. gun L/40* (rifling, 44 grooves)	" ...	14,983 6,562†	14,983 11,483†

Material—Steel.

Weight—

Shell complete, 40 kg. (88 lbs.).

Bursting charge, 4.4 kg. (9.7 lbs.). *Fp. 02* (compressed T.N.T. in red millboard case).

Exploder—*Gr. Zdlg. C/98* = large 1898 pattern exploder ; picric acid in cylindrical tinned brass case.

Employment—*As percussion shell*: good effect against living targets in the open, in tall timbered woods and in villages ; against *matériel*, shielded batteries, wire entanglements, weak masonry and light cover.

As time shell: very effective against living targets in the open or under cover.

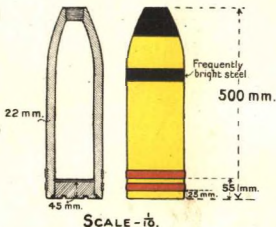
Remarks—Some specimens contain a smoke producer, 315 g. in weight, containing a mixture of phosphorus and arsenic.

* The naval designation of this gun is 15 cm. S.K. L/40 (15 cm. Q.F. gun L/40), although it is known in the Army as s. 15 cm. K. (15 cm. heavy gun).

† With reduced charge.

15 cm. Spgr. L/3'6 (D z.)

Calibre, 14.97 cm. (5.89") (?).



Thickness of walls—22 mm.

Base plug—Diameter, 120 mm. ; thickness, 45 mm.

Width of driving bands—Upper band, 20 mm.; lower, 15 mm.

Distinctive markings—The shoulder is lacquered black. The black nose indicates a filled shell.

15 cm. Naval H.E. Shell with False Cap.

5 calibres long; 10 c.r.b.; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. Q.F. gun L/40* (rifling, 44 grooves)	Percussion fuze † ...	yards. —	yards. 20,451

Material—Steel.

Weight—

Shell complete, 42 kg. (94.5 lbs.).

Bursting charge, 4.4 kg. (9.7 lbs.). *Fp.* 02 (compressed T.N.T. in red millboard case).

Exploder—*Gr. Zdlg. C/98 (0.05 V.)* = large 1898 pattern delay action exploder (delay = 0.05 sec.); picric acid in cylindrical tinned brass case.

Employment—Against back areas and usually at long ranges; against roads and traffic centres, dumps, wagon lines, camps and villages.

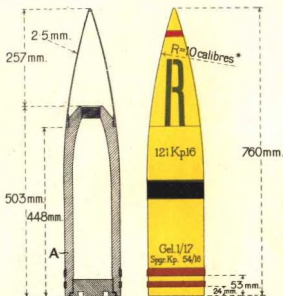
Remarks—The false cap is made in one piece, and is screwed directly on to the head of the shell without an adapter ring. The curve of the ogive is continuous.

* The naval designation of this gun is 15 cm. S.K. L/40 (15 cm. Q.F. gun L/40), although it is known in the Army as s. 15 cm. K. (15 cm. heavy gun).

† Designation unknown (see S.S. 306, "Notes on German Fuzes," 2nd edition, page 146).

15 cm. Spgr. L/5 (Dz.) (Haube).

Calibre, 14.97 cm. (5.89") (?).

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 22 mm.

Base plug—Diameter, 120 mm. ; thickness, 45 mm.

Width of driving bands—Upper band, 20 mm. ; lower, 15 mm.

Distinctive markings—In some specimens, the false cap is painted grey.

The "R" denotes that the shell contains a smoke producer.

As in most naval shell, the shoulder is lacquered black.

* Dimension approximate only.

17 cm. Naval H.E. Shell.

3 calibres long; 2 c.r.h.; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
17 cm. Q.F. naval gun L/40 (rifling, 52 grooves) Mounted as follows:—			
17 cm. gun on wheeled carriage	Percussion fuze*	...	19,248
17 cm. gun on platform mounting	—	—	
17 cm. gun on railway mounting	—	—	

Material—Steel.

Weight—

Shell complete, 64.0 kg. (141 lbs.).

Bursting charge, 3.2 kg. (7.0 lbs.). Grf. 88† (compressed picric acid in red millboard case).

Exploder—Gr. Zdlg. C/98 = 1898 pattern exploder; picric acid in cylindrical tinned brass case.

Employment—Against back areas and usually at long ranges; against roads and traffic centres, dumps, wagon lines, camps and villages.

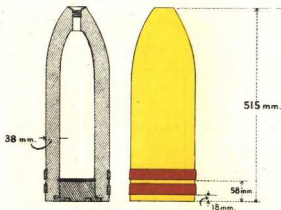
Remarks—

* Designation unknown. See S. S. 306, "Notes on German Fuzes," 2nd edition, page 148.

† Shell manufactured since 1910 are filled with 3.5 kg. (7.7 lbs.) Fp. 02 (T.N.T.).

17 cm. Spgr. L/3 (Kz.).

Calibre, 17.2 cm. (6.77") (?).

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

Thickness of walls—38 mm.

Base plug—Diameter, 163 mm. ; thickness, 57 mm.

Width of driving bands—28 mm.

Distinctive markings—The shoulder should be lacquered black and the nose of the shell painted black; the latter marking indicates a filled shell.

17 cm. Streamline Naval H.E. Shell with False Cap.

4.7 calibres long; 8 c.r.h.; nose fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
17 cm. Q.F. naval gun L/40, (rifling, 52 grooves) Mounted as follows:— 17 cm. gun on wheeled carriage 17 cm. gun on platform mounting 17 cm. gun on railway mounting	Percussion fuze ...	yards. —	yards. 25,700

Material—Steel; the cap is of mild steel.

Weight—

Shell complete without false cap, 60.55 kg. (133.4 lbs.).

Bursting charge, 6.4 kg. (14.2 lbs.). *Fp.* 02 (compressed T.N.T. in 2 red millboard cases).

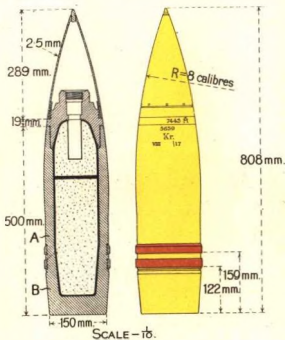
Exploder—*lg. Zdlg. C/08*—long 1908 pattern (delay action) exploder; picric acid in cylindrical tinned brass case.

Employment—Against back areas, at long ranges; against roads and traffic centres, dumps, wagon lines, camps and villages.

Remarks—With this shell is used a percussion fuze made of white metal and provided with a centrifugal safety device. It can apparently be set for either delay or non-delay action by means of a key, which is inserted through the aperture in the point of the false cap.

17 cm. Spgr. L/4'7 (Haube) (?).

Calibre, 17.2 cm. (6.77") (?).



Thickness of walls—At A, 24 mm.; at B, 32 mm.

Thickness of base—50 mm.

Width of driving bands—23 mm.

Distinctive markings—

21 cm. Naval H.E. Shell with False Cap.

4.9 calibres long* ; 10 c.r.h. ; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
21 cm. Q.F. naval gun L/45 (rifling, 60 grooves?)	<i>Spgr. m. K.</i>	yards. —	yards. 29,200 (20,670, without false cap)
21 cm. Q.F. naval gun on railway mounting (rifling, grooves)		—	

Material—Steel.

Weight—

Shell complete, 110 kg. (242.5 lbs.) approx.

Bursting charge, 6.89 kg. (15.2 lbs.). *Fp. 02* (compressed T.N.T. in red millboard case).

Exploder—*lg. Zdlg. C/08* = long 1908 pattern (delay action) exploder ; picric acid in cylindrical tinned brass case.

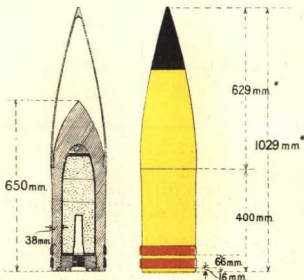
Employment—Against back areas, at long ranges ; against roads and traffic centres, dumps, wagon lines, camps and villages.

Remarks—

* The original shell is 3.1 calibres long.

21 cm. Spgr. L/3·1 m. Bdz. (m. Haube) (?).

Calibre, 21 cm. (8·27") (?).

SCALE— $\frac{1}{15}$.

Thickness of walls—38 mm.

Base plug—Diameter, 163 mm. ; thickness, 57 mm.

Width of driving bands—Upper band, 40 mm. ; lower band, 35 mm.

Distinctive markings—The shoulder should be lacquered black. The black nose indicates a filled shell.

* ‡ * These dimensions are only approximate. The cap has been damaged in all specimens hitherto obtained, but the total length is known to be 4·9 calibres.

21 cm. Naval H.E. Shell.

4.2 calibres long; 10 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
21 cm. Q.F. naval gun L/40 (?) (rifling, 64 grooves ?)	<i>Spgr. m. K.</i>	yards. —	yards. At least 23,000
21 cm. Q.F. naval gun on rail- way mounting (rifling, grooves)			

Material—Steel.

Weight—

Shell complete, 115 kg. (253.8 lbs.).

Bursting charge, 8.14 kg. (17.91 lbs.). *Fp. 02* (compressed T.N.T. in red millboard case).

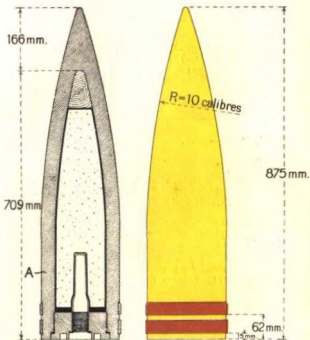
Exploder—*lg. Zdlg. C/08* = long 1908 pattern (delay action) exploder; picric acid in cylindrical tinned brass case.

Employment—Against back areas, at long ranges; against roads and traffic centres, dumps, wagon lines, camps and villages.

Remarks—

21 cm. Spgr. L/4.2 m. Bdz.

Calibre, 21 cm. (8.27") (?).

SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 36 mm.

Base plug—Diameter, 157 mm. ; thickness, 72 mm.

Width of driving bands—35 mm.

Distinctive markings—

24 cm. Naval H.E. Shell with False Cap.

Original shell, 28 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
24 cm. naval Q.F. gun L/40... (rifling, 72 grooves) Mounted as follows:— 24 cm. gun L/40 on railway mounting 24 cm. gun on platform mounting	<i>Spggr. m.K.</i> ...	yards. —	yards. over 24,000]

Material—Steel.

Weight—

Shell complete, 150 kg. (330·7 lbs.) approx.

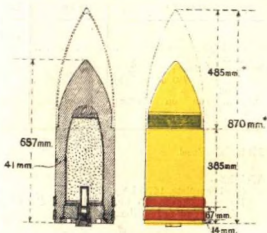
Bursting charge, 8·3 kg. (18·3 lbs.). *Fp.* 02 (compressed T.N.T. in red millboard case).

Exploder—*Gr. Zdlg. C/98 m. 0·05. Sek. Verz.* = large 1898 pattern, exploder (delay = 0·05 sec.); picric acid in cylindrical tinned brass case.

Employment—Against back areas and at long ranges; against railheads, traffic centres, dumps, camps and villages.

24 cm. Spgr. L/2'8 m. Bdz. (m. Haube).

Calibre, 23.6 cm. (9.29") (?).

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

Thickness of walls—41 mm.

Base plug—Diameter, 186 mm. ; thickness, 72 mm.

Width of driving bands—40 mm.

Distinctive markings—

* These dimensions are only approximate, as the cap has been damaged in all specimens hitherto obtained.

24 cm. Naval H.E. Shell.

4.1 calibres long; 10 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
24 cm. naval Q.F. gun L/40 (rifling, 72 grooves) Mounted as follows:— 24 cm. gun L/40 on railway mounting 24 cm. gun on platform mounting	... <i>Spgr. m. K.</i> ...	yards. —	yards. 29,090

Material—Steel.

Weight—

Shell complete, 147.5 kg. (325 lbs.).

Bursting charge, 15 kg. (33 lbs.). *Fp.* 02 (compressed T.N.T. in 2 red millboard cases).

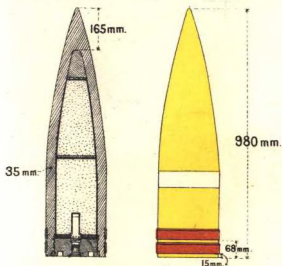
Exploser—*Gr. Zdlg. C/98 m. 0.05 Sek. Verz.* = large 1898 pattern exploder (delay = 0.05 sec.); picric acid in cylindrical tinned brass case.

Employment—Against back areas, at long ranges; against railheads, traffic centres, dumps, camps, and villages.

Remarks—

24 cm. Spgr. L/4'1 m. Bdz.

Calibre, 23.6 cm. (9.29") (?).

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

Thickness of walls—35 mm.

Base plug—Diameter, 186 mm. ; thickness, 72 mm.

Width of driving bands—42 mm.

Distinctive markings—

28 cm. Naval H.E. Shell.

3.5 calibres long; 2.7 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
28 cm. howitzer ... (rifling, grooves)	... <i>Bodenzünder für Spreng- granaten</i>	yards. —	yards.

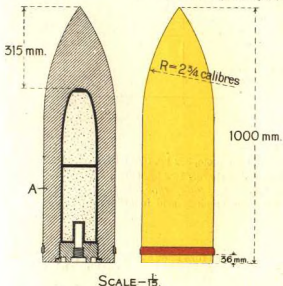
Material—Steel.**Weight**—

Shell complete, 346 kg. (763 lbs.).

Bursting charge, 11.74 kg. (25.9 lbs.). *Fp. 02* (compressed T.N.T. in 2 millboard cases).**Exploder**—**Employment**—**Remarks**—

28 cm. Spgr. L/3.5 m. Bdz.

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



Thickness of walls—At A, 68 mm.

Base plug—Diameter, 175 mm. ; thickness, 75 mm.

Width of driving band—28 mm.

Distinctive markings—

28 cm. Naval H.E. Shell.

3·6 calibres long ; base fuze.

Used with				Maximum range.	
Gun.		Fuze.		Time.	Perc'n.
28 cm. naval gun ... (rifling, 80 grooves)		... <i>m. V. u. K.</i> ...		yards. —	yards. at least 30,000

Material—Steel.

Weight—

Shell complete, 302 kg. (665·8 lbs.).

Bursting charge, 18·3 kg. (40·3 lbs.).

Exploder—*lg. Zdlg. C/08.* = large 1908 pattern exploder (delay = 0·05 sec.) ; picric acid in cylindrical tinned brass case.

Employment—

Remarks—The fuze known as *m. V. u. K.* is identical with the naval fuze *Spgr. m. K.*, except for the marking and for the addition of a tortuous delay channel.

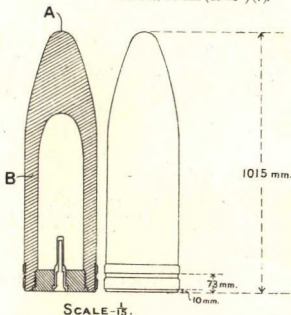
The 28 cm. *Spgr. L/3·1 m. Bdz. (m. Hauke)* is similar in design to the 24 cm. shell described on page 321, but the filling and exploder and all dimensions below the shoulder are identical with those of the 28 cm. *Spgr. L/3·6 m. Bdz.* described above. It differs in the following particulars :—

Weight : 267 kg. (588 lbs.) without false cap.

Fuze : *Spgr. m. K.*

28 cm. Spgr. L/3'6 m. Bdz.(?).

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



Thickness of walls—At A, 315 mm.; at B, 49 mm.

Base plug—Diameter, 217 mm.; thickness, 85 mm.

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

Distinctive markings—

Correction—For the dimensions shown in the plate, read 17 mm., 78 mm. and 1,010 mm., respectively.

30.5 cm. Naval H.E. Shell.

3.3 calibres long; 2 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
30.5 cm. naval gun (?) (rifling, 88 grooves)	...	(?)	(?)
		yards.	yards.
		—	Probably at least 32,000

Material—Steel.

Weight—

Shell complete, 410 kg. (904 lbs.) approx.

Bursting charge, 10.8 kg. (23.8 lbs.). *Fp. 02* (compressed T.N.T. in 2 cotton bags separated by a cardboard disc).

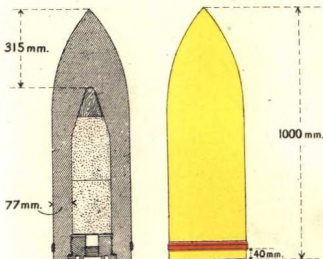
Exploder--

Employment—Against permanent fortifications and field works of exceptional strength.

Remarks—

30.5 cm. Spgr. L/3.3 m. Bdz. (P).

Calibre, 30.5 cm. (12").

SCALE— $\frac{1}{15}$.

Thickness of walls—77 mm.

Base plug—Diameter, 190 mm. ; thickness, 95 mm.

Width of driving band—30 mm.

Distinctive markings—

35.6 cm. Naval H.E. Shell with False Cap.

calibres long; c.r.h.; base fuze.

Used with		Maximum range, percussion.
Gun.	Fuze.	
35.6 cm. Q.F. naval gun, L/50 (?) (rifling, 72 grooves)	<i>Spgr. m. K.</i>	yards. At least 50,300

Material—Steel.

Weight—

Shell complete, probably 620 kg. (12½ cwt.).

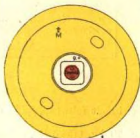
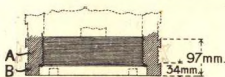
Exploder—

Employment—Against open towns and villages, and railheads and billets.

Remarks—This gun is probably a Krupp coast defence gun on platform mounting.

35.6 cm. Spgr. L/p m. Bdz. (m. Haube) (P).

Calibre, 35.6 cm. (14").



SCALE— $\frac{1}{10}$.

Thickness of walls—At shoulder, 30 mm.; at A, 39 mm.; at B, 35 mm.

Base plug—Diameter, 282 mm.; thickness, 100 mm.

Width of driving band—40 mm.*

Distinctive markings—

* This refers to the lowest driving band. The number of driving bands is two, or possibly three.

38 cm. Naval H.E. Shell with False Cap.

Original shell 3·6 calibres long ; ·2·4 c.r.h. ; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
38 cm. naval Q.F. gun L/45 (?) (rifling, 100 grooves)	<i>Spgr. m.K.</i> <i>m. V. u.K.</i>	yards. —	yards. At least 46,000

Material—Steel.

Weight—

Shell complete (without false cap, gaine, or fuze), 695·6 kg.
(1,533 lbs.).

Bursting charge, 70 kg. (154·3 lbs.). *Fp. 02* (compressed
T.N.T. in 2 red millboard cases).

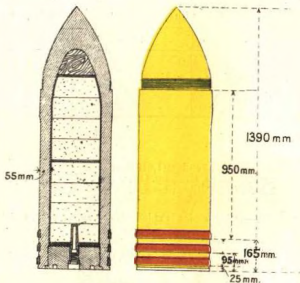
Exploder—

Employment—Against open towns, permanent forts, and field fortifications of exceptional strength.

Remarks—The fuze, known as *m. V. u.K.* is identical with the naval fuze *Spgr. m.K.*, except for the marking and for the addition of a tortuous "delay" channel.

38 cm. Spgr. L/3'6 m. Bdz. (m. Haube) (P).

Calibre, 38·1 cm. (15").



SCALE— $\frac{1}{20}$.

Thickness of walls—55 mm.

Base plug—Diameter, 303 mm. ; thickness, 120 mm.

Width of driving bands—40 mm.

Distinctive markings—

38 cm. Naval H.E. Shell.

4.1 calibres long; 5 c.r.h.; base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
38 cm. naval Q.F. gun L/45 (?) (rifling, 100 grooves)	m. F.u. K.	yards. —	yards. At least 46,000

Material—Steel.

Weight—

Shell complete, 748 kg. (1,649 lbs.).

Bursting charge, 66.85 kg. (147.3 lbs.). *Fp. 02.* (compressed T.N.T. in 2 millboard cases).

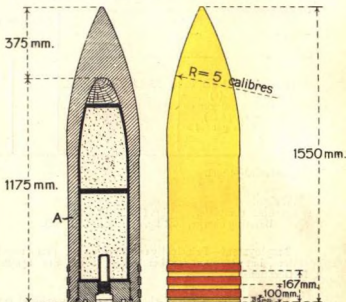
Exploder—Delay action exploder (delay=0.05 sec.), weighing 100 g.

Employment—Against open towns, permanent forts, and field works of exceptional strength.

Remarks—The fuze is identical with the naval fuze *Spgr. m. K.* except for the marking and for the addition of a tortuous "delay" channel.

38 cm. Spgr. L/4'1 m. Bdz. (?)

Calibre, 38.1 cm. (15").

SCALE— $\frac{1}{20}$.

Thickness of walls—At A, 52 mm.

Base plug—Diameter, 303 mm. ; thickness, 120 mm.

Width of driving bands—Upper band, 38 mm. ; middle, 35 mm. ; lower, 45 mm.

Distinctive markings—

42 cm. H.E. Shell with False Cap.

2·5 calibres long (?) (without cap, 1·7 calibres); 6 c.r.h. (?);
base fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
42 cm. short naval gun on fixed mounting (?)	<i>kz. Bd.Z. 10</i>	—	
42 cm. short naval gun on wheeled carriage (?) (rifling of both guns, 120 grooves)	Ditto	—	

Material—Steel.

Weight—

Shell complete, kg. (lbs.).

Bursting charge, 60·4 kg. approx. (133·1 lbs.).

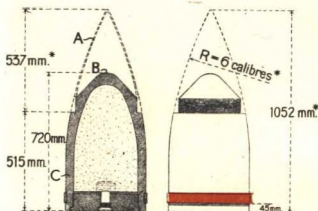
Employment—Principally employed against permanent fortifications, but also used for bombarding towns and against field fortifications.

Remarks—The pitch of the rifling of the mortar or cut-down naval gun (?) which fired this projectile = 6° approx.

There is no definite information available as regards the piece from which this novel type of projectile is fired.

42 cm. Spgr. L/1'7 m. Bdz. (m. Haube) (?).

Calibre, 42.3 cm. (16.65").

SCALE— $\frac{1}{20}$.

Thickness of walls—At A, 5 mm.; at B, 60 mm.; at C, 41 mm.

Base plug—Diameter, 367 mm.; thickness, 92 mm.

Width of driving band—50 mm.

Distinctive markings—

* Dimension approximate only.

24 cm. Naval Shrapnel with False Cap.

4·2 calibres long; 10 c.r.h.; clockwork fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
24 cm. naval Q.F. gun I./40 (rifling, 72 grooves) Mounted as follows:— 24 cm. gun I./40 on railway mounting 24 cm. gun on platform mounting	<i>Dopp. Z. 16</i>	yards. over 22,000	yards. —

Material—Steel.

Weight—

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

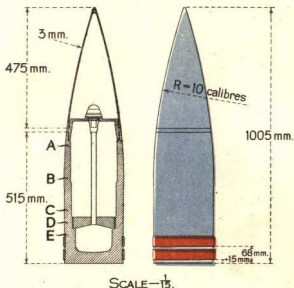
Bullets—About 1,500 16·8-g. steel bullets, 27 to the lb., set in pitch.

Employment—Against kite balloons at long ranges; against camps and villages.

Remarks—The clockwork fuze *Dopp. Z. 16* can be set for a maximum of about 55 seconds.

24 cm. Schr. L/4.2 (Haube) (?).

Calibre, 23.6 cm. (9.29") (?).



Thickness of walls—At A, 16 mm.; at B, 26 mm.; at C, 29 mm.; at D, 31 mm.; at E, 44 mm.

Thickness of base—43 mm.

Width of driving bands—40 mm.

Distinctive markings—Specimens of this shrapnel have been found painted like the 15 cm. Schr. 03 (Haube), shown on page 255 (body, red; false cap, grey). Possibly the point is painted black.

38 cm. Naval Shrapnel.

3·6 calibres long ; 3·7 c.r.h. ; clockwork fuze.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
38 cm. naval Q.F. gun L/50 (?) (rifling, 100 grooves)	<i>Dopp. Z. 28-38...</i>	yards. At least 22,500	yards. —

Material—Steel.

Weight—

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

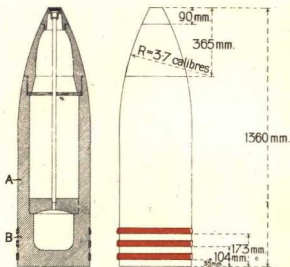
Bullets— 36-g. lead bullets, 13 to the lb.

Employment—

Remarks—The weight of the shell empty is believed to be about 550 kg. (*say* 10 cwt.).

38 cm. Schr. L/3·6 (P).

Calibre, 38·1 cm. (15").



SCALE—20.

Thickness of walls—At A, 60 mm. ; at B, 85 mm.

Thickness of base—85 mm.

Width of driving bands—32 mm.

Distinctive markings—

7.6 cm. Light Minenwerfer H.E. Shell.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
Light Minenwerfer (old pattern) (<i>l.M.W. a/A</i>) (rifling, 6 grooves)	<i>l.W.M.Zdr.</i> ...	yards. 1,148	yards. 1,148

Material—Steel.

Weight—

Shell complete, 4.5 kg. (9.9 lbs.).

Bursting charge, 0.52–0.56 kg. (1.15–1.2 lbs.). *Donarit* or *Perdit* (in an air-tight tinned iron container).

Variation—

Weight—

Shell complete, 4.62 kg. (10.2 lbs.).

Bursting charge, 0.55 kg. (1.2 lbs.). *Donarit*.

Distinctive marking—

“S 1” in black and the weight “4.62 K” in white.

Employment—Against living targets (*e.g.*, the garrisons of trenches, working parties, etc.); against sap-heads, centres of communication, entrances to mine galleries, mine craters, and concentrations of troops; in major operations, for barrage fire, either offensive or defensive, and for reducing machine gun nests, strong points, pillboxes, etc. Also reported to be occasionally used against low-flying aeroplanes.

Remarks—This shell is self-propelling, the charge being contained in the chamber in the base and consisting of perforated discs of smokeless powder, each 0.3 mm. thick and weighing 1 g. These discs are made up in packages of 3 or 6.

Four charges, weighing 6, 9, 12 and 15 g. respectively, are used with this shell. The charge is fired by means of a primer screwed into the centre of the base plug.

Shell of more recent manufacture were fitted with a base plug in which there were 8 holes (gas escapes) and these plugs were also issued separately for use with the original shell. It was probably found that, the total surface of the gas escapes being too small and the holes too far apart, unequal pressures set up, which gave rise to prematures in the bore.

Particulars of the light Minenwerfer (old pattern on rectangular bed).

Weight in action—2 cwt.

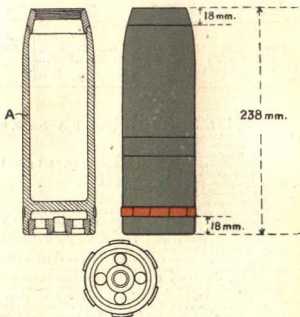
Rate of fire—Up to 20 rounds a minute for short periods.

Personnel required to carry the Minenwerfer into action—6 men.

Most favourable range—328–1,094 yards.

Leichte Wurf-Mine (l.W.M.).

Calibre, 7.6 cm. (2.99").



Thickness of walls—At A, 7.5 mm.

Thickness of base—10 mm.

Thickness of base plug—15 mm.

Width of driving band*—10 mm. ; in some cases 20 mm.

Distinctive markings—None.

* This Minenwerfer being a rifled muzzle-loader, the driving band is studded to fit the grooves of the rifling. The bands were originally of copper, but were subsequently made of white metal.

1916 Pattern 7.6 cm. Light Minenwerfer H.E. Shell.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
New light Minenwerfer (<i>l. M. W. n/A.</i>) (rifling, 6 grooves)	<i>l. W. M. Zdr. 2</i> ...	yards. 1,422	yards. 1,422
	<i>Az. 16 f. l. W. M.</i> ...	—	1,422

Material—Steel.

Weight—

Shell complete, 4.5 kg. (9.9 lbs.).

Bursting charge, 0.54–0.56 kg. (1.1–1.2 lbs.). *Donarit, Westphalit, or Perdit.*

Variation—

Designation—*l. Spr. M. (Käthe).*

Distinctive marking—one black band, or “K” in 6 places in black.

Width of driving band—15 mm. (zinc band).

Base plug—steel or white metal, 8 holes.

Charges—No. 5 was not used.

Maximum range—1,203 yards.

This was an earlier pattern and by now should be obsolete.

Employment—Same as for the older pattern (*see* page 352).

Mainly intended for use against living targets.

When fired at close ranges and with high angles of elevation, the effect is similar to that of a field gun H.E. shell.

Remarks—There are three different makes of this shell, which differ merely by the process of manufacture. These are:—

l. Spr. M. 16 (Lotte). Cast steel, bored and fitted with a screwed head.

l. Spr. M. 16 (Erna). Forged steel, with screwed head.

l. Spr. M. 16 a (Anna). Forged steel, made in one piece.

All three are direct filled, i.e., there is no special container for the bursting charge. The cavity is closed by the steel gaine. The threaded washer which is screwed down on to the flange of the latter ensures a tolerably air-tight joint.

The driving band is of zinc, containing about 1.4 per cent. copper and 1.3 per cent. iron.

In order to hold 5 instead of 4 charges, the cavity in the base of the 1916 shell has been enlarged by reducing the thickness of the base plug from 15 to 10 mm. There are 6 holes (gas escapes) in the base plug.

The four charges used are Nos. II, III, IV and V, and weigh respectively 11, 14.5, 18 and 25 g. Charge No. 4 consists, for example, of packets Nos. 1, 2, 3 and 4 tied together. No. 1 is not used alone.

Particulars of the new light Minenwerfer—

Weight in action—nearly 3 cwt.; on flat trajectory carriage, 4 cwt.

Rate of fire—up to 20 rounds a minute for short periods.

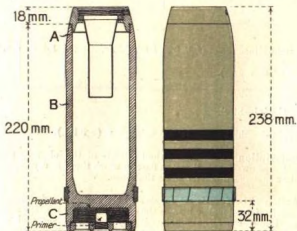
Range—High-angle fire, 328–1,422 yards; flat trajectory, 164–1,203 yards. For range table, *see* Appendix XXI.

This Minenwerfer was designed for trench warfare, and the regulation carriage on circular base-plate is made for high-angle fire only. For open warfare two new carriages have been introduced, known respectively as the *Flachbahn-Lafette* (carriage for flat trajectory fire) and the *Flachbahn-Gestell* (stand for flat trajectory fire).

Leichte Spreng-Mine 16 (1. Spr. M.16).

(Lotte or Erna.)

Calibre, 7.6 cm. (2.99").



SCALE— $\frac{1}{4}$.

Thickness of walls—

At A, 6 mm. ; at B, 7 mm. ; at C, 8 mm.

Thickness of base—14 mm.

Thickness of base plug—10 mm.

Width of driving band*—15 mm.

Distinctive markings—Three black bands, denoting an H.E. filling.

Shell of recent manufacture are designated and marked as follows :—

<i>Lotte</i>	...	"L"	in 6 places in black.
<i>Annaliese</i>	...	"A"	" "
<i>Ernaliese</i>	...	"E"	" "

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

7.6 cm. Light Minenwerfer Message Shell.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
New light Minenwerfer (<i>l.M.W.</i> <i>n/A.</i>) (rifling, 6 grooves)	<i>l.W.M.Zdr. 2</i> ...	yards.	yards.
		1,422	1,422

Material—Steel.

Weight—Shell complete, 4.5 kg. approx. (9.9 lbs.).

Description—The message shell consists of the following parts:—
A light Minenwerfer shell case, a flare in which there is a compartment to take a message, a burster and a time fuze.

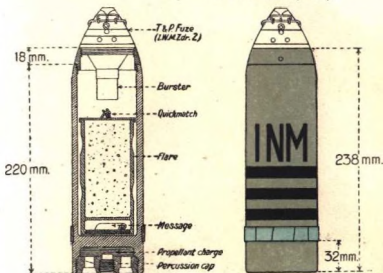
Action—The fuze is set for an air-burst; as the shell bursts open, the flare is lighted and so heralds the approach of the message shell. It is not clear whether the container is projected out of the shell case or not. The flare continues to burn for several seconds after it has struck the ground and apparently becomes so hot that a pair of pincers is supplied for handling it. The cover of the message compartment has then to be unscrewed with a special key.

Employment—The message shell provides a means of communication between battalion and regimental H.Q., and from the latter to the artillery, the brigade, or to a report centre. For forwarding reports to the division, &c., this system is linked up with the telephone and wireless stations behind the front. At receiving stations the observer should be posted in a dug-out, with a loop-hole giving on to a well-defined target. This target will have been previously registered. It must be concealed from the enemy, otherwise the receipt of the projectile will be observed and will draw hostile fire. Reports forwarded by this means should always be sent in duplicate by two successive rounds.

Remarks—The introduction of the message shell was due to the hope that it would still be possible to send a message in a light Minenwerfer shell, when all other means of communication had broken down.

Leichte Nachrichten-Mine (L.N.M.).

Calibre, 7.6 cm. (2.99").



SCALE— $\frac{1}{4}$.

The shell body is that of the 1916 pattern light Minenwerfer shell (see page 354).

Distinctive markings—The letters "L.N.M." and 3 black bands. Shell of recent manufacture are marked with a blue "N" in 6 places.

NOTE.—The 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.

Used with			Maximum range.	
Minenwerfer.			Time.	Perc'n.
Medium Minenwerfer (old pattern) (m.M.W.) (rifling, 6 grooves)		Z.m.W.M.	yards	yards.
		Z.s.u.m.W.M.	1,006*	1,006*

Material—Steel.

Weight—

Shell complete, 45·2 kg. (99·6 lbs.).

Bursting charge, 9·8 kg. (21·6 lbs.). Ammonium nitrate mixture.

Variations—

(1) *Weight*—

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

Bursting charge, 10·6 kg. (23·4 lbs.). Ammonium nitrate mixture.

Base—A steel plate, 154 mm. in diameter and 22 mm. thick, is attached to the base by 5 screws.

(2) *Weight*—

Shell complete, 54 kg. (119 lbs.).

Bursting charge, 14·1 kg. (31·1 lbs.). Perchlorate of potash and dinitrobenzene, in equal parts.

Base—As above.

(3) *Designation*—m.W.M. 13.

Weight—

Shell complete, 49·5 kg. (109·1 lbs.).

Bursting charge, 12 kg. (26·4 lbs.). Donarit, Westphalit or Perdit.

Driving band—Zinc alloy.

Thickness of walls—14 mm.

Thickness of base—17 mm.

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

Remarks—Five charges, of 44, 66, 88, 110 and 132 g. respectively, were used with this shell, and later on a super-charge No. 6 of 154 g. was introduced.

Particulars of the medium Minenwerfer—(Old pattern on rectangular bed)—

Weight in action—9½ cwt.

Rate of fire—30-35 rounds per hour.

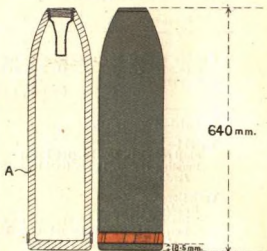
Personnel required to carry the Minenwerfer into action : 17 men.

Most favourable range—164-984 yards.

* With Charge No. 6. The normal maximum range is 840 yards with Charge No. 5.

Mittlere Wurf-Mine (m.W M.).

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**—Two, three or four green bands denote a perchlorate of potash and dinitrobenzene filling [see under "Variations" (2)].

One or two black bands indicate a projectile with stronger base than that of the original shell.

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

1916 Pattern 17 cm. Medium Minenwerfer H.E. Shell.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Pere'n.
1916 pattern medium Minenwerfer (<i>m.M.W. 16</i>) (rifling, 6 grooves)	2 percussion fuzes— (1) Non-delay action. (2) Delay action.	yards. —	yards. 1,258

Material—Forged steel.

Weight—

Shell complete, 49.5 kg. (109.1 lbs.).

Bursting charge, 12 kg. (26.4 lbs.). *Donarit, Westphalit or Perdit.*

Variation—

Weight—

Shell complete, 53 kg. approx. (116.8 lbs.).

Bursting charge, 14 kg. (31 lbs.). Mixture of perchlorate of potash and dinitrobenzene.

Employment—*With non-delay action*: Very good effect against living targets and open trenches, by means of fragments and concussion; great moral effect.

Deep dug-outs are not destroyed. Good effect against wire entanglements, but double the number of rounds is required as compared with the heavy 25 cm. shell.

With delay action: Mined dug-outs, 10–13 feet deep, are blown in. Good effect against strong points and fortified villages. The effect against wire entanglements is less than with non-delay action shell.

Particulars of the 1916 pattern medium Minenwerfer—

Weight in action—11 cwt.

Rate of fire—30–35 rounds per hour.

Personnel required to carry the Minenwerfer into action—21 men.

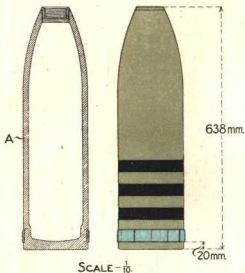
Most favourable range—328–1,258 yards.

This Minenwerfer is used in open warfare.

Remarks—The driving band is of zinc alloy.

Mittlere Spreng-Mine 16 (m. Spr. M. 16).

Calibre, 17 cm. (6.69").



Thickness of walls—At A, 13 mm.

Thickness of base—21 mm.

Width of driving band*—32 mm.

Distinctive markings—Three black bands, denoting an H.E. filling.

Green bands (2, 3 or 4) denote a perchlorate of potash and dinitrobenzene filling (see under "Variation").

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

1914 Pattern 17 cm. Medium Minenwerfer Incendiary Shell.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
Medium Minenwerfer (old pattern) <i>m.M.W.</i> (rifling, 6 grooves)	<i>Z.m.W.M....</i> <i>Z.s.u.m.W.M.</i>	yards. 1,126	yards. 1,126

Material—Steel.

Weight—

Shell complete, 37·4 kg. (82·5 lbs.).

Bursting charge, 0·01 kg. (0·02 lb.).

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

6·4 kg. (14·1 lbs.).

0·8 kg. (1·8 lbs.).

Powder.

Thermite.

Metallic sodium.

Paraffin wax.

Employment—

As an incendiary shell.

Remarks—In plate opposite :—

B is a wooden cylinder in place of the picric acid exploder in the gaine of the fuze. It is pierced by a channel filled with black powder leading from the fuze to C.

C is a tin receptacle containing the powder charge.

The metallic sodium is contained in a tin container, which is hermetically sealed, and is set in paraffin wax.

The remainder of the shell, including the channel down the centre of the metallic sodium receptacle, is filled with thermite.

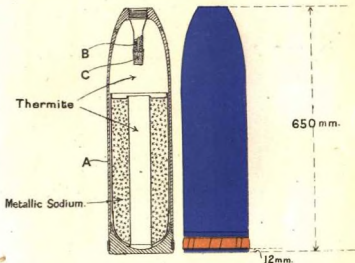
The small holes, in the walls just above the shoulder, are closed with lead plugs.

Five charges of 44, 66, 88, 110 and 132 g. were used.

This shell was apparently not a success and is no longer issued. The same shell case has been found with a gas filling.

Mittlere Brand-Mine 14.

Calibre, 17 cm. (6.69").

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

Thickness of walls—At A, 5 mm.

Thickness of base—15 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.

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

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
		yards.	yards.
Heavy Minenwerfer (old pattern) (<i>s.M.W.</i>). (rifling, 6 grooves)	<i>Z.m.W.M.</i>	776	776
	<i>Z.s.u.m.W.M.</i>		

Material—Steel.

Weight—

Shell complete, 63 kg. (138.9 lbs.).

Bursting charge, 25–26 kg. (55–57 lbs.). *Nitrolit* (*An.* $\frac{60}{40}$).

Variation— $\frac{1}{2}$ *s. Spr. M. 16* (*halbe schwere Spreng-Mine 16*, or 1916 pattern half-sized heavy Minenwerfer H.E. shell).

Weight—

Shell complete—61 kg. (134.4 lbs.).

Bursting charge—20 kg. (44 lbs.). *Nitrolit* (*An.* $\frac{60}{40}$).

Length—598 mm.

Driving band—Zinc.

Distinctive markings—Three black bands.

Maximum range—919 yards.

Employment—Against wire entanglements, breastworks and deep trenches, dug-outs, observation posts, trench-mortar and machine-gun emplacements, mine shafts and craters.

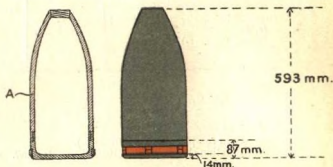
Good burying effect and also effect due to concussion, but small penetration; against wire entanglements its destructive effect is similar to that of the full-sized heavy H.E. shell (*see* page 372).

Remarks—According to a document dated July, 1917, all short heavy Minenwerfer H.E. shell should now be obsolete.

Three charges of 100, 130 and 155 g. were in use, but charge No. 3 was only used with the 1916 pattern.

Kurze schwere Wurf-Mine (kz.s.W.M.).

Calibre, 25 cm. (9.84").



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

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, and filled with $An. \frac{60}{40}$.

* 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.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
Heavy Minenwerfer (old pattern) (s.M.W.) (rifling, 6 grooves)	Z.s.W.M. Z.s.u.m.W.M.	yards. 601	yards. 601

Material—Steel.

Weight—

Shell complete, 94 kg. (207·2 lbs.).

Bursting charge, 47 kg. (103·6 lbs.). *Donarüt.*

Variations—

- (1.) 1,000 mm. in length; made in one casting, with a screwed-in base.
- (2.) 950 mm. in length; with 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.

Employment—Against wire entanglements, breastworks, and deep trenches; dug-outs, observation posts, trench-mortar and machine-gun emplacements, mine shafts and craters.

Remarks—Originally 3 charges of 100, 130 and 155 g. were in use, with a super-charge, No. 4, of 185 g. for exceptional cases. With No. 3, the maximum range was 460 yards and with No. 4, 514 yards. In a document dated July, 1917, the maximum range is, however, given as 601 yards, which indicates the introduction of a further charge.

Particulars of the heavy Minenwerfer (old pattern on rectangular bed)—

Weight in action—11½ cwt.

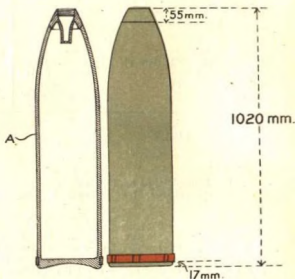
Rate of fire—20 rounds per hour.

Personnel required to carry the Minenwerfer into action—21 men.

Most favourable range—219-601 yards.

Lange schwere Wurf-Mine. (lg. s.W.M.).

Calibre, 25 cm. (9·84").



SCALE— $\frac{1}{15}$

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.

1916 Pattern 25 cm. Heavy Minenwerfer Full-sized H.E. Shell.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
1916 pattern heavy Minenwerfer (s.M.W. 16) (rifling, 6 grooves)	2 percussion fuzes— (1) Non-delay action (2) Delay action	yards. —	yards. 1,094

Material—Steel.

Weight—

Shell complete, 94 kg. (207.2 lbs.).

Bursting charge, 47 kg. (103.6 lbs.). *Donarit*.

Employment—*With non-delay action*: Great moral and destructive effect, due to the force of the bursting charge; annihilating effect due to concussion, even against troops in dug-outs, as long as these are not too deep. Single fragments are scattered up to 440 yards. The destructive effect is not sufficient against deep-mined dug-outs. A direct hit will clear a space 33 feet or more in diameter in a wire entanglement.

With delay action: Very great penetration. Mined dug-outs with 23–30 feet of earth cover are blown in. The craters in average soil are 16–20 feet deep, with a diameter of 26–33 feet.

Particulars of 1916 pattern heavy Minenwerfer—

Weight in action—15 cwt.

Rate of fire—20 rounds per hour.

Personnel required to carry the Minenwerfer into action—
28 men.

Most favourable range—547–1,094 yards.

Remarks—

Ganze schwere Spreng-Mine 16 (1/1 s. Spr.
M. 16).

Thickness of walls— mm.

Thickness of base— mm.

Width of driving band— mm.

Distinctive markings—

17 cm. Medium Flügel-Minenwerfer H.E. Bomb (with vanes).

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
Medium Flügel-Minenwerfer (smooth-bore)	—	yards. —	yards. 1,600 (?)

Material—

Weight—

Shell complete, 56 kg. (?) (123 lbs.).

Bursting charge,

Employment—Same as for 1916 pattern medium Minenwerfer H.E. shell (*see* page 362); probably much more effective.

Particulars of medium Flügel-Minenwerfer—

Remarks—

mittlere Flügel-Mine (m.Fl.M.).

Calibre, 17 cm. (?) (6.69").

Thickness of walls—

Distinctive markings—

24 cm. Heavy Flügel-Minenwerfer H.E. Bomb (with vanes).

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
Heavy Flügel-Minenwerfer (smooth bore)	2 percussion fuzes— (1) Non-delay action (2) Delay action	yards. —	yards. 1,312*

Material—Steel.

Weight—

Shell complete, 100 kg. (220.5 lbs.).

Bursting charge, 42 kg. (92.6 lbs.).

Employment—Same as for 1916 pattern heavy Minenwerfer (long) H.E. shell (*see* page 372), but probably much more effective, as, owing to the vanes, the bomb keeps head foremost in flight and has greater penetrative effect.

Remarks—The tail of the bomb comprises 4 vanes and screws into the bomb. Bombs are issued unfuzed. Two fuzes are issued with each bomb, one a delay action fuze, the other non-delay. The former is stated to be almost instantaneous and is for use against living targets and wire entanglements. The full charge of 1.76 lbs. of smokeless powder in rings is made up in two bags containing 1.1 lb. and 0.63 lb. respectively. The first mentioned contains an igniter and is also used as a reduced charge. The gun is fired by a friction tube.

Particulars of the heavy Flügel-Minenwerfer—

Weight in action: 25 cwt.

Rate of fire: 25 rounds per hour.

Personnel (required to carry the Flügel-Minenwerfer into action): 42 men.

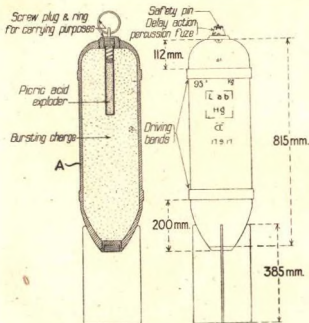
Most favourable range: 492–1,312 yards.

For range table, *see* Appendix XXII.

* According to an entry in a captured note-book, the range of this Minenwerfer has been increased to 2,400 m. (2,625 yards) by the introduction of a (lighter ?) bomb, known as a *3/4 Mine*.

schwere Flügel-Mine (s.Fl.M.).

Calibre, 24 cm. (9 '45").



SCALE — $\frac{1}{15}$.

Thickness of walls—8 mm.

Distinctive markings—The non-delay action fuze is neither painted nor marked. The delay action fuze is painted brown and marked "m.V."

18 cm. Smooth-Bore Minenwerfer H.E. Bomb.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
18 cm. smooth-bore Minenwerfer.	<i>Z. gl. W.M.</i>	yards. 650	yards. —
18 cm. gas projector (<i>Gaswerfer</i>)	"	approx. at least 1,400	

Material—Cast iron.

Weight—

Bomb complete, 27.4 kg. (60.4 lbs.).

Bursting charge, 8.0 kg. (17.6 lbs.). Ammonium nitrate explosive.

Employment—In trench warfare, against the garrisons of trenches, and for the destruction of trenches, shelters, &c.

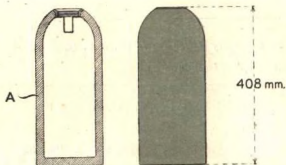
Remarks—The fuze is a time fuze only. A picric acid exploder weighing 19.5 g. is contained in an iron tube, which forms part of a screwed-in adapter.

The bomb is fired with a papier maché base plate 4 mm. thick which acts as a gas check.

For particulars of the 18 cm. smooth-bore Minenwerfer, and of the projector, see page 455.

Glatte Wurf-Mine (gl. W.M.).

Calibre,* 18 cm. (7·08").



SCALE — $\frac{1}{10}$.

Thickness of walls—At A, 14 mm.

Thickness of base—18 mm.

Driving band—None.

Distinctive markings—

* Of the mortar; the external diameter of the bomb is about 17·8 cm. (7·0").

24 cm. Canister Bomb (Rum Jar).

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Pere'n.
24 cm. heavy <i>Ladungswerfer Ehrhardt</i> (Smooth-bore bomb-thrower)	T. & P. (canister bomb fuze)	yards. 290*	yards. 290*

Material—Sheet iron, welded. Wooden base.

Weight—

Bomb complete, 20 kg. (44 lbs.).	Bursting charge, 14 kg. (30·8 lbs.).
" " 30 kg. (66 lbs.).	Bursting charge, 23 kg. (50 lbs.).
" " 40 kg. (88 lbs.).	Bursting charge, 32·5 kg. (72 lbs.).

The explosive used is an ammonium nitrate mixture.

Employment—In trench warfare, against the garrisons of trenches and for the destruction of trenches, shelters, &c.

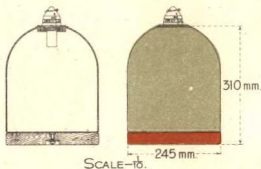
Remarks—This canister bomb or "rum jar" is the best known of the earlier types of trench-mortar bomb. It is now practically obsolete.

Particulars of the 24 cm. heavy "Ladungswerfer Ehrhardt"—The gun consists of a steel tube, about 3 feet in length, into which screws the breech piece. The gun is mounted on a cast steel carriage, which is pivoted on a rectangular wood and steel platform. The latter measures about 2' 0" x 3' 9". The mortar is fired by means of a fiction tube. Black powder charges are used.

* With the 20 kg. bomb; 208 and 175 yards with the 30 and 40 kg. bombs respectively.

Ladungs-Mine.

Calibre,* 24.5 cm. (9.6").



The drawing shows the 20 kg. bomb. The two heavier types are longer, but otherwise identical in construction.

Thickness of walls—1.5 mm.

Thickness of wooden base plate—30 mm.

Driving band—None.

Distinctive markings—

* Of the mortar; the external diameter of the bomb is about 24 cm. (9.4").

GERMAN GAS SHELL.*

Introduction.—German gas shell contain a liquid or solid substance with toxic properties, which is converted by the burst of the shell into a cloud of vapour or fine particles, part of the contents being driven into the ground in the neighbourhood of the shell crater. If the substance has a high boiling point and is not readily decomposed by the water in the soil, the part on the ground will evaporate slowly, giving rise to persistent effects which may last for hours or days, depending on the nature of the substance and the atmospheric conditions.

The older pattern of gas shell contained a liquid in the cylindrical portion and an H.E. bursting charge in the head. Gas shell of more recent types are usually completely filled with liquid, the exploder in the gaine being sufficient to burst the shell. In "Green Cross 2" shell, a central tube containing H.E. runs the whole length of the shell, and "Blue Cross" shell contain two-thirds H.E. in order to scatter the solid substance contained in a glass bottle. In some cases, the liquid contents are placed in lead or porcelain containers as they corrode steel.

It was formerly possible to divide the shell fillings used by the enemy into lachrymatory, which attack the eyes temporarily and are otherwise harmless, and lethal, which are directly poisonous. The enemy now employs shell fillings with properties varying from purely lachrymatory to purely lethal, including intermediate varieties producing both effects. In addition, he uses substances which blister the skin, and also some which irritate the nose and cause violent sneezing.

Substances employed.—Table I (see page 389) gives a list of the substances employed by the enemy in gas shell. The most important types of shell fillings are as follows:—

"*Green Cross*" contains diphosgene (trichlormethylchloroformate), a liquid with an unpleasant smell resembling phosgene. It is highly lethal and slightly lachrymatory, but has little persistence.

"*Green Cross 1*" contains diphosgene mixed with chloropicrin, the vapour of which has a powerful lachrymatory effect, and is also lethal. This filling is more persistent than the preceding one.

Recent specimens of this filling contain a red dye which has no toxic properties. It stains the shell holes so that they may be easily identified.

"*Green Cross 2*" contains phosgene, diphosgene and diphenylchlorarsine. The latter substance is a solid. Small quantities of its vapour cause pain in the nose and throat, and sneezing. The mixture is lethal and lachrymatory, but has only slight persistence.

* For tables of German gas shell, see pages 17-21.

"*Blue Cross*."—In this type about two-thirds of the shell is filled with H.E., the remaining space being occupied by a glass bottle containing diphenylchlorarsine. The shell bursts with an explosion similar to that of an ordinary H.E. shell, and causes sneezing. It is often used with one of the types of "*Green Cross*" shell described above.

In a projector bomb of recent introduction, the H.E. and diphenylchlorarsine form one substance, made up in the form of pellets about the size of a pea. This substance detonates readily, producing a black smoke which is extremely irritant to the respiratory organs.

"*Yellow Cross*" contains dichlorethylsulphide, the so-called "mustard gas," a liquid with a faint garlic-like smell. Although the vapour produces no immediate discomfort, it is highly lethal, and, in addition, produces inflammation of the eyes. The ill-effects are not noticeable until some hours after exposure. If the skin comes in contact with the liquid or is exposed to the concentrated vapour, no pain is felt at the time, but blisters are developed about six hours afterwards.

Dichlorethylsulphide is very persistent and may remain in the ground for several days after a bombardment.

A variation of "*Yellow Cross*" (possibly "*Yellow Cross 1*") consists of about equal parts of ethyldichlorarsine and dichlormethylether. This is a liquid, brown in colour, transparent and fuming rather strongly in air.

It has a pungent smell described variously as like chloroform and like garlic. The physiological effects are irritation of the eyes, nose and throat, sneezing, headache, vomiting, and loss of feeling in the hands and feet. The last-mentioned symptom is the most characteristic, and is due to the ethyldichlorarsine.

This gas dissipates more rapidly than the original "*Yellow Cross*."

Ethyldibromarsine may also be contained in shell of this type.

Phenyl carbylamine chloride (marking unknown) is a substance with a very unpleasant pungent smell. The vapour is a moderate lachrymator and a mild lung irritant, and produces vomiting. It is very persistent, and the shell often contain purple dyes similar to those used with "*Green Cross 1*."

Method of employment.—The enemy usually employs gas shell in short concentrated bursts of fire in order to surprise troops before they can adjust their respirators. These bursts of fire are often repeated at intervals to secure a neutralizing or harassing

effect. Sometimes a slow rate of fire is kept up continuously for the latter purposes.

Gas shell are most effective in producing casualties in a calm or wind of low velocity, as the small cloud of gas liberated at the burst is not dispersed quickly. Most gas shelling takes place between the hours of dusk and dawn, as the atmospheric conditions are usually most favourable at that time, and also the difficulty of seeing when wearing the mask is much greater in the dark.

The nature of the ground has also a great influence on the effectiveness of gas shell; targets in woods or valleys are protected from the wind, and the gas is dispersed less rapidly than in the open and may hang about for a considerable time.

The following extracts from a German document, dated July, 1917, illustrate the employment of artillery gas shell:—

I.—Small gas shoots against a limited objective.

Type of gas shell to employ.—"Blue Cross" and "Green Cross 1" (50 per cent. of each), or "Green Cross 2," or "Blue Cross," or "Yellow Cross" (75 per cent.) and H.E. (25 per cent.).

Registration.—With H.E. shell (bracket for example, 4,000-4,100 metres).

Method of fire.—Bursts of fire with gas shell at, for example, 4,050, 4,000, and 4,100 metres. Advantage will be taken of the direction of the wind. The shoot will be executed rapidly and will be repeated $\frac{1}{2}$ hour or 1 hour later.

Bursts of fire with "Blue Cross" shell can be interpolated in a bombardment with H.E. shell, or can be combined with the latter.

Ammunition expenditure.—

(7.7 cm.) field gun	...	...	...	100 rounds*
or (10.5 cm.) light field howitzer or 10 cm. gun	...	...	50	" "
or (15 cm.) heavy field howitzer or 15 cm. long gun	...	...	25	" "
or 21 cm. howitzer (<i>Mörser</i>)	...	...	10	" "

II.—Medium gas shoots against groups of targets, portions of positions, woods, &c.

Type of shell to employ.—"Blue Cross" and "Green Cross 1" (50 per cent. of each), or "Green Cross 2" or "Yellow Cross" (75 per cent.) and H.E. (25 per cent.).

Registration.—With H.E. shell.

Method of fire.—Bursts of fire with gas shell on each hectare,† as stated above under "Small gas shoots." Advantage will be taken of the direction of the wind, and fire will be repeated at

* With "Yellow Cross" shell double this amount.

† A hectare = 100 × 100 m. = 10,000 sq. m. (11,960 sq. yds.)

irregular intervals. To ensure rapid execution, as many batteries as possible will co-operate.

Maximum duration.—Two hours.

Hectarest† in which there are no targets may be left out, so that those in which there are targets can be shelled more heavily.

Ammunition expenditure.—As for "Small gas shoots."

III.—Large gas bombardments (area shoots covering several square kilometres).

Type of shell to employ.—For important hectarest "Blue Cross" and "Green Cross 1" (50 per cent. of each), or "Green Cross 2."

For less important hectarest "Green Cross 1" or "Green Cross 2," or "Yellow Cross" (only when necessitated by questions of ammunition supply).

Registration.—With H.E. shell.

Method of fire.—On the important hectarest, bursts of fire with gas shell. The method of fire and the ammunition expenditure will be as stated under "Small gas shoots."

The whole area will be gassed simultaneously; the ammunition expenditure per hectarest will be as follows:—

(7.7 cm.) field gun	60 rounds.
or (10.5 cm.) light field howitzer or 10 cm. gun ...	30 "
or (15 cm.) heavy field howitzer or 15 cm. long gun	15 "
or 21 cm. howitzer (<i>Mörser</i>)	6 "

This "gassing" may be more protracted than the bursts of fire with gas shell.

Towards the conclusion of the shoot, the hectarest to windward should be particularly heavily shelled.

Maximum duration.—Two hours.

SMOKE SHELL.

Smoke shell (*see* page 430) are sometimes employed towards the end of a gas shell bombardment to increase the visibility of the gas cloud, so that it can be seen when the area is free from gas.

† A hectare = 100 × 100 m. = 10,000 sq. m. (11,960 sq. yds.).

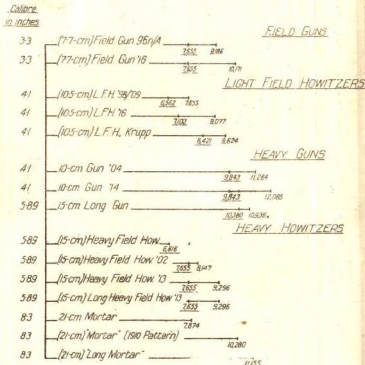
TABLE I.—SUBSTANCES EMPLOYED IN GERMAN GAS SHELL.

Substance.	Formula.	Boiling Point in Degrees C.	Density.	Method of Recognition.	Effect.*	Container.	Persistence on Ground.
Benzyl bromide ...	$C_6H_5CH_2Br$...	199°	1.44	Smells like mustard and cress. Immediate lachrymation.	L.	Lead or porcelain.	Very high.
Xylyl bromide ...	$CH_3C_6H_4CH_2Br$...	215°	1.57		A. & L.	None	Moderate.
Bromomethylethylketone	$CH_3CHBr.COCH_3$	50-52° at 20 mm.	1.40	Immediate irritation in nose and throat and lachrymation.	A. & L.	None	Moderate.
Chloropicrin ...	CCl_3NO_2 ...	112°	1.97	Unpleasant musty smell. Immediate lachrymation.	A. & L.	None	Moderate.
Dichlorethylsulphide ...	$(CH_2Cl.CH_2)_2S$...	217°	1.27	Smells like garlic or mustard. No immediate effect on eyes or lungs.	V. & delayed L. & A.	None	Very high.
Diphenylchlorarsine ...	$(C_6H_5)_2AsCl$...	310° MP. 38°	1.44	Causes irritation and pain in nose and throat, and often sneezing.	S.	Glass bottle	None.
Ethylchlorarsine ...	$C_2H_5AsCl_2$...	150°	1.71	Irritant action on nose and throat. Delayed effect on eyes.	A. & S.	None	Moderate.
Ethylbromarsine ...	$C_2H_5AsBr_2$...	122°	2.36		Slight A. & L.	None	Low.
Dichlormethylether ...	$(CH_3Cl)_2O$...	103°	1.35	Not used alone.	Slight A. & L.	None	Low.
Monochlormethylethylchloroformate.	$Cl.CO.O.CH_2Cl$...	108°	1.47	Smells like phosgene. Slight lachrymation.	A. & slight L.	Lead	Low.
Phenyl carbylamine chloride.	$C_6H_5NC.Cl_2$...	206°	1.29	Unpleasant pungent smell. Lachrymation.	A. & L.	None	Very high
Phosgene ...	$COCl_2$...	8°	1.43	Characteristic smell and effect on taste (tolacco reaction). Slight lachrymation.	A. & slight L.	None	Very low.
Trichlormethylchloroformate (diphosgene).	$Cl.CO.O.CCl_3$...	128°	1.65	Smells like phosgene. Slight lachrymation.	A. & L.	None	Low.

* A. = Asphyxiant, lethal, poisonous; L. = Lachrymator (tear gas); S. = Sternutator (causes irritation and pain in the nose and throat, and often sneezing; V. = Vesicant (skin irritant, causing blisters).

MAXIMUM RANGES OF GERMAN GUNS WHEN FIRING GAS SHELL.

The normal maximum ranges with gas shell, as laid down officially, are underlined.



Addendum—

The 15 cm. gun '16 which has a maximum range of 24,934 yards fires a yellow cross gas shell with false cap (see page 422).

TYPES OF GERMAN GAS SHELL AND LABELS ON SHELL BASKETS.

A captured document, dated 28th September, 1917, gives the labels on the shell baskets for the types of gas shell then in use. These are shown in the following table, together with the nature of the filling of those types which have been identified. It is not yet known whether a filling of phenyl carbylamine chloride belongs to any of these types:—

Type.	Label on Shell Basket.	Filling.	Nature.
Green Cross ...		Diphosgene	Lethal.
Green Cross 1 ...		Diphosgene 30-66 % chloro- picrin.	Lethal.
Green Cross 2 ...		60 % Phosgene 25-30 % Diphosgene. 10-15 % Diphenylchlorarsine	Causes sneezing in addition to lethal effect.
Blue Cross ...		Diphenylchlorarsine + H.E.	Causes sneezing in addition to H.E. effect.
Yellow Cross ...		Dichlorethylsulphide ...	Lethal, and attacks the eyes and skin.
Yellow Cross 1		50 % Ethyldichlorarsine. 50 % Dichlormethylether.	

All these types of gas shell were fired by each of the following guns, the only exception being Green Cross 2, which was not fired by the 7.7 cm. field guns:—

- (7.7 cm.) field guns 96 n/A. and '16.
- (10.5 cm.) light field howitzers '98/'09, '16 and Krupp.
- 10 cm. guns '04 and '14.
- (15 cm.) heavy field howitzers '02, '13 and long pattern '13.
- 15 cm. long gun.
- 21 cm. mortar, "mortar" and 21 cm. long mortar.

Labels on German gas shell which differ from the above should be immediately reported.

1915 Pattern Field Gun Gas Shell.

Green Cross.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(7.7 cm.) field gun 96 n/A. ... (rifling, 32 grooves)	K.Z. 14 ...	yards. —	yards. 9,186

Weight—

Shell complete, 7.1 kg. (15.7 lbs.).

Exploder, 23 g. (0.8 oz.). *Grf. 88* (picric acid).

Liquid contents, 0.465 kg. (1.02 lbs.).

Nature of liquid—Diphosgene.**Volume of liquid—**0.285 litre.

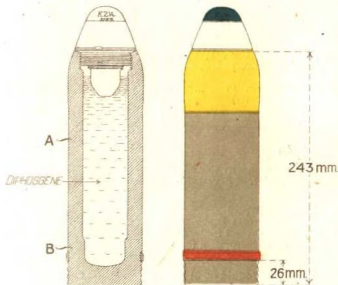
Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{0.285 \text{ litre}}{7.1 \text{ kg.}} = 4 \text{ per cent.}$

Remarks—The shell is burst open by the detonation of the picric acid exploder in the gaine of the fuze. The fuze is sealed with cement. The use of this shell with a gas filling was soon abandoned on account of its small capacity.

K. Gr. 15 Grkz.

Fixed ammunition; designation of complete round,
K. Gr. Patr. 15 Grkz.

Calibre, 7.7 cm. (3.03").



SCALE — $\frac{1}{4}$.

Thickness of walls—At A, 15 mm. ; at B, 18 mm.

Thickness of base—20 mm.

Width of driving band—8 mm.

Distinctive markings—The cap of the fuze is painted green.

A small cross is sometimes stamped on the fuze. This probably indicates that the joint between the gaine and the fuze body has been sealed with cement in order to prevent infiltration of the liquid filling.

The joint between the fuze and the shell is also sealed with cement, and the fuze is not stabbed round the edge. (On H.E. shell, the fuze is stabbed in about six places into small notches in the rim of the fuze hole.)

The shell is *not* marked Fp. $\frac{60}{40}$ as it would be if filled with amatol.

Long Pattern Field Gun Gas Shell.

Green Cross and Green Cross 1.

Used with		Maximum range.*	
Gun.	Fuze.	Time.	Perc'n.
(7·7 cm.) field gun 96 n/A. (rifling, 32 grooves)	... <i>K.Z. 14</i> ... <i>K.Z. 14 n.A.</i> <i>E.K.Z. 17</i>	yards. —	yards. 9,186
(7·7 cm.) field gun '16 (rifling, 32 grooves)	... Ditto ...	—	10,171

Weight—

Shell complete, 7·29 kg. (16·1 lbs.).

Exploder, 23 g. (0·8 oz.). *Grf. 88* (picric acid).

Nature of liquid—

Green Cross : Diphosgene or brommethylethylketone.

Green Cross 1 : 30—70 per cent. diphosgene + 70—30 per cent. chloropicrin (by volume).

Volume of Liquid—0·61 litre.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{0·61 \text{ litre}}{7·29 \text{ kg.}} = 8·4 \text{ per cent.}$$

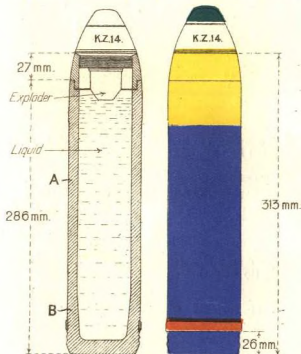
Remarks—Green Cross 1 shell have been examined which contained red dyes in addition to the ordinary filling.

* The normal maximum range of both guns when firing gas shell is 7,655 yards.

L.F.K. Gr. Grkz.
L.F.K. Gr. Grkz. 1.

Fixed ammunition; designation of complete round
L.F.K. Gr. Patr. Grkz.

Calibre, 7.7 cm. (3.03").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 10 mm. ; at B, 12 mm.

Thickness of base—15 mm.

Width of driving band—8 mm.

Distinctive markings—On the top of the fuze is sometimes stamped a cross (see page 393). The cap of the fuze is painted green. A green cross is sometimes painted on the base of the shell and always on the base of the cartridge case. There is no distinction between the markings of Green Cross and Green Cross 1 shell.

Long Pattern Field Gun Gas Shell.

Blue Cross.

Used with			Maximum range.*	
Gun.		Fuze.	Time.	Perc'n.
(7.7 cm.) field gun 96 n/A. ... (rifling, 32 grooves)	...	<i>E.K.Z. 16</i> ... <i>K.Z. 11 Gr.</i>	yards. —	yards. 9,186
(7.7 cm.) field gun '16 ... (rifling, 32 grooves)	...	Ditto	—	10,171

Weight—

Shell complete, 7.37 kg. (16.2 lbs.) with *E.K.Z. 16*; 6.87 kg. (15.1 lbs.) with *K.Z. 11 Gr.*

From another specimen :—

Exploder, 23 g. (0.8 oz.). *Grf. 88* (picric acid).

H.E. bursting charge, 0.651 kg. (1.43 lbs.). *Fp. 02* (T.N.T., cast).

Contents of bottle, 0.124 kg. (0.27 lb.).

84 per cent. T.N.T. for 16 per cent. diphenylchlorarsine (by weight).

Nature of contents—Diphenylchlorarsine, as a brownish crystalline solid.

Remarks—The diphenylchlorarsine is contained in a bottle of thick green glass set in cast T.N.T. The bottle is closed either by a cork covered with a layer of plaster, or by a cardboard disc, a layer of pitch, and a layer of oxychloride cement, or by plaster, and the neck surrounded by pitch.

When fuzed with *K.Z. 11 Gr.*, this shell can be burst in the air.

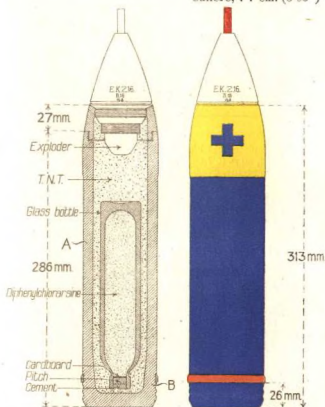
On specimens of 7.7 cm. blue cross shell recently examined there are 3 small crosses stamped on the head of the shell.

* The normal maximum range of both guns when firing gas shell is 7,655 yards.

L.F.K. Gr. Blaukreuz.

Fixed ammunition; designation of a complete round,
L.F.K. Gr. Patr. Blaukreuz.

Calibre, 7.7 cm. (3.03")



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 10 mm. ; at B, 12 mm.

Thickness of base—15 mm.

Width of driving band—8 mm.

Distinctive markings—A blue cross painted on the head.

Although containing a bursting charge of *Fp. 02* (T.N.T.),
Fp. 02 is not always stamped on the shoulder.

Long Pattern Field Gun Gas Shell.

Yellow Cross.

Used with		Maximum range.*	
Gun.	Fuze.	Time.	Perc'n.
(7.7 cm.) field gun 96 n/A.	E.K.Z. 17 ...	yards.	yards.
(rifling, 32 grooves)		—	9,186
(7.7 cm.) field gun '16	"	—	10,171
(rifling, 32 grooves)			

Weight—

Shell complete, 7.14 kg. (15.7 lbs.).

Exploser, 20 g. (0.7 oz.). Grf. 88 (picric acid).

Liquid contents, 0.800 kg. (1.76 lbs.).

Nature of liquid—80–90 per cent. dichlorethylsulphide + 20–10 per cent. solvent, either carbon tetrachloride or chlorobenzene (by volume).

Volume of liquid—0.610 litre.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{0.610 \text{ litre}}{7.14 \text{ kg.}} = 8.55 \text{ per cent.}$$

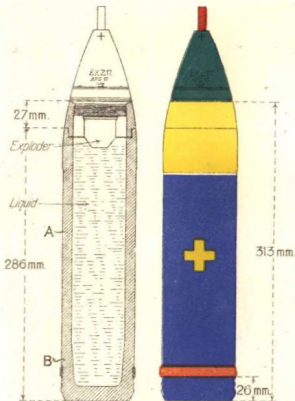
Remarks—This shell is now made monoblock, i.e., without a screwed-in head; this eliminates the danger arising from the yellow cross liquid leaking through the joint between the shell body and the head.

* The normal maximum range of both guns when firing gas shell is 7,655 yards.

L.F.K. Gr. Gelbkreuz.

Fixed ammunition; designation of a complete round,
L.F.K. Gr. Patr. Gelbkreuz.

Calibre, 7.7 cm. (3.03").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 10 mm. ; at B, 12 mm.

Thickness of base—15 mm.

Width of driving band—8 mm.

Distinctive markings—The fuze is painted green. It appears that all yellow cross shells are intended to be marked with three yellow crosses, two on the body diametrically opposed, and one on the base. The omission of one or more of these crosses does not indicate a variation of filling.

Certain specimens show two bands of white paint covering the joints. These bands are for the purpose of detecting leaks. The white paint contains a dye stuff which turns it red on contact with the contents of the shell.

For the meaning of the cross stamped on the fuze, see page 393.

Long Pattern Light Field Howitzer Gas Shell.

Green Cross and Green Cross 1.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(10.5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	<i>H.Z. 14...</i> ... <i>E.H.Z. 17</i>	yards. —	yards. 7,655*
(10.5 cm.) light field howitzer '16 (rifling, 32 grooves)	Ditto	—	9,077*
(10.5 cm.) light field howitzer, Krupp (rifling, grooves)	Ditto	—	9,624*
10 cm. gun '04	Ditto	—	11,264*
10 cm. gun '14 (rifling, 32 grooves)	Ditto	—	12,085*

Weight—

Shell complete, 15.8–16.2 kg. (34.9–35.7 lbs.).

Exploder, 58 g. (2 oz.). *Grf. 88* (picric acid).

Nature of liquid—Green Cross: Diphosgene or brommethyl-ethylketone.

Green Cross 1: 30–70 per cent. diphosgene + 70–30 per cent. chloropicrin (by volume).

Volume of liquid—1.270–1.340 litres.

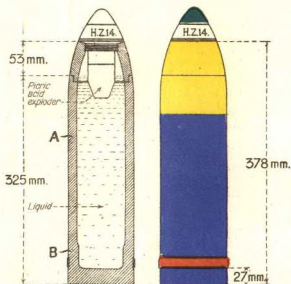
Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{1.34 \text{ litres}}{16.2 \text{ kg.}} = 8.3 \text{ per cent.}$

Remarks—The liquid from the Green Cross 1 variation has, on occasion, been found to contain a red dye (Aurin).

For the variation containing dibromomethylarsine, see page 406.

* The *normal* maximum ranges when firing gas shell are officially laid down as being 6,562, 7,103, 8,421, 9,843 and 9,843 yards, respectively.

L.F.H.Gr. Grkz.
L.F.H.Gr. Grkz. 1.
 Calibre, 10.5 cm. (4.1").



SCALE— $\frac{1}{8}$.



Thickness of walls—At A, 14 mm. ; at B, 17 mm.

Thickness of base—24 mm.

Width of driving band—14 mm.

Distinctive markings—It is officially laid down that the cap of the fuze shall be painted green, but sometimes it is painted red or left unpainted.

A green cross is painted on the base of the shell.

Long Pattern Light Field Howitzer Gas Shell.

Blue Cross.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Pere'a.
		yards.	yards.
(10.5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	<i>H.Z. 05 Gr. ...</i> <i>H.Z. 16</i>	—	7,655*
(10.5 cm.) light field howitzer '16 ... (rifling, 32 grooves)	Ditto	—	9,077*
(10.5 cm.) light field howitzer, Krupp (rifling, 32 grooves)	Ditto	—	9,624*
10 cm. gun '04 (rifling, 32 grooves)	Ditto	—	11,264*
10 cm. gun '14 (rifling, 32 grooves)	Ditto	—	12,085*

Weight—

Shell complete, 15.8 kg. (34.8 lbs.).

Exploder, 58 g. (2 oz.). *Grf. 88* (picric acid).

H.E. bursting charge, 1.3 kg. (2.87 lbs.). *Fp. 02* (T.N.T.).

Contents of bottle, 0.41 kg. (0.9 lb.).

76 per cent. T.N.T. for 24 per cent. diphenylchlorarsine (by weight).

Nature of contents of bottle—Diphenylchlorarsine, as a brownish crystalline solid.

Remarks—Most shell of this pattern found on the British front have been fitted with *H.Z. 05 Gr.* fuze, but recent specimens have been found with *H.Z. 16* and *E.H.Z. 17* fuzes.

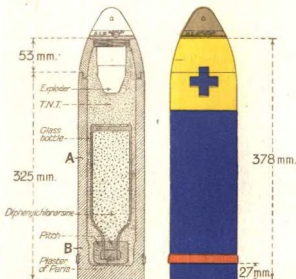
Air bursts can be obtained with *H.Z. 05 Gr.*, a T. and P. fuze.

10 cm. guns register with the H.E. shell described on page 106.

* The normal maximum ranges when firing gas shell are officially laid down as being 6,562, 7,103, 8,421, 9,843 and 9,843 yards, respectively.

L.F.H. Gr. Blaukreuz.

Calibre, 10.5 cm. (4.1").



SCALE— $\frac{1}{8}$.

Thickness of walls—At A, 14 mm. ; at B, 17 mm.

Thickness of base—24 mm.

Width of driving band—14 mm.

Distinctive markings—A blue cross painted on the shoulder.

Long Pattern Light Field Howitzer Gas Shell.

Yellow Cross and Yellow Cross 1. (?)

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
(10.5 cm.) light field howitzer '98/'09 (rifling, 32 grooves)	<i>E.H.Z. 17</i> ...	yards. —	yards. 7,655*
(10.5 cm.) light field howitzer '16 (rifling, 32 grooves)	"	—	9,077*
(10.5 cm.) light field howitzer, Krupp (rifling, grooves)	"	—	9,624*
10 cm. gun '04 (rifling, 32 grooves)	"	—	11,264*
10 cm. gun '14 (rifling, 32 grooves)	"	—	12,085*

Weight—

Shell complete, 14.8 kg. (32.6 lbs.).

Exploder, 21 g. (0.74 oz.). *Grf. 88* (picric acid).

Liquid contents, 1.58 kg. (3.5 lbs.).

Nature of liquid—80-90 per cent. dichlorethylsulphide + 20-10 per cent. of a solvent, either carbon tetrachloride or chlorobenzene (by volume).

Volume of liquid—1.2 litres.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{1.2 \text{ litres}}{14.8 \text{ kg.}} = 8.1 \text{ per cent.}$

Variations—These may possibly be the shell designated by the Germans, *Gelbkreuz. 1* (Yellow Cross 1).

(1) **Weight**: Shell complete, 15.12 kg. (33.3 lbs.).

Liquid contents, 2 kg. (4.4 lbs.).

Nature of liquid: 47.7 per cent. ethyldichlorarsine + 52.3 per cent. dichlormethylether (by volume). The liquid is brown in colour, transparent, and fuming rather strongly in air. Its smell was similar to carbon tetrachloride, but it is also extremely irritating.

(2) **Nature of liquid**: 17-18 per cent. dichlormethylether + 37 per cent. ethyldichlorarsine + 40-45 per cent. dibromomethylarsine.

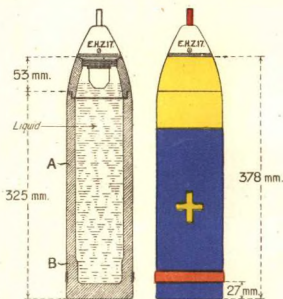
The gas from this shell would be more persistent than that from (1). This variation is reported to have been marked with a *green cross*.

Remarks—This shell is now made monoblock (*see under "Remarks," page 398*).

* The normal maximum ranges when firing gas shell are officially laid down as being 6,562, 7,103, 8,421, 9,843 and 9,843 yards, respectively.

L.F.H. Gr. Gelbkreuz.
L.F.H. Gr. Gelbkreuz. 1. (?).

Calibre, 10.5 cm. (4.1").



SCALE— $\frac{1}{8}$.

Thickness of walls—At A, 14 mm.; at B, 17 mm.

Thickness of base—24 mm.

Width of driving band—14 mm.

Distinctive markings—It appears that all yellow cross shell are intended to be marked with three yellow crosses, two diametrically opposed on the body and one on the base. The omission of one or more of these crosses does not indicate a variation of filling.

1915 Pattern 10 cm. Gun Gas Shell.

Green Cross 1.

Used with		Maximum range.	
Gun.	Fuze..	Time.	Perc'n.
		yards.	yards.
10 cm. gun '04	<i>Gr. Z. 04</i> ...	—	11,264*
	<i>Gr. Z. 14 n/A.</i>		
10 cm. gun '14	"	—	12,085*
(rifling of the above, 32 grooves)			

Weight—

Shell complete, 17.5 kg. (38.6 lbs.).

Exploder, 60 g. (2.1 oz.). *Grf. 88* (picric acid).

Liquid contents, 2.2 kg. (4.85 lbs.).

Nature of liquid—Green Cross 1 : 30–70 per cent. diphosgene
+ 70–30 per cent. chloropicrin (by volume).

Volume of liquid—1.33 litres.

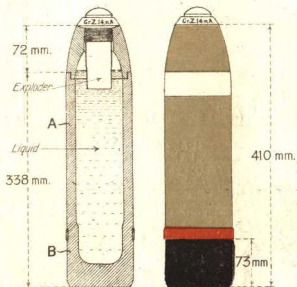
$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{1.33 \text{ litres}}{17.5 \text{ kg.}} = 7.6 \text{ per cent.}$$

Remarks—

* The *normal* maximum range for both guns when firing gas shell is officially laid down as 9,843 yards.

10 cm. Gr. 15 Grkz. 1.

Calibre, 10.5 cm. (4.1").

SCALE— $\frac{1}{6}$.

Thickness of walls—At A, 14 mm.; at B, 17 mm.

Thickness of base—35 mm.

Width of driving band—16 mm.

Distinctive markings—

1912 Pattern 15 cm. Gas Shell.

"T," Green "T," and "K" Shell.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
(15 cm.) heavy field howitzer ... (rifling, 32 grooves)	<i>Gr. Z. 04</i>	—	6,616
(15 cm.) heavy field howitzer '02 (rifling, 36 grooves)	"	—	8,147*
(15 cm.) heavy field howitzer '13 (rifling, 36 grooves)	"	—	9,296*
15 cm. long gun (rifling, 36 grooves) ...	"	—	10,936*

Weight—

Shell complete, 41·7 kg. (92·0 lbs.).

Bursting charge, 1·5 kg. (3·3 lbs.). *Fp. 02* (T.N.T., cast).

Exploder, 43 g. (1·5 oz.).

Liquid contents, 2·6–3·0 kg. (5·7 to 6·6 lbs.).

Nature of liquid—K-shell: Monochlormethylchloroformate (*K-Staff*).T-shell: Benzyl bromide and or xylyl bromide (*T-Staff*).**Volume of liquid—**2·3 litres, approx.

Volume of liquid 2·3 litres

Efficiency = $\frac{\text{Weight of shell}}{\text{Weight of shell}} = \frac{41·7 \text{ kg.}}{41·7 \text{ kg.}} = 5·5 \text{ per cent.}$ **Variation—**Green "T" shell.*Weight:* Shell complete, 42·4 kg. (93·5 lbs.).Bursting charge, 1 kg. (2·2 lbs.). *Fp. 02* (T.N.T.).*Nature of contents:* 88 per cent. xylyl bromide + 12 per cent. brommethylethylketone (by volume).*Volume of liquid:* 2·27 litres.

Volume of liquid 2·27 litres

Efficiency = $\frac{\text{Weight of shell}}{\text{Weight of shell}} = \frac{42·4 \text{ kg.}}{42·4 \text{ kg.}} = 5·35 \text{ per cent.}$

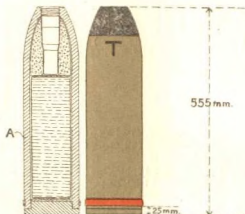
Green "T" shell are intended for use in cold weather. This explains the addition of brommethylethylketone, which would make the liquid more volatile.

Remarks.—The head of the shell is filled by a comparatively large bursting charge, below which is a container, filled with a liquid and set in paraffin wax or magnesium oxychloride cement. In most shell of this pattern the container is made of sheet lead, but in some cases it is of porcelain, 3·5 mm. in thickness. A container is required because of the corrosive action on steel of the "T" and "K" fillings.

The more recent types of fillings do not require a container as the liquids employed do not corrode steel.

* The normal maximum ranges when firing gas shell are officially laid down as being 7,655 yards with the '02 and '13 pattern howitzers, and 10,380 yards with the 15 cm. long gun.

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



SCALE — $\frac{1}{10}$.

The shell illustrated is a T-shell.

Thickness of walls—At A, 19 mm.

Thickness of base—34 mm.

Width of driving band—15 mm.

Distinctive markings—

A black head with a black "T" indicates a "T" shell (*T-Granate*).

A green head with green "T" indicates a green "T" shell (*T-Granate grün*).

A yellow head with a yellow "K" indicates a "K" shell (*K-Granate*).

A black ring round the cylindrical portion of a "T" shell indicates that the liquid is in a porcelain container.

1912 n/A. Pattern 15 cm. Gas Shell.

Green Cross; Green Cross 1; Phenylcarbylamine chloride.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
(15 cm.) heavy field howitzer ...	<i>Gr. Z. 14 n/A.</i>	—	6,616
(15 cm.) heavy field howitzer '02 ...	"	—	8,147*
(15 cm.) heavy field howitzer '13 ...	"	—	9,296*
(rifling of the above, 36 grooves)	"	—	
(15 cm.) long heavy field howitzer '13	"	—	9,296*
(rifling, 32 grooves)	"	—	
15 cm. long gun ...	"	—	10,936*
(rifling, 36 grooves)	"	—	

Weight—

Shell complete, 41·36 kg. (91·2 lbs.).

Exploder, 60 g. (2·1 oz.). *Grf. 88* (picric acid).

Nature of liquid—

Green Cross: Diphosgene or brommethylethylketone.

Green Cross 1: 30–70 per cent. diphosgene (by volume) + 70–30 per cent. chloropicrin.

Volume of liquid—3·9 litres.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{3·9 \text{ litres}}{41·36 \text{ kg.}} = 9·4 \text{ per cent.}$$

Variations—

(1) *Weight*: Shell complete, 39·88 kg.

Exploder, 60 g.

Weight of liquid contents, 5·04 kg.

Nature of contents: Phenylcarbylamine chloride.

Volume of liquid: 3·91 litres.

Volume of liquid: 3·91 litres

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{3·91 \text{ litres}}{39·88 \text{ kg.}} = 9·8 \text{ per cent.}$$

(2) *Weight*: Shell complete, 40·8 kg.

Nature of liquid: Brommethylethylketone.

Volume of liquid: 3·9 litres.

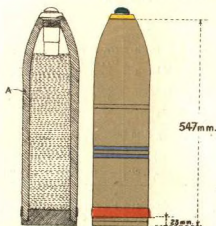
$$\text{Efficiency} = \frac{3·9 \text{ litres}}{40·8 \text{ kg.}} = 9·6 \text{ per cent.}$$

Remarks—All joints are cemented. Shell with the Green Cross 1 filling sometimes contain a red dye (Fuchsin).

* The *normal* maximum ranges are officially laid down as 7,655 yards with the '02 and '13 pattern howitzers, and 10,380 yards with the 15 cm. long gun.

15 cm. Gr. 12 n/A.* Grkz.
15 cm. Gr. 12 n/A. Grkz. 1.

Calibre, 14.97 cm. (5.89").



SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 19 mm.

Thickness of base—41 mm.

Width of driving band—15 mm.

Distinctive markings—Two blue bands are painted round the cylindrical portion of this shell in order to distinguish it from the original 1912 pattern shell. Some shells have one or more green bands above the cylindrical portion. In some cases a green cross is painted on the base and on the shoulder also. The figure 1 after the cross indicates the variation known as Green Cross 1. The steel collar over the fuze is sometimes painted yellow, while the cap is sometimes painted green.

* n/A. = *neuer Art* or improved pattern, and refers to the shell case only and not to the filling.

1912 n/A. Pattern 15 cm. Gas Shell.

Green Cross 2.

Yellow Cross.

Used with			Maximum range.	
Gun.	Fuze.		Time.	Perc'n.
			yards.	yards.
(15 cm.) heavy field howitzer	<i>Gr. Z. 92</i>	... ..	—	6,616
	<i>Gr. Z. 17†</i>	... ..	—	8,147*
(15 cm.) heavy field howitzer '02	"	... ..	—	9,296*
(15 cm.) heavy field howitzer '13	"	... ..	—	9,296*
(rifling of the above, 36 grooves)	"	... ..	—	9,296*
(15 cm.) long heavy field howitzer '13	"	... ..	—	10,936*
(rifling, 32 grooves)	"	... ..	—	10,936*
15 cm. long gun ... ..	"	... ..	—	10,936*
(rifling, 36 grooves)	"	... ..	—	10,936*

Weight—

Shell complete, 41.7 kg. (91.8 lbs.).

Explosive, 18 g. (0.6 oz.). *Grf. 88* (picric acid).

Bursting charge, 0.187 kg. (4.12 lbs.).

Liquid contents, 4.8 kg. (10.58 lbs.).

Nature of liquid—Green Cross 2: 60 per cent. phosgene + 25 per cent. diphosgene + 15 per cent. diphenylchlorarsine (by volume).

Volume of liquid—3.2 litres, approx.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{3.2 \text{ litres}}{41.7 \text{ kg.}} = 7.7 \text{ per cent.}$

Remarks—The fuze is an obsolete type of percussion fuze. It is used with an exploder similar to *Zdlg. 92* = *Zündladung 92* or 1892 pattern exploder. The picric acid cartridge is in a brass case, which slips into a brass or steel gaine. The latter is screwed into the shell. These shell are issued unfuzed.

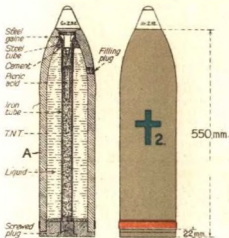
The main bursting charge of T.N.T. is contained in a central iron tube which extends the whole length of the shell. This tube is closed at the lower end by a screwed plug, and its lower end is let into the base plug. The upper end fits into another short length of tube with an enlarged end. The latter simply rests against the inside of the shell. All joints are sealed with cement.

* The normal maximum ranges are officially laid down as 7,655 yards with the '02 and '13 pattern howitzers, and 10,380 yards with the 15 cm. long gun.

† Only found hitherto in the yellow cross shell.

15 cm. Gr. 12 n/A. Grkz. 2.
15 cm. Gr. 12 n/A. Gelbkreuz.

Calibre, 14.97 cm. (5.89")



SCALE— $\frac{1}{10}$



Thickness of walls—At A, 19 mm.

Thickness of base—41 mm.

Width of driving band—15 mm.

Distinctive markings—A green cross and the figure 2 on the base and on the cylindrical portion indicate "Green Cross 2" (*Grünkreuz 2*). Specimens have been found roughly marked with an additional red cross on the cylindrical portion, but in some cases the red cross was underneath the final coating of grey paint; it may be intended to afford a more visible indication or to indicate some process during filling.

According to a document issued in 1918, the figures 83 are painted in white on the base and on the cylindrical portion of Green Cross 2 shell.

1912 n/A. Pattern 15 cm. Gas Shell.

Blue Cross.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
(15 cm.) heavy field howitzer ...	<i>Gr. Z. 14 n/A.</i>	—	6,616*
(15 cm.) heavy field howitzer '02 ...	—	—	8,147*
(15 cm.) heavy field howitzer '13 ...	—	—	9,296*
(rifling of the above, 36 grooves)			
(15 cm.) long heavy field howitzer '13	—	—	9,296*
(rifling, 32 grooves)			
(15 cm.) long gun ...	—	—	10,936*
(rifling, 36 grooves)			

Weight—

Shell complete, 41·2 kg. (90·8 lbs.).

Exploder, 60 g. (2·1 oz.).

Bursting charge, 3·47 kg. (7·66 lbs.). *Fp. 02* (T.N.T.).

Contents of bottle, 1·35 kg. (2·98 lbs.).

Cement, 0·5 kg. (1·1 lbs.).

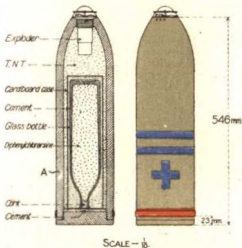
Nature of contents of bottle—Diphenylchlorarsine, a brownish crystalline solid.

Remarks—Embedded in the explosive is a glass bottle filled with diphenylchlorarsine. The bottle is closed with an ordinary cork. It is set in magnesium oxychloride cement and enclosed in a cardboard case. Three small crosses are stamped on the head of the shell.

* See footnote on page 414.

15 cm. Gr. 12 n/A. Blaukreuz.

Calibre, 14.97 cm. (5.89").



Thickness of walls—At A, 19 mm.

Thickness of base—41 mm.

Width of driving band—15 mm.

Distinctive markings—Two blue bands are painted round the cylindrical portion of this shell in order to distinguish it from the original 1912 pattern shell.

Two blue crosses, diametrically opposed, are painted on the body, and one on the base.

? Pattern 15 cm. Gas Shell.

Yellow Cross.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
(15 cm.) heavy field howitzer ...	<i>Gr. Z. 14 n/A.</i>	—	6,616*
(15 cm.) heavy field howitzer '02 ...	—	—	8,147*
(15 cm.) heavy field howitzer '13 ...	—	—	9,296*
(rifling of the above, 36 grooves)			
(15 cm.) long heavy field howitzer '13	—	—	9,296*
(rifling, 32 grooves)			
(15 cm.) long gun ...	—	—	10,936*
(rifling, 36 grooves)			

Weight—

Shell complete, 40·23 kg. (88·69 lbs.).

Explosive, 62 g. (2·2 oz.). *Grf. 88* (picric acid).

Bursting charge, 0·70 kg. (1·54 lbs.). *Fp. 02* (T.N.T.).

Nature of liquid—80 per cent. dichlorethylsulphide + 20 per cent. of a solvent, chlorobenzene (by volume).

Volume of liquid—2·88 litres.

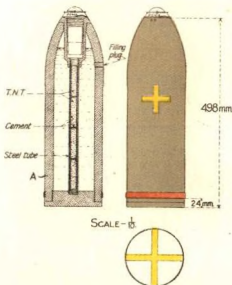
$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{2·88 \text{ litres}}{40·23 \text{ kg.}} = 7·15 \text{ per cent.}$$

Remarks—The construction of this new shell resembles that of the 15 cm. Green Cross 2 shell shown on page 417. It is, however, 52 mm. shorter and the arrangement of the central tube is somewhat different. It weighs about 3 lbs. less. The bursting charge in the central tube consists of four pellets of T.N.T. crystals. Each pellet is wrapped in waxed paper and set in cement. In addition, there is the usual picric acid explosive in the gaine of the fuze.

* These ranges are only approximate as they apply to the 1912 n/A shell. See also footnote on page 414.

15 cm. Gr. 12 (verst.) ? Gelbkreuz.

Calibre, 14.97 cm. (5.89").



Thickness of walls—At A, 21 mm.

Thickness of base—40 mm.

Width of driving band—15 mm.

Distinctive markings—It appears that all Yellow Cross shell are intended to be marked with three yellow crosses, two on the body, diametrically opposed, and one on the base. The omission of one or more of these crosses does not indicate a variation of filling.

? Pattern 15 cm. Gun Gas Shell with False Cap.

Yellow Cross.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
15 cm. experimental gun on wheeled carriage (<i>Vers. K.i.R.L.</i>).	<i>Gr. Z. 04</i> ...	yards. —	yards. 21,107
15 cm. gun '16 (?) ... (rifling of both guns, 48 grooves?)	"	—	24,934

Weight—

Shell complete, 50 kg. approx. (110 lbs.).
 Exploder, 43 g. (1.5 oz.). *Grf. 88* (picric acid).
 Bursting charge,
 Liquid contents, 3.49 kg. (7.69 lbs.).

Nature of liquid—80 per cent. dichlorethylsulphide + 20 per cent. of a solvent, chlorobenzene (by volume).

Volume of liquid—3.08 litres.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{3.08 \text{ litres}}{50 \text{ kg.}} = 6.1 \text{ per cent.}$
 (approx.)

Remarks—This shell has been fired into billets at a range of at least 20,000 yards.

15 cm. Gr. ♀ (Haube) Gelbkreuz.

Calibre, 14.97 cm. (5.89").

The construction of this shell is similar to that of the H.E. shell with false cap described on page 162.

Thickness of walls—At A, 24 mm. ; at B, 27 mm.

Thickness of base—45 mm.

Width of driving bands—23 mm.

Distinctive markings—

1896 n/A. Pattern 21 cm. Gas Shell.

Green Cross 2 and Yellow Cross.

Used with			Maximum range.	
Gun.	Fuze.		Time.	Perc'n.
			yards.	yards.
21 cm. mortar (rifling, 64 grooves)	<i>Gr. Z. 92</i>		—	7,874
"Mortar" (21 cm.) (1910 pattern) (rifling, 64 grooves)	"		—	10,280
"Long mortar" (21 cm.)... (rifling, grooves)	"		—	11,155

Weight—

Shell complete, 116.5 kg. (257 lbs.).

Explosive, 18 g. (0.6 oz.). *Grf. 88* (picric acid).

Bursting charge, 0.878 kg. (1.93 lbs.). *Fp. 02* (T.N.T.).

Nature of liquid—

Green Cross 2 : 60 per cent. phosgene + 25 per cent. diphosgene + 15 per cent. diphenylchlorarsine (by volume).

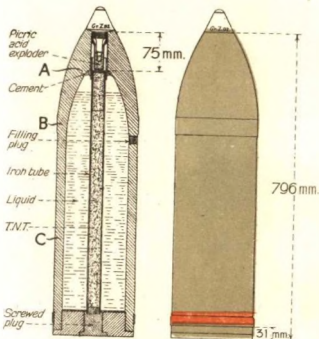
Yellow Cross : 80 per cent. (ca.) dichlorethylsulphide + 5 per cent. dichlormethylether and trioxymethylene + 15 per cent. of a solvent, chlorobenzene (by volume).

Volume of liquid—8.0 litres.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{8.0 \text{ litres}}{116.5 \text{ kg.}} = 6.9 \text{ per cent.}$$

Remarks—This shell is similar in design to the 1912 n/A. pattern 15 cm. gas shell described on page 416.

21 cm. Gr. 96 n/A. Grkz. 2.
 21 cm. Gr. 96 n/A. Gelbkreuz.
 Calibre, 21.1 cm. (8.3").



SCALE— $\frac{1}{10}$.

Thickness of walls—At A, 50 mm. ; at B, 30 mm. ; at C, 24 mm.

Thickness of base—54 mm.

Width of driving band—24 mm.

Distinctive markings—A black band about 15 cm. wide is apparently painted round the cylindrical portion of the Green Cross 2 shell.

It appears that all Yellow Cross shell are intended to be marked with three yellow crosses, two on the body, diametrically opposed, and one on the base. The omission of one or more of these crosses does not indicate a variation of filling.

1915 Pattern 9 cm. Gun Shrapnel.

2·2 calibres long ; 1·5 c.r.h.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
9 cm. gun '73/'88 ... (rifling, 24 grooves)	...	yards.	yards.
	<i>Dopp. Z. 92 lg. Brlg.</i> }	7,109	7,109
	<i>Dopp. Z. 92 n. F.</i> ... }		
	<i>Dopp. Z. 92 f. 10 cm. K.</i> }	6,124	7,109
	<i>Dopp. Z. 92 K. 15</i> ... }		

Material—Steel.

Weight—

Shell complete, 7·9 kg. (17·4 lbs.).

Bursting charge, 0·08 kg. (0·17 lb.). Black powder.

Bullets—193 10-g. bullets, 45 to the lb., set in sulphur.

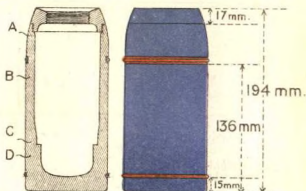
Employment—Effective against living targets in the open or under partial cover.

Remarks—In shrapnel of recent manufacture the bullets are set in pitch.

For range table, *see* Appendix IV.

9 cm. Schr. 15.

Calibre, 8.8 cm. (3.46").

SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 6 mm.; at B, 8.5 mm.; at C, 11.5 mm.; at D, 16 mm.

Thickness of base—16 mm.

Width of driving bands—Upper band, 5 mm.*; lower, 4.5 mm.*

Distinctive markings—A black ring round the cylindrical portion denotes that the bullets are made of steel.

* There are considerable variations in the width of both these bands.
(B 13641)

1912 Pattern 15 cm. Smoke Shell.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
		yards.	yards.
(15 cm.) heavy field howitzer ..	<i>Gr. Z. 04</i> ...	—	6,616
(15 cm.) heavy field howitzer '02 ...	"	—	8,147*
(15 cm.) heavy field howitzer '13 ...	"	—	9,296*
(rifling of the above, 36 grooves)			
(15 cm.) long heavy field howitzer '13	"	—	9,296*
(rifling, 32 grooves)			
15 cm. long gun	"	—	10,936*
(rifling, 36 grooves)			

Weight—

Shell complete, 41·7 kg. (91·9 lbs.).

Bursting charge, 2·95 kg. (6·5 lbs.). *Fp. 02* (T.N.T., cast).**Volume of container—**1·55 litres.**Nature of contents—**Sulphur trioxide.

Employment—The method of employment is laid down in the following extracts from the "Instructions for the Employment of Green Cross Gas Shell," dated 18.2.17:—

"The effect of the "Green Cross"† gas shell now used is obtained by drifts, which outlast the upward dispersion of the more or less plainly visible drifts by about 2 hours in winter and 1 hour in summer. The area under fire may, therefore, be approached in from 1—2 hours after the apparent dispersion of the drifts.

"In order to increase the visibility of gas drifts, *smoke shell* can be fired, at the conclusion of the bombardment, at points with reference to which it is important to ascertain when they are free from gas."

Remarks—The shell case is of the ordinary 15 cm. *Gr. 12* pattern with the *Gr. Z. 04* fuze. The upper half of the shell is filled with T.N.T.; the lower half of the shell is occupied by a lead or sheet iron container which is filled with sulphur trioxide.

The chief peculiarity of this shell is the large quantity of explosive.

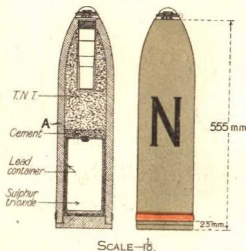
Note.—Similar 7·7 cm. and 10·5 cm. smoke shell have been reported. Specimens are required for examination.

* See footnote on page 414.

† i.e., the original *Grünkrew* (diphosgene filling).

15 cm. Nebel-Geschoss.

Calibre, 14.97 cm. (5.89").



Thickness of walls—At A, 19 mm.

Thickness of base—34 mm.

Width of driving band—15 mm.

Distinctive markings—A black letter "N," which signifies *Nebel*, i.e., mist or smoke.

7.6 cm. Light Minenwerfer Gas Shell.

Old pattern with conical head and lead container.

Contents: Asphyxiating or lachrymatory.

Used with		Maximum range.*	
Minenwerfer.	Fuze.	Time.	Perc'n.
Light Minenwerfer (old pattern) (<i>L.M.W.o/A.</i>) (rifling, 6 grooves)	<i>L.W.M.Zdr.</i> ...	yards. 1,148	yards. 1,148
New light Minenwerfer (<i>L.M.W.n/A.</i>) (rifling, 6 grooves)	"	1,203	1,203

Material—Drawn steel tube.

Weight—

Shell complete, 5.5 kg. (12.1 lbs.).

Exploder, 40 g. (1.4 oz.). *Grf.-88* (picric acid).

Volume of liquid—0.54 litre.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{0.54 \text{ litre}}{5.5 \text{ kg.}} = 9.8 \text{ per cent.}$

Variation—

Length—275 mm.

Weight—

Shell complete, 5.34 kg. (11.8 lbs.)

Exploder, 25 g. (0.88 oz.)

Volume of liquid—0.50 litre.

Employment—See page 438.

Remarks—This shell is self-propelling (see "Remarks" on page 352). The walls of the shell are of steel tube, reinforced near the base by a liner of similar tube. The two tubes are apparently acetylene-welded on to a forged base. Into the head is fitted a steel tube, closed at the bottom, and containing a picric acid exploder. The liquid is in a lead container. The space between this container and the walls of the shell is filled with a white cement, consisting of carbonate and oxychloride of magnesium.

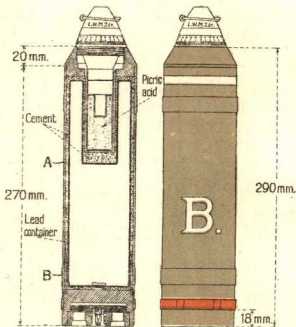
Four propelling charges, weighing respectively 7.5, 11, 14.5 and 18 g. (0.6 oz.), were used with the shell 290 mm. in length.

When the new light Minenwerfer was introduced, it was laid down that the fifth propelling charge was not to be used with gas shell of the older patterns. This limited the range to about 1,100 m. (1,203 yards).

* Ranges approximate only.

leichte Gas-Mine.

Calibre, 7.6 cm. (2.99").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 3 mm.; at B, 6 mm.

Thickness of base—15 mm.

Thickness of base plug—15 mm.

Width of driving band*—10 mm.

Distinctive markings and contents—One white band and a white "B" denote "B-Stoff," a filling of either xylyl bromide or brommethylethylketone.

Two white bands and a "C" denote "C-Stoff," a filling of either monochlormethylchloroformate or trichlormethylchloroformate (diphosgene).

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

7.6 cm. Light Minenwerfer Gas Shell.

Old pattern with conical head; direct filled.

Contents: Phosgene.

Used with		Maximum range.*	
Minenwerfer.	Fuze.	Time.	Perc'n.
Light Minenwerfer (old pattern) (<i>L.M.W.a/A.</i>) (rifling, 6 grooves)	<i>L.W.M.Zdr.</i> ...	yards. 1,148	yards. 1,148
New light Minenwerfer (<i>L.M.W.n/A.</i>) (rifling, 6 grooves)	" ...	1,203	1,203

Material—Drawn steel tube.

Weight—

Shell complete, 4.4–4.6 kg. (9.7–10.1 lbs.).

Explosive, 16 g. (0.56 oz.). *Grf. 88* (picric acid).

Volume of liquid—0.46 litre.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{0.46 \text{ litre}}{4.35 \text{ kg.}} = 10.4 \text{ per cent.}$

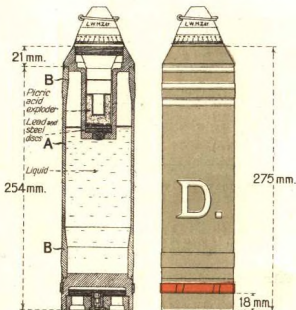
Employment—See page 438.

Remarks—The liquid filling (phosgene) does not attack steel, so that a lead container is not required. The head of the shell is welded. The shell is filled through the hole at the bottom of the explosive tube, this hole being subsequently sealed with a lead plug and a number of steel and lead discs firmly pressed in. The driving band is of copper. There are four holes (gas escapes) in the base plug.

* Ranges approximate only, see under "Remarks" on page 432.

leichte Gas-Mine.

Calibre, 7.6 cm. (2.99").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 3 mm. ; at B, 6 mm.

Thickness of base—13 mm.

Thickness of base plug—15 mm.

Width of driving band*—10 mm.

Distinctive markings and contents—Three white bands and a black "D" or six white bands. These markings denote "D-Stoff" or phosgene.

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

7.6 cm. Light Minenwerfer Gas Shell.

Old pattern with ogival head; direct filled.

Contents: Phosgene.

Used with		Maximum range.*	
Minenwerfer.	Fuze.	Time.	Perc'n.
Light Minenwerfer (old pattern) (<i>l. M.W.a/A.</i>) (rifling, 6 grooves)	<i>l. W.M. Zdr.</i> ...	yards. 1,148	yards. 1,148
New light Minenwerfer (<i>l. M.W.n/A.</i>) (rifling, 6 grooves)	" ...	1,203	1,203

Material—Drawn steel tube; head and base welded.

Weight—

Shell complete, 4.4 kg. (9.7 lbs.).

Exploder, 15 g. (0.53 oz.).

Liquid contents, 0.69 kg.

Volume of liquid—0.485 litre.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{0.485 \text{ litre}}{4.400 \text{ kg.}} = 11.0 \text{ per cent.}$$

Employment—See page 438.

Remarks—The definite adoption of the phosgene filling, which requires no special container, enabled the construction of this type of shell to be simplified; the head is made ogival, *i.e.*, the usual shape. The adapter and exploder tube are in one piece, which is screwed in and welded.

The filling hole in the bottom of the gaine is closed by a screwed plug and lead washer.

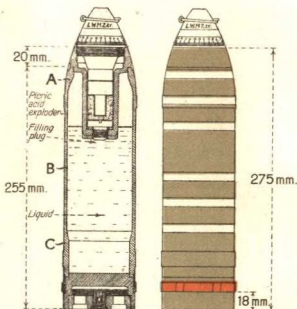
Four propelling charges, weighing respectively 7.5, 11, 14.5 and 18 g. (0.6 oz.), were used with this shell.

In some of these shell there are 4 holes (gas escapes) in the base plug, and in others 8.

* Ranges approximate only; see under "Remarks" on page 432.

leichte Gas-Mine.

Calibre, 7.6 cm. (2.99").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 6 mm. ; at B, 3 mm. ; at C, 5 mm.

Thickness of base—13 mm.

Thickness of base plug—15 mm.

Width of driving band*—10 mm.

Distinctive markings and contents—Three or six white bands, denoting a filling of "D-Stoff" or phosgene.

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

7.6 cm. Light Minenwerfer Gas Shell.

New short pattern; direct filled.

Contents: Phosgene.

Used with		Maximum range.*	
Minenwerfer.	Fuze.	Time.	Perc'n.
New light Mineawerfer (<i>l. M. W.</i> <i>n/A.</i>) (riding, 6 grooves)	<i>l. W. M. Zdr. 2</i> ...	yards. 1,422	yards. 1,422
	<i>Az. 16 f.l. W. M.</i>	—	1,422

Material—Steel.

Weight—

Shell complete, 4.15 kg. (9.1 lbs.).

Exploser, 16 g. (0.56 oz.). *Grf. 88* (picric acid).

Liquid contents, 0.715 kg. (1.57 lbs.).

Volume of liquid—0.50 litre.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{0.50 \text{ litre}}{4.15 \text{ kg.}} = 12 \text{ per cent.}$

Action—The liquid contents are disseminated in the form of gas when the shell is burst open by the detonation of the picric acid exploder. The gas is heavier than air, and settles in shelters, trenches, hollows, &c.

Employment—Generally in bursts of harassing fire against the garrisons of trenches, working and carrying parties; against traffic centres and assembly places; also in gas bombardments, in conjunction with larger calibres of gas shell.

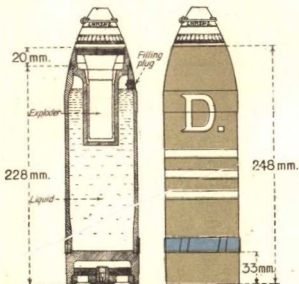
Remarks—This short shell holds more phosgene than any of the former patterns. This is due to the method of filling. By placing the filling plug as high as possible in the wall of the shell the cavity can be almost completely filled.

For the propelling charges used with this shell see page 354.

* Most favourable range, 328–1,422 yards.

leichte Gas-Mine.

Calibre, 7.6 cm. (2.99").



SCALE— $\frac{1}{4}$.

Thickness of walls—At A, 3 mm.

Thickness of base—10 mm.

Thickness of base plug—10 mm.

Width of driving band*—10 mm.

Distinctive markings and contents—Three white bands and a white "D" denote "D-Stoff" or phosgene.

These shells have also been found marked by four white bands.

According to a captured German document, dated 26.10.17, a gas shell is now manufactured which is marked with a "G" in white in six places.

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

7.6 cm. Light Minenwerfer Gas Shell.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
New light Minenwerfer (<i>I. M. W.</i> <i>n/A.</i>) (rifling, 6 grooves)		yards.	yards.

Material—

Weight—

Shell complete,
Exploder,
Liquid contents,

Volume of liquid—

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} =$$

Employment—

Remarks—

leichte Gas-Mine.

Calibre 7.6 cm. (2.99").

Thickness of walls—

Thickness of base—

Thickness of base plug—

Width of driving band—

Distinctive markings and contents—The letter "G"
stencilled in white on the body in 6 places.

1912 n/A. Pattern 17 cm. Medium Minenwerfer Gas Shell.

Original pattern with lead container and bursting charge in circular case.

Contents: Brommethylethylketone or chlormethylchloroformate.

Used with		Maximum range.	
Gun.	Fuze.	Time.	Perc'n.
Medium Minenwerfer (old pattern) (<i>m.M.W.</i>) (rifling, 6 grooves)	<i>Z.m.W.M.</i> ... <i>Z.s.u.m.W.M.</i> ...	yards. 1,301	yards. 1,301

Material—Steel.

Weight—

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

Bursting charge, 0.5 kg. (1.1 lbs.). *Fp. 02* (T.N.T.).

Liquid contents, 11.5 kg.* (25.4 lbs.).

Volume of liquid—8 litres.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{8 \text{ litres}}{42 \text{ kg.}} = 19 \text{ per cent.}$$

Employment—This shell is employed in trench warfare as an asphyxiating and lachrymatory shell.

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 steel plate H and a tin case F containing the bursting charge which consists of about 500 g. of T.N.T.

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

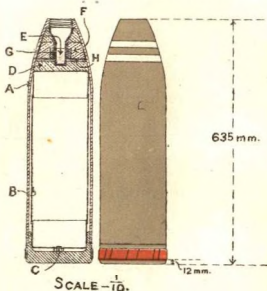
Seven propelling charges, weighing respectively 44, 66, 88, 110, 132, 154 and 176 g. (6.2 oz.), were used with this shell.

* Officially laid down as 10–11 kg.

B.—M. 12 n/A.*

C.—M. 12 n/A.

Calibre, 17 cm. (6.69").



Thickness of walls—At A, 6 mm. ; at B, 6 mm.

Thickness of base—30 mm.

Width of driving band†—28 mm.

Distinctive markings and contents—One white band denotes "B-Stoff," a filling of brommethylethylketone. Two white bands denote "C-Stoff," a filling of monochlormethylchloroformate.

* i.e., B-Stoff Mine 1912 neuer Art or improved 1912 pattern Minenwerfer shell, with B-Stoff filling.

† 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.

Old pattern with lead container and bursting charge in central tube.

Contents : Monobrom and dibrommethylethylketone.

Used with		Maximum range.*	
Minenwerfer.	Fuze.	Time.	Perc'n.
Medium Minenwerfer (old pattern) (<i>m. M. W.</i>) (rifling, 6 grooves)	<i>Z. s. w. m. W.M.</i>	yards. 1,300	yards. 1,300

Material—Steel.

Weight—

Shell complete, 44 kg. approx. (97 lbs.).

Bursting charge—

T.N.T. crystals	...	...	37 g.
Picric acid pellet	...	...	90 g.
Cast T.N.T.	...	...	500 g.

627 g. (1.38 lbs.)

Liquid contents ... 12.18 kg. (26.85 lbs.). 65 per cent.
monobrom 35 per cent. dibrommethylethylketone
(proportion variable).

Volume of liquid—8 litres.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{8 \text{ litres}}{44 \text{ kg.}} = 18.2 \text{ per cent.}$

Employment.—See page 444.

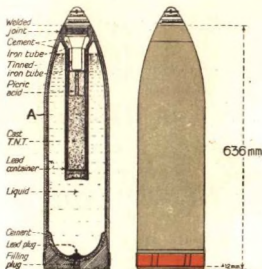
Remarks—The explosive is contained in a tinned iron tube closed at the top by a cup, which receives the gaine of the fuze. This inner tube is set in paraffin wax in an outer tube. The latter is welded to the top of the shell body.

The liquid contents are in a container of sheet lead 2 mm. thick. The filling hole is at the bottom and is closed by a lead screw plug. The container is set in cement.

* Ranges approximate only.

B-Mine (B.M.).

Calibre, 17 cm. (6·69").



SCALE—10.

Thickness of walls—At A, 5 mm.

Thickness of base—At centre, 14 mm.

Width of driving band*—28 mm.

Distinctive markings and contents—One white band, denoting "B-Stoff" a filling of brommethylethylketone; also the letters B.M. for "B-Stoff Mine."

* 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.

New pattern; direct filled.

Contents: Phosgene.

Used with		Maximum range.*	
Minenwerfer.	Fuze.	Time.	Perc'n.
Medium Minenwerfer (old pattern) (rifling, 6 grooves)	<i>Z. s. u. m. W. M.</i>	yards. 1,300†	yards. 1,300†
1916 pattern medium Minenwerfer (rifling, 6 grooves)	"	1,750	1,750

Material—Steel.

Weight—

Shell complete, 34.5 kg. (76.0 lbs.).

Bursting charge, 0.25 kg. (0.55 lb.). *Fp. 02* (T.N.T.).

Liquid contents, 12 kg. (26.4 lbs.).

Volume of liquid—8.5 litres.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{8.5 \text{ litres}}{34.5 \text{ kg.}} = 24.6 \text{ per cent.}$$

Employment—This shell is employed in trench warfare. This gas (phosgene) is asphyxiating and slightly lachrymatory.

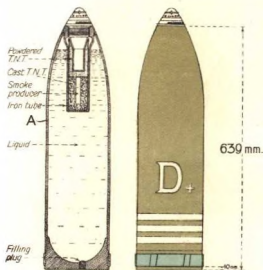
Remarks.—Since the liquid filling is of phosgene, which does not attack the steel walls of the shell, no special lead container is required. The filling hole is in the base of the shell. The bursting charge is contained in an iron tube, the lower portion of which is filled with cast T.N.T. and the upper with T.N.T. in crystals. A smoke producer (red phosphorus and arsenic) is embedded in the cast T.N.T.

* Most favourable range, 437–1,750 yards.

† Approximate only.

mittlere Gas-Mine (m. Gas-M.).

Calibre, 17 cm. (6.77").

SCALE— $\frac{1}{10}$.

Thickness of walls—5 mm.

Thickness of base—14 mm. (at centre).

Width of driving band—34 mm.

Distinctive markings and contents—Three white bands and a white "D," and sometimes a white cross in addition, denote "D-Stoff" or phosgene.

(B 13641)

F

25 cm. Half-Sized Heavy Minenwerfer Gas Shell.

New pattern : direct filled.

Contents : Phosgene.

Used with		Maximum range.*	
Minenwerfer.	Fuze.	Time.	Perc'n.
Heavy Minenwerfer (old pattern) (<i>s.M.W.</i>) (rifling, 6 grooves)	<i>Z.s.u.m.W.M.</i>	yards. 930	yards. 930

Material—Steel.

Weight—

Shell complete, 61 kg. (134·5 lbs.).

Bursting charge, 0·29 kg. (0·62 lb.). *Fp.* 02 (T.N.T.).

Liquid contents, 23·5 kg. (52 lbs.).

Volume of liquid—16·4 litres.

Efficiency = $\frac{\text{Volume of liquid}}{\text{Weight of shell}} = \frac{16·4 \text{ litres}}{61 \text{ kg.}} = 27 \text{ per cent.}$

Employment—See page 448.

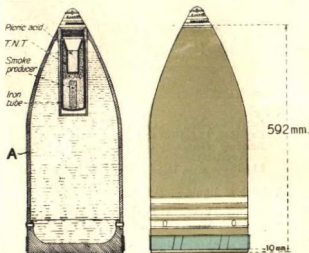
Remarks—The body of the shell is riveted to the base in four places. All joints are filled with cement. The bursting charge is in an iron container ; the upper portion consists of T.N.T. in crystals and the lower of cast T.N.T. A smoke producer, 34 g. in weight and containing the usual red phosphorus—arsenic mixture, is embedded in the cast T.N.T.

According to a German document dated July, 1917, this shell was to become obsolete when present stocks were exhausted.

* Ranges approximate only.

halbe schwere Gas-Mine ($\frac{1}{2}$ s. Gas-Mine).

Calibre, 25 cm. (9 84").



SCALE— $\frac{1}{10}$.

Thickness of walls—8 mm.

Thickness of base—23 mm.

Width of driving band—38 mm.

Distinctive markings and contents—Three white bands denote "D-Stoff" or phosgene.

18 cm. Smooth-Bore Minenwerfer Bomb.

Contents: Phosgene or phosgene and chloropicrin.

Used with		Maximum range.	
Minenwerfer.	Fuze.	Time.	Perc'n.
*18 cm. smooth-bore Minenwerfer (<i>gl. M.W.</i>)	<i>Z.s.u.m. W.M.</i> ...	yards. at least 1,400	yards. at least 1,400
18 cm. gas projector (<i>Gaswerfer</i>)	" ...	"	"

Material—Steel.

Weight—

Bomb complete, 30.14 kg. (66.45 lbs.).

Exploder, 19 g. (0.67 oz.). *Grf. 88* (picric acid).

Bursting charge, 0.115 kg. (0.25 lb.). *Fp. 02* (T.N.T. crystals).

Liquid contents, 7.48 kg. (16.49 lbs.). Phosgene.

Volume of liquid—5.23 litres.

$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of bomb}} = \frac{5.23 \text{ litres}}{30.14 \text{ kg.}} = 17 \text{ per cent.}$$

From another specimen:—

Weight—

Bomb complete, 29.4 kg. (64.8 lbs.).

Exploder, 20 g. (0.7 oz.). *Grf. 88* (picric acid).

Bursting charge, 0.14 kg. (0.31 lb.). *Fp. 02* (T.N.T.).

Liquid contents, 7.3 kg. (16.1 lbs.).

Nature of contents—48.3 per cent. phosgene + 51.7 per cent. chloropicrin.

Volume of liquid—4.64 litres.

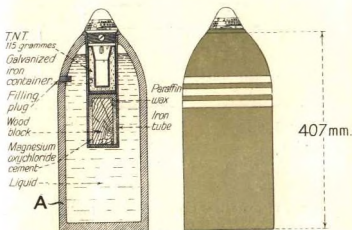
$$\text{Efficiency} = \frac{\text{Volume of liquid}}{\text{Weight of bomb}} = \frac{4.64 \text{ litres}}{29.4 \text{ kg.}} = 15.8 \text{ per cent.}$$

Employment—A large number of these bombs, frequently several hundred, are discharged simultaneously against a small area. Sometimes the discharge is repeated. The discharge is accompanied by a sheet of flame and a loud explosion.

The bomb in flight emits a trail of sparks and makes a loud whirring noise. It bursts with a loud detonation, producing a thick white cloud.

glatte Gas-Mine (?).

Calibre,* 18 cm (7.08").

SCALE— $\frac{1}{8}$.

Thickness of walls—At A, 14 mm.

Thickness of base—18 mm.

Distinctive markings—Three white rings, or three white rings and a white "D" denote a gas bomb.

Remarks—The fuze is sometimes modified to allow of the percussion pellet being put out of action and then acts on time only. It is sometimes marked *Z.m.u.sch. W.M.*

The 18 cm. smooth-bore Minenwerfer is an obsolete bronze muzzle-loading trench mortar. It is mounted on a non-recoil steel carriage, which is pivoted on a rectangular steel platform. Weight in action, 9 cwt.

The 18 cm. gas projector, according to prisoners' statements, is similar to our own.

* Of the mortar; the external diameter of the bomb is about 17.8 cm. (7.0").

18 cm. Smooth-Bore Minenwerfer Bomb.

Contents: Hexanitrodiphenylamine and diphenylchlorarsine.

Used with		Maximum range.	
Projector.	Fuze.	Time.	Perc'n.
18 cm. smooth-bore projector (<i>Gaswerfer</i>)	<i>Z.s.u.m.W.M.*</i> ...	yards. At least 1,400	yards. At least 1,400

Material—Steel.

Weight—

Bomb complete, kg. (lbs.),
Exploder,
Contents,

Nature of contents—51 per cent. hexanitrodiphenylamine
+ 48.2 per cent. diphenylchlorarsine.

Employment—Fired in the course of a projector attack in
conjunction with phosgene bombs.

Remarks—The filling is a mixture of high-explosive and an
irritant substance. It is a solid, pale yellow in colour and in the
form of pellets about the size of a pea. These pellets consist of
brownish crystals covered with yellow powder. No smell is
apparent at the ordinary temperature. The filling detonates well,
producing a dense black smoke which is extremely irritating to the
respiratory organs.

* The percussion system can be locked by means of a set screw and the
fuze set so as to act on time only.

glatte Blaukreuz-Mine (?).

Calibre,* 18 cm. (7.08").

Thickness of walls—

Thickness of base—

Distinctive markings—A blue cross. The bomb is painted grey.

* Of the mortar; the external diameter of the bomb is about 17.8 cm. (7.0").

APPENDIX I.

RANGE TABLE.

(7·7 cm.) Field Gun 96 n/A.

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.
metres.	yards.	° ' "	° ' "	secs.	f.s.
0	0	...	...	...	M.V. 1,526
500	547	0 45	0 49	1·2	1,339
1,000	1,094	1 34	1 52	2·4	1,203
1,500	1,640	2 30	3 11	3·9	1,102
2,000	2,187	3 37	4 45	5·4	1,024
2,500	2,734	4 52	6 37	7·0	968
3,000	3,281	6 19	8 45	8·7	919
3,500	3,828	7 49	11 04	10·7	876
4,000	4,374	9 30	13 41	12·7	840
4,500	4,921	11 26	16 34	14·7	810
5,000	5,468	13 28	19 49	17·2	784
†5,500	6,015	15 52†	23 26	19·7	761
6,000	6,562	18 26	27 22	22·4	741
6,500	7,109	21 22	31 52	25·3	732
7,000	7,655	24 52	36 56	28·7	725
7,500	8,202	29 15	42 49	32·8	732
8,000	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 will also serve as a guide for the Universal, 1914, 1915 and Long Pattern Shell. The Stream-line Shell ("C" Shell) is not fired from this gun.

† The maximum elevation on the gun is 16°.

APPENDIX II.

This range table is now obsolete, see
Appendix IIa.

RANGE TABLE.

(77 cm.) Field Gun '16.

EXTRACTS FROM THE PROVISIONAL RANGE TABLE FOR
SECTION COMMANDERS.

1916 Pattern Field Gun.

Normal Charge (*Gebrauchsladung*).

Range.		1915 Pattern* H.E. Shell, with <i>L.K.Z. 11 Gr.</i> Fuze.		Long Pattern H.E. shell with <i>E.K.Z. 16</i> and <i>L.K.Z. 16 m.V.</i> Fuzes.		1896 Pattern (modified) Shrapnel, with <i>Dopp. Z. 96 m/A.</i> Fuze.	
		Angle of elevation.	Fuze setting.†	Angle of elevation.	Angle of elevation.	Angle of elevation.	Fuze setting.‡
metres.	yards.	M.V. = 1,571 f.s.		M.V. = 1,558 f.s.		M.V. = 1,555 f.s.	
500	547	0 30	575	0 30	0 30	0 30	350
1,000	1,094	1 15	1,025	1 15	1 15	1 15	750
1,500	1,640	2 07	1,450	2 11	2 11	2 11	1,175
2,000	2,187	3 07	1,900	3 11	3 11	3 11	1,600
2,500	2,734	4 11	2,350	4 22	4 22	4 22	2,025
3,000	3,280	5 26	2,800	5 49	5 49	5 49	2,475
3,500	3,828	6 52	3,250	7 26	7 26	7 22	2,925
4,000	4,374	8 26	3,725	9 07	9 07	9 11	3,375
4,500	4,921	10 15	4,175	10 56	11 04	11 04	3,825
5,000	5,468	12 11	4,625	12 56	13 04	13 04	4,250
5,500	6,015	14 15	5,075	15 11	15 22	15 22	4,700
6,000	6,562	16 30	5,550	17 37	17 49	17 49	5,150
6,500	7,109	19 00	6,000	20 26	20 34	20 34	5,600
7,000	7,655	21 49	6,500	23 34	23 45	23 45	6,100
7,500	8,202	25 11	7,000	27 04	27 49	27 49	6,675
7,600	8,312	25 56	7,100	27 52	28 49	28 49	6,800
7,700	8,421	26 45	...	28 45	29 56	29 56	6,950
8,000	8,749	29 34	...	31 45	34 26	34 26	...
8,200	8,968	31 52	...	34 26	41 22	41 22	...
8,500	9,296	37 00	...	41 30	...	...	...
8,600	9,405	39 45	...	...	...	...	...

NOTE.—The permanent deflection as laid down in the range table is allowed for
by the sight being inclined.

* According to a document dated 20.3.18, the normal charge is no longer used with
this shell.

† Setting of fuze to burst shell on the target.

‡ Setting of fuze to burst shell 82 yards short of the target.

APPENDIX IIA.

RANGE TABLE.

(7·7 cm.) Field Gun '16.

REMARKS ON THE PROVISIONAL RANGE TABLE FOR
THE 1916 PATTERN GERMAN FIELD GUN, FOR THE
USE OF SECTION COMMANDERS.

Berlin, 1917.

This range table was captured in June, 1918. It cancels the original provisional range table which was issued under IA/40705, dated 15th October, 1917, and is given on page 460.

The new table applies to the 1915, long, and streamline H.E. shell, and to the 1896 pattern shrapnel. For the two charges now in use, the elevation *only* is given for every 100 metres of range.

The following points are of interest :—

1. The propelling charges called No. 1 and No. 2, made up and issued separately, replace the original normal charge which could be decreased to form a reduced charge and increased to form a supercharge.

2. Charge No. 1 produces lower muzzle velocities than the old normal charge.

	M.V. with old Normal Charge.	M.V. with Charge No. 1.
1915 H.E. shell ...	1,571 f.s.	1,365 f.s.
Long " "	1,558 "	1,352 "
1896 shrapnel ...	1,555 "	1,430 "

3. Charge No. 1 is only used at ranges up to 6,000 m. (6,562 yards). Long shell and shrapnel are apparently not fired at ranges exceeding 6,000 m. It is known that the long shell is extremely inaccurate at long ranges.

4. Charge No. 2. produces somewhat higher muzzle velocities than the old supercharge.

	M.V. with old Supercharge.	M.V. with Charge No. 2.
1915 H.E. shell ...	1,745 f.s.	1,788 f.s.
Streamline H.E. shell	1,968 "	1,975 "

5. The former and present maximum ranges for the 1915 and streamline shell compare as follows :—

	Maximum Ranges. With old Supercharge.	With Charge No. 2.
1915 H.E. shell ...	10,389 yds.	9,952 yds.
Streamline H.E. shell	11,264 "	11,702 "

These considerations lead to the following conclusions :—

1. The maximum range of the gun has been increased to 11,702 yards by adopting a propelling charge producing a higher muzzle velocity.

2. The increase in maximum range due to using a streamline shell is 1,750 yards.

3. Lower muzzle velocities, and consequently less wear in the gun, are now obtained by the use at medium ranges of a smaller reduced charge than that used formerly.

APPENDIX TO RANGE TABLE No. 2.

(10.5 cm.) Light Field Howitzer '98/'09.

Fuze settings for Charges Nos. 1-6 inclusive and No. 8.*

Range.		Angle of elevation.		Fuze setting.	Range.		Angle of elevation.		Fuze setting.
metres.	yards.	°	'	metres.	metres.	yards.	°	'	metres.
CHARGE No. 1.					CHARGE No. 5.				
700	765	6	37	1,225	3,500	3,828	24	22	4,525
800	875	7	41	1,375	3,600	3,937	25	37	4,675
900	984	8	49	1,575	3,700	4,046	26	56	4,800
1,000	1,094	10	00	1,725	3,800	4,156	28	22	4,950
1,100	1,203	11	11	1,900	3,900	4,265	29	56	5,100
1,200	1,312	12	26	2,075	4,000	4,374	31	37	5,250
1,300	1,422	13	41	2,250	4,100	4,484	33	20	5,450
1,400	1,531	14	56	2,425	4,200	4,593	36	00	5,650
1,500	1,640	16	15	2,625	CHARGE No. 6.				
1,600	1,750	17	41	2,800	4,100	4,484	24	30	4,875
1,700	1,859	19	07	2,975	4,200	4,593	25	34	4,975
1,800	1,968	20	37	3,150	4,300	4,703	26	41	5,075
1,900	2,078	22	11	3,350	4,400	4,812	27	56	5,200
2,000	2,187	23	56	3,550	4,500	4,921	29	19	5,325
2,100	2,297	25	56	3,750	4,600	5,031	30	49	5,475
2,200	2,406	28	07	3,975	4,700	5,140	32	26	5,600
2,300	2,515	30	41	4,200	4,800	5,249	34	19	5,750
2,400	2,625	33	45	4,500	4,900	5,359	36	37	5,925
2,500	2,734	38	22	4,850	CHARGE No. 8.				
CHARGE No. 2.					6,000	6,502	25	41	5,600
2,400	2,625	25	52	3,900	6,100	6,671	26	37	5,700
2,500	2,734	27	45	4,100	6,200	6,780	27	34	5,800
2,600	2,843	29	56	4,350	6,300	6,890	28	30	5,900
2,700	2,953	32	30	4,600	6,400	6,999	29	26	6,000
2,800	3,062	35	41	4,900	6,500	7,109	30	30	6,100
CHARGE No. 3.					6,600	7,218	31	34	6,200
2,700	2,953	26	15	4,150	6,700	7,327	32	45	6,300
2,800	3,062	27	56	4,300	6,800	7,437	34	07	6,400
2,900	3,171	29	49	4,525	6,900	7,546	35	49	6,500
3,000	3,281	32	00	4,775	7,000	7,655	38	00	6,600
3,100	3,390	35	00	5,025	Charges to be used for given ranges.				
CHARGE No. 4.					Range.		Charge No.		
3,000	3,281	25	22	4,325	metres.				
3,100	3,390	26	52	4,475	2,100	— 2,400	1		
3,200	3,500	28	30	4,650	2,500	— 2,700	2		
3,300	3,609	30	19	4,825	2,800	— 3,000	3		
3,400	3,718	32	22	5,025	3,100	— 3,500	4		
3,500	3,828	35	00	5,250	3,600	— 4,100	5		
2,900	3,937	38	52	5,550	4,200	— 4,800	6		
					4,900	— 6,300	7		
					6,400	— 7,000	8		

* The time ring on the fuze is graduated in fifties and hundreds of metres for Charge No. 7, which was formerly the full charge.

APPENDIX III.

RANGE TABLE.

(10.5 cm.) Light Field Howitzer '98/'09.

EXTRACTS FROM RANGE TABLE No. 2.

(10.5 cm.) Light Field Howitzer '98/'09.

Range.		1905 Pattern "Universal" Shell.*					
		Angle of elevation.		Angle of descent.		Time of flight.	Remaining velocity.
metres.	yards.	° ' "		° ' "		secs.	f.s.
CHARGE No. 2.							
...	0	...		...		...	M.V. 600
...	2,625	25	52	29	22	15.7	515
...	2,734	27	45	31	30	16.8	515
...	3,062	35	41	40	22	21.1	512
CHARGE No. 3.							
...	0	...		...		...	M.V. 640
...	2,953	26	15	30	00	16.9	541
...	3,281	32	00	36	37	20.5	535
...	3,390	35	00	40	00	22.1	535
CHARGE No. 4.							
0	0	...		...		...	M.V. 689
3,000	3,281	25	22	29	22	17.8	564
3,300	3,609	30	19	35	11	20.8	558
3,600	3,937	38	52	45	00	25.8	561
CHARGE No. 5.							
0	0	...		...		...	M.V. 764
3,500	3,828	24	22	28	45	19.1	613
3,900	4,265	29	56	36	00	22.5	600
4,200	4,593	36	00	43	11	26.5	604
CHARGE No. 6.							
0	0	...		...		...	M.V. 840
4,100	4,484	24	30	29	30	21.1	650
4,500	4,921	29	19	35	22	24.1	640
4,900	5,359	36	37	44	11	29.2	643
CHARGE No. 7.†							
0	0	...		...		...	M.V. 991
500	547	1	11	1	37	1.7	955
1,000	1,094	2	49	3	26	3.4	925
1,500	1,640	4	34	5	22	5.3	892
2,000	2,187	6	30	7	34	7.2	860
2,500	2,734	8	30	10	00	9.2	830
3,000	3,281	10	41	12	45	11.3	800
3,500	3,828	13	15	15	56	13.7	771
4,000	4,374	15	56	19	30	16.1	745
4,500	4,921	18	56	23	26	18.8	728
5,000	5,468	22	30	28	04	21.9	712
5,500	6,015	26	41	33	30	25.4	702
6,000	6,562	32	30	40	26	30.0	699
6,300	6,890	38	00	46	45	34.3	709

* This range table will also serve as a guide for the 1914, 1915 and Long Pattern Shell and for the 1916 Pattern Shrapnel.

† A new charge, No. 8, has been introduced in order to obtain an increased range when specially required. The maximum range with Charge No. 8 is 7,655 yards.

‡ Maximum range with Charge No. 7, which is the largest charge usually employed.

EXTRACTS FROM APPENDIX TO RANGE TABLE No. 5.

9 cm. Gun '73/88.

1915 Pattern Shrapnel, with <i>Dopp. Z. 92 lg. Brlg.</i>					1915 Pattern Shrapnel with <i>Dopp. Z. 92 f.². 10 cm. K. or Dopp. * Z. 92 K. 15.</i>	
Range.		Angle of elevation.	Angle of descent.	Time of flight.	Angle of elevation.	Time of flight.
metres.	yards.	° '	° '	secs.	° '	secs.
500	547	0 26	0 56	1·2	0 26	1·2
1,000	1,094	1 30	2 19	2·7	1 30	2·5
1,500	1,640	2 45	4 07	4·4	2 45	4·0
2,000	2,187	4 15	6 15	6·2	4 15	5·5
2,500	2,734	5 56	8 52	8·2	5 56	7·4
3,000	3,281	7 52	12 00	10·3	7 52	9·4
3,500	3,828	10 04	15 34	12·6	10 04	11·5
4,000	4,374	12 34	19 45	15·6	12 34	14·0
4,500	4,921	15 30	24 52	18·5	15 30	16·6
5,000	5,468	19 07	30 56	22·4	19 07	19·6
5,500	6,015	23 30	37 49	26·2	23 30	24·3
5,600	6,124	...	...	...	24 30	26·0
6,000	6,562	29 19	46 07	32·3	...	...
6,500	7,109	41 30	59 52	41·9	...	...

APPENDIX IV.

RANGE TABLE.

9 cm. Gun.

EXTRACTS FROM RANGE TABLE No. 5.

9 cm. Gun '73/88.

Range.		1888, 1914A and 1914 Pattern Shell. 1891 and 1915 Pattern Shrapnel.		
		Angle of descent.	Time of flight.	Remaining velocity.
metres. 0	yards. 0	° ' "	secs. ...	f.s. M.V. 1,450
100	110	0 11	0.2	1,391
500	547	0 56	1.2	1,196
1,000	1,094	2 19	2.7	1,047
1,500	1,640	4 07	4.4	951
2,000	2,187	6 15	6.2	879
2,500	2,734	8 52	8.2	817
3,000	3,281	12 00	10.3	764
3,500	3,828	15 34	12.6	722
4,000	4,374	19 45	15.2	682
4,500	4,921	24 52	18.1	650
5,000	5,468	30 56	21.4	623
5,500	6,015	37 49	25.2	610
6,000	6,562	46 07	30.3	617
6,500	7,109	59 52	39.9	679

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; 1914 2 1/2" A and 1915 Pattern Shell and 1896 Pattern Shrapnel.				10 cm. Shell; 1914, 1914 A and 1915 Pattern 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.
metres.	yards.	" "	" "	secs.	f.s.	" "	secs.	f.s.	" "	" "	secs.	f.s.	" "
0	0	...	...	...	M.V. 1,830	...	...	M.V. 1,923	...	...	...	...	M.V. 1,637
500	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
1,000	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
1,500	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
2,000	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
2,500	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
3,000	3,281	3 56	5 41	7-1	1,109	3 45	5 11	6-8	1,152	4 56	6 37	7-8	1,043
3,500	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
4,000	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
4,500	4,921	7 19	11 11	12-1	964	6 49	10 19	11-5	997	8 52	12 30	12-8	932
5,000	5,468	8 37	13 22	13-9	932	8 00	12 19	13-3	965	10 19	14 41	14-8	905
5,500	6,015	10 04	15 45	15-8	905	9 22	14 34	15-1	935	11 56	17 07	16-8	883
6,000	6,562	11 37	18 15	17-7	882	10 49	16 56	17-0	909	13 37	19 45	18-9	863
6,500	7,109	13 19	21 00	19-8	863	12 19	19 30	19-0	889	15 26	22 34	21-1	846
7,000	7,655	15 11	24 00	22-2	843	14 00	22 11	21-2	869	17 34	25 41	23-4	833
7,500	8,202	17 15	27 07	24-6	833	15 41	24 49	23-3	856	19 49	29 00	25-9	820
8,000	8,749	19 26	30 30	27-1	827	17 26	27 30	25-5	846	22 22	32 37	28-6	814
8,500	9,296	21 56	34 15	29-8	820	19 19	30 19	27-8	843	25 11	36 30	31-6	810
9,000	9,843	24 41	38 15	32-9	820	21 30	33 30	30-3	843	28 26	40 45	35-0	817
9,500	10,389	27 52	42 30	36-4	827	24 04	37 11	33-2	846	32 26	45 41	39-2	830
10,000	10,936	...	...	...	...	...	...	...	...	34 45	48 19	41-3	837
10,500	11,483	31 49	47 22	40-5	846	27 11	41 22	36-6	850	...	...	...	...
10,800	11,811	34 41	50 19	43-2	863	...	...	...	...	...	...	...	...
		...	...	...	...	31 11	46 34	40-8	863	...	...	...	...
		...	...	...	...	34 41	50 34	44-4	876	...	...	...	...

* A new range table known as "6a" has been issued, but the present table (6) should serve as a rough guide. This range table is not used with the 10 cm. Gun '14, for which a "provisional" range table has been issued, known as the "Vorläufige Schusstafel für die 10 cm. K. 14." Maximum range, 12,085 yards.

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

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

§ 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. Heavy Gun.

EXTRACTS FROM RANGE TABLE No. 9.

12 cm. Heavy Gun.*

Range.		1888 a/A, 1914A and 1914 Pattern Shell.				1880/92 and 1915 Pattern Shrapnel.			
		Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
metres.	yards.	° ' "	° ' "	secs.	f.s.	° ' "	° ' "	secs.	f.s.
0	0	...	...	...	...	...	...	...	M.V. 1,280
500	547	...	...	...	...	0 56	1 00	1.3	1,148
1,000	1,094	...	...	...	...	2 04	2 26	2.8	1,053
1,500	1,640	...	...	...	...	3 22	4 04	4.4	984
2,000	2,187	...	...	...	...	4 49	5 56	6.2	928
2,100	2,297	4 34	6 04	6.3	922	...	...	...	...
2,500	2,734	5 49	7 52	7.8	875	6 28	8 11	8.0	879
3,000	3,281	7 30	10 30	9.9	827	8 11	10 45	10.0	840
3,500	3,828	9 26	13 30	12.0	784	10 04	13 30	12.1	804
4,000	4,374	11 37	16 56	14.4	751	12 07	16 34	14.2	778
4,500	4,921	14 00	20 49	16.8	722	14 22	19 52	16.6	755
5,000	5,468	16 45	25 15	19.6	696	16 45	23 19	19.1	738
5,500	6,015	19 45	30 04	22.2	679	19 30	27 19	21.9	728
6,000	6,562	23 30	35 37	25.8	669	22 34	31 37	24.8	718
6,500	7,109	28 00	42 00	29.9	668	25 56	36 15	28.1	715
6,800	7,218†	...	...	...	...	26 37	37 15	28.8	715
7,000	7,555	33 45	49 34	35.4	689	...	...	...	...
7,300	7,984‡	38 49	55 45	39.9	715	...	...	...	...

* Not to be confused with the captured French 120 mm. gun or the captured Russian 12 cm. light field howitzer.

† Maximum range with shrapnel.

‡ Maximum range with shell.

(N 13641)

EXTRACTS FROM A SUPPLEMENT TO RANGE TABLE No. 10.

13 cm. Gun.

Range.		13 cm. shrapnel with Dopp. Z. 92 lg. Brig. Fuze.				
		Angle of elevation.	Angle of descent.	Fuze setting.*	Time of flight.	Remaining velocity.
metres.	yards.	° ' "	° ' "	secs.	secs.	f.s.
0	0	...	...	...	...	M.V. 2,270
500	547	0 11	0 19	1½	0.7	2,162
1,000	1,094	0 30	0 41	2½	1.5	2,054
1,500	1,640	0 52	1 07	3½	2.3	1,952
2,000	2,187	1 15	1 34	4½	3.2	1,850
2,500	2,734	1 37	2 04	5	4.1	1,752
3,000	3,281	2 04	2 41	7½	5.1	1,660
3,500	3,828	2 34	3 26	8½	6.1	1,572
4,000	4,374	3 04	4 15	10	7.2	1,489
4,500	4,921	3 37	5 07	10½	8.3	1,411
5,000	5,468	4 11	6 07	11½	9.5	1,342
5,500	6,015	4 52	7 15	13	10.8	1,280
6,000	6,562	5 34	8 34	14½	12.1	1,227
6,500	7,109	6 19	9 54	15½	13.5	1,181
7,000	7,655	7 07	11 22	16½	15.0	1,142
7,500	8,202	7 56	12 56	18½	16.5	1,109
8,000	8,749	8 49	14 37	19½	18.0	1,079
8,500	9,296	9 45	16 19	21½	19.6	1,056
9,000	9,843	10 45	18 11	22½	21.2	1,040
9,500	10,389	11 49	20 04	24½	22.9	1,024
10,000	10,936	12 52	22 00	25½	24.6	1,014
10,500	11,483	14 04	24 04	27½	26.4	1,007
11,000	12,030	15 19	26 15	28½	28.4	997
11,500	12,577	16 41	28 30	30½	30.4	994
12,000	13,124	18 15	30 56	31½	32.6	991
12,500	13,670	19 52	33 26	33½	34.9	988
13,000	14,217	21 41	36 07	34½	37.3	991
13,500	14,764	23 45	39 00	36½	40.0	994
14,000	15,311	26 00	42 04	37½	42.9	1,001

* Length of fuze to burst shrapnel 80 metres short of target.

(N 13641)

APPENDIX VII.

RANGE TABLE.

13 cm. Gun.

EXTRACTS FROM RANGE TABLE No. 10.

13 cm. Gun.

Range.		13 cm. Shell, 1914 Pattern Shell.				13 cm. Shrapnel. With <i>Dopp. Z. 92 f. 10 cm. K.</i> and <i>Dopp. Z. 92 K. 15 Fuzes.</i>			
		Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.	Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.
metres.	yards.	°	'	secs.	f.s.	°	'	secs.	f.s.
500	547	0 11	0 19	0.7	2,280	0 11	0 19	0.7	2,280
1,000	1,094	0 34	0 41	1.5	2,172	0 34	0 37	1.5	2,185
1,500	1,640	0 52	1 07	2.4	2,070	0 52	1 00	2.3	2,093
2,000	2,187	1 15	1 34	3.2	1,968	1 15	1 30	3.1	1,998
2,500	2,734	1 37	2 04	4.1	1,873	1 37	2 00	4.0	1,906
3,000	3,281	2 04	2 41	5.0	1,781	2 00	2 34	4.9	1,821
3,500	3,828	2 30	3 22	6.0	1,693	2 26	3 11	5.9	1,736
4,000	4,374	3 00	4 07	7.1	1,608	2 56	3 52	6.9	1,653
4,500	4,921	3 30	4 56	8.2	1,526	3 26	4 41	8.0	1,578
5,000	5,468	4 04	5 52	9.4	1,450	3 56	5 34	9.1	1,506
5,500	6,015	4 41	6 52	10.7	1,381	4 30	6 30	10.3	1,437
6,000	6,562	5 26	8 00	11.9	1,316	5 07	7 34	11.5	1,375
6,500	7,109	6 07	9 11	13.3	1,260	5 49	8 49	12.8	1,319
7,000	7,656	6 52	10 30	14.7	1,206	6 34	10 07	14.2	1,266
7,500	8,202	7 41	12 00	16.2	1,165	7 19	11 30	15.6	1,220
8,000	8,749	8 37	13 37	17.7	1,125	8 07	13 00	17.1	1,178
8,500	9,296	9 34	15 22	19.4	1,092	9 00	14 37	18.7	1,142
9,000	9,843	10 34	17 19	21.1	1,066	9 56	16 22	20.3	1,112
9,500	10,389	11 37	19 19	22.8	1,047	10 56	18 15	21.9	1,086
10,000	10,936	12 49	21 26	24.6	1,030	12 00	20 11	23.7	1,066
10,500	11,483	13 56	23 37	26.3	1,017	13 04	22 11	25.4	1,050
11,000	12,030	15 11	25 52	28.2	1,010	14 19	24 22	27.3	1,037
11,500	12,577	16 26	28 04	30.2	1,004	15 34	26 34	29.3	1,024
12,000	13,124	17 52	30 19	32.2	997	17 00	28 52	31.3	1,017
12,500	13,670	19 19	32 34	34.3	997	18 30	31 19	33.5	1,010
13,000	14,217	20 52	34 52	36.5	997	20 07	33 52	35.8	1,007
13,500	14,764	22 34	37 11	38.8	997	22 00	36 30	38.3	1,004
14,000	15,311	25 19	39 37	41.2	1,004	23 56	39 15	41.0	1,007
14,400	15,748	25 45	41 37	43.3	1,010	...	...	...	1,010

The maximum elevation on the carriage is 26°.

APPENDIX VIII.

RANGE TABLE.

15 cm. Ringkanone.

EXTRACTS FROM RANGE TABLE No. 12.

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

Range.		1880 Pattern Shell. 1914 and 1914A Pattern Shell with forward driving band.				1880/92 Pattern Shrapnel. 1915 Pattern Shrapnel with forward driving band.			
		Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.	Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.
metres.	yards.	° ' "	° ' "	secs.	f.s.	° ' "	° ' "	secs.	f.s.
M.V.	...	...	...	...	1,499	...	...	...	1,322
500	547	0 41	0 52	1.2	1,293	0 52	1 00	1.3	1,197
1,000	1,094	1 34	2 04	2.5	1,138	1 56	2 19	2.8	1,102
1,500	1,640	2 37	3 37	4.0	1,037	3 07	3 45	4.3	1,037
2,000	2,187	3 52	5 19	5.7	968	4 26	5 22	5.9	981
2,500	2,734	5 19	7 26	7.3	909	5 52	7 19	7.6	938
3,000	3,281	6 52	9 49	9.2	880	7 22	9 26	9.4	899
3,500	3,828	8 37	12 30	11.3	820	9 04	11 45	11.3	866
4,000	4,374	10 34	15 34	13.5	781	10 52	14 22	13.2	837
4,500	4,921	12 41	18 56	15.8	751	12 49	17 11	15.3	810
5,000	5,468	15 00	22 34	18.2	725	14 52	20 07	17.5	791
5,500	6,015	17 30	26 26	20.8	712	17 04	23 22	19.8	778
6,000	6,562	20 15	30 41	23.6	702	19 30	26 52	22.4	768
6,500	7,109	23 22	35 22	27.0	699	22 15	30 37	25.2	761
6,900	7,546†	...	...	...	...	24 34	33 52	27.6	761
7,000	7,655	27 15	41 00	30.8	695	...	...	...	...
7,500	8,202	33 37	49 34	36.3	712	...	...	...	...
7,600	8,312‡	36 49	53 19	38.8	718	...	...	...	...

* An obsolete piece, not to be confused with modern German 15 cm. guns.

† Maximum range with shrapnel.

‡ Maximum range with 1880 Pattern Shell. The maximum range with the 1914A and 1914 Pattern Shell with forward driving band is 7,900 m. (8,640 yards).

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 Pattern Shrapnel.‡			
		Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.	Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.
metres.	yards.	° ′	° ′	secs.	f.s.	° ′	°	secs.	f.s.
M.V.	...	...	...	...	1,624	...	...	...	1,640
500	547	0 37	0 41	1·1	1,480	0 34	0 37	1·0	1,512
1,000	1,094	1 19	1 30	2·3	1,345	1 15	1 26	2·2	1,394
1,500	1,640	2 04	2 30	3·5	1,234	1 56	2 22	3·4	1,286
2,000	2,187	2 56	3 45	4·8	1,145	2 49	3 37	4·7	1,196
2,500	2,734	4 00	5 15	6·3	1,079	3 45	4 56	6·1	1,129
3,000	3,281	5 07	6 56	7·9	1,024	4 45	6 26	7·5	1,073
3,500	3,828	6 19	8 49	9·6	984	5 52	8 04	9·2	1,027
4,000	4,374	7 37	10 49	11·4	948	7 04	9 52	10·8	991
4,500	4,921	9 04	13 00	13·2	915	8 22	11 49	12·6	958
5,000	5,468	10 41	15 26	15·2	889	9 45	14 00	14·5	932
5,500	6,015	12 22	18 00	17·2	866	11 19	16 19	16·4	909
6,000	6,562	14 07	20 41	19·3	846	13 00	18 49	18·4	889
6,500	7,109	16 00	23 34	21·5	833	14 45	21 30	20·5	873
7,000	7,656	18 00	26 37	23·8	820	16 41	24 26	22·7	860
7,500	8,202	20 15	29 49	26·3	814	18 49	27 34	25·1	846
8,000	8,749	22 41	33 15	29·1	810	21 07	30 56	27·8	837
8,200	8,968½	...	...	...	...	22 11	32 26	28·9	837
8,500	9,296	25 30	37 00	32·1	810	...	...	...	...
9,000	9,843	28 37	41 07	35·4	817	...	...	...	...
9,500	10,389	32 34	45 56	39·3	833	...	...	...	...
10,000	10,936½	39 11	53 15	45·6	860	...	...	...	...

* No. 14A is used with the 1912, 1912 n/A., 1914 and 1914A Pattern Shell, but No. 14 will probably serve as a rough guide for these shells.

† An obsolete piece, still employed, however, particularly for firing gas shell.

‡ This table is probably employed with the 1907 and 1915 Pattern Shrapnel.

§ Maximum range with time shrapnel.

|| Maximum range with shell.

APPENDIX X.

RANGE TABLE.

(15 cm.) Heavy Field Howitzer '02.

EXTRACTS FROM RANGE TABLE No. 16.

(15 cm.) Heavy Field Howitzer '02.

Range.		1883, 1888, 1896, 1904, 1912, 1912 n/A., 1914 and 1914A Pattern Shell.											
		Charge No. 1, 0.57 kg. (1.3 lbs.).				Charge No. 2, 0.63 kg. (1.4 lbs.)				Charge No. 3, 0.71 kg. (1.6 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.
metres.	yards.	°	'	secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	f.s.
0	0	...	...	...	M.V. 613	...	...	...	M.V. 666	...	...	...	M.V. 728
1,000	1,091	8 04	8 41	5.4	584	...	...	...	...	...	...	...	...
1,500	1,640	12 52	13 49	8.5	568	...	...	...	...	...	...	...	...
2,000	2,187	18 15	19 49	11.9	554	...	...	...	...	...	...	...	...
2,500	2,734	24 52	27 19	15.8	541	...	...	...	...	...	...	...	...
2,700	2,953	...	...	...	...	22 19	24 45	15.5	581	...	...	...	...
3,000	3,281	35 07	38 45	21.5	535	26 11	29 19	17.9	574	...	...	...	...
3,100	3,390	39 15	43 22	23.8	538	...	...	...	...	21 37	24 22	16.4	620
3,500	3,828	...	...	...	...	36 15	40 37	24.0	571	26 00	29 34	19.4	613
3,600	3,937	...	...	...	...	42 00	46 45	27.0	574	...	...	...	...
3,800	4,156	...	...	...	...	...	...	...	...	...	...	...	...
4,000	4,374	...	...	...	...	...	...	...	...	34 11	39 00	24.9	607
4,175	4,566	...	...	...	...	...	...	...	...	40 52	46 15	28.8	610
4,500	4,921	...	...	...	...	...	...	...	...	...	...	...	...
4,900	5,359	...	...	...	...	...	...	...	...	...	...	...	...

(n 13641)

[Range Table continued overleaf.]

APPENDIX X.

RANGE TABLE.

(15 cm.) Heavy Field Howitzer '02.

EXTRACTS FROM RANGE TABLE No. 16—(continued from page 472).

(15 cm.) Heavy Field Howitzer '02.

Range.		1883, 1888, 1896, 1904, 1912, 1912 n/A., 1914 and 1914A Pattern Shell.											
		Charge No. 4, 0.81 kg. (1.8 lbs.).				Charge No. 5, 0.95 kg. (2.09 lbs.).				Charge No. 6, 1.2 kg. (2.65 lbs.). (Full Charge.)			
		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.
metres. 0	yards. 0	°	'	secs.	f.s. M.V. 804	°	'	secs.	f.s. M.V. 902	°	'	secs.	f.s. M.V. 1,066
1,000	1,094	...	...	...	...	3 34	4 07	3.8	853	...	...	...	...
1,500	1,640	...	...	...	...	5 39	6 19	5.8	830	...	...	...	...
2,000	2,187	...	...	...	...	7 34	8 45	7.8	804	...	...	...	...
2,500	2,734	...	...	...	...	10 09	11 26	10.0	784	...	...	...	...
3,000	3,281	...	...	...	...	12 34	14 26	12.3	761	...	...	...	...
3,500	3,828	...	...	...	...	15 22	17 52	14.7	745	...	...	...	...
3,800	4,156	22 41	26 07	18.8	663	...	...	...	...	...	...	...	...
4,000	4,374	24 37	28 26	20.2	659	18 24	21 45	17.3	728	...	...	...	...
4,500	4,921	30 30	35 30	24.5	650	21 52	26 00	20.2	715	...	...	...	...
4,900	5,359	39 37	45 52	30.9	653	...	...	...	...	...	...	...	...
5,000	5,468	...	...	...	...	26 09	31 07	23.6	702	...	...	...	...
5,500	6,015	...	...	...	...	31 41	37 56	27.9	695	21 30	27 22	22.5	748
5,900	6,452	...	...	...	...	40 45	48 22	35.0	705	...	...	...	...
6,000	6,562	...	...	...	...	...	...	...	...	24 41	31 37	25.6	738
6,500	7,109	...	...	...	...	...	...	...	...	28 34	36 26	29.0	738
7,000	7,655	...	...	...	...	...	...	...	...	33 37	42 22	33.4	748
7,450	8,147	...	...	...	...	...	...	...	...	41 26	50 45	40.0	774

APPENDIX XI.

RANGE TABLE.

(15 cm.) Heavy Field Howitzer '13.

EXTRACTS FROM PROVISIONAL RANGE TABLE.*

(15 cm.) Heavy Field Howitzer '13.

1883, 1888, 1896, 1904, 1912, 1912 n/A., 1914 and 1914A Pattern Shell.													
Range.		Charge No. 1, 0.57 kg. (1.3 lbs.).				Charge No. 2, 0.63 kg. (1.4 lbs.).				Charge No. 3, 0.71 kg. (1.6 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.
metres.	yards.	° ' "	° ' "	secs.	f.s.	° ' "	° ' "	secs.	f.s.	° ' "	° ' "	secs.	f.s.
0	0	...	...	...	M.V. 640	...	...	...	M.V. 689	...	...	...	M.V. 755
1,000	1,094	7 30	7 56	5.3	613	...	...	...	...	...	...	...	...
1,500	1,640	11 45	12 34	8.2	597	...	...	...	...	...	...	...	...
2,000	2,187	16 34	17 49	11.2	581	...	...	...	...	...	...	...	...
2,500	2,734	22 19	24 07	14.9	568	17 52	19 15	13.1	630	...	...	...	...
2,900	3,171	...	...	...	...	...	...	...	...	17 34	19 11	14.0	676
3,000	3,281	30 00	33 15	19.4	558	23 07	25 11	16.6	613	18 22	20 11	14.6	669
3,100	3,390	32 07	35 37	20.6	558	...	...	...	...	...	...	...	...
3,500	3,828	...	...	...	...	30 30	33 41	21.2	597	23 00	25 37	18.0	653
3,600	3,937	...	...	...	...	32 15	35 56	22.4	594	...	...	...	...
4,000	4,374	...	...	...	...	...	...	...	...	29 07	32 52	22.1	636
4,200	4,593	...	...	...	...	...	...	...	...	32 34	36 49	24.4	633

* 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.

Range Table continued overleaf.

RANGE TABLE.

(15 cm.) Heavy Field Howitzer '13.

EXTRACTS FROM PROVISIONAL RANGE TABLE*—(continued from page 474).

(15 cm.) Heavy Field Howitzer '13.

1883, 1888, 1896, 1904, 1912, 1912 n/A., 1914 and 1914A Pattern Shell.																	
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.). (Full charge.)			
		Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.	Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.	Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.	Angle of elevation.	Angle of descent.	Time of flight.	Rem. vel.
metres.	yards.	°	'	secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	f.s.
M.V.	...	...	...	...	833	...	...	...	942	...	...	...	...	...	...	...	1,196
1,000	1,094	...	...	...	...	...	...	...	...	2	26	2	15	3	2	1,060	...
1,500	1,640	...	...	...	...	...	...	...	...	3	41	3	45	4	8	1,010	...
2,000	2,187	...	...	...	...	...	...	...	...	5	15	5	30	6	4	971	...
2,500	2,734	...	...	...	...	...	...	...	...	6	49	7	34	8	2	938	...
3,000	3,281	...	...	...	...	...	...	...	...	8	37	9	46	10	1	909	...
3,500	3,828	18	11	20	34	15.8	709	...	...	10	30	12	26	12	1	879	...
4,000	4,374	22	07	25	22	18.9	692	16	52	19	41	16.5	758	12	26	14	56
4,500	4,921	27	07	31	19	22.7	679	19	56	23	49	19.2	738	14	37	17	41
4,900	5,359	32	26	37	49	26.4	669	...	...	...	...	...	...	...	...	...	...
5,000	5,468	...	...	...	...	...	...	23	45	28	30	22.4	722	16	56	20	45
5,500	6,015	...	...	...	...	...	...	28	19	34	11	26.0	712	19	30	24	04
5,900	6,452	...	...	...	...	...	...	33	07	39	52	29.8	712	...	...	...	...
6,000	6,562	...	...	...	...	...	...	...	...	23	30	27	56	24	0	791	...
6,500	7,109	...	...	...	...	...	...	...	...	20	49	32	11	27	0	781	22 34
7,000	7,655	...	...	...	...	...	...	...	...	20	52	37	11	30	7	781	25 45
7,400	8,093	...	...	...	...	...	...	...	...	34	04	42	04	34	1	784	...
7,500	8,202	...	...	...	...	...	...	...	...	...	...	...	...	...	...	29 34	37 41
8,000	8,749	...	...	...	...	...	...	...	...	...	...	...	...	...	...	34 07	42 52
8,500	9,296	...	...	...	...	...	...	...	...	...	...	...	...	...	...	40 52	49 52

* 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.

APPENDIX XI.

RANGE TABLE.

(15 cm.) Heavy Field Howitzer '13.

ADDENDUM TO PROVISIONAL RANGE TABLE.

(15 cm.) Heavy Field Howitzer '13.

1914 Pattern Shell (Short Shell) with *Dopp. Z. 92 lg. Brlg.* Fuze.

Range.			Fuze setting.			Range.			Fuze setting.		
metres.	yards.	secs.				metres.	yards.	secs.			
CHARGE No. 1.						CHARGE No. 5.					
1,000	1,094	6 $\frac{1}{2}$				4,000	4,374	17 $\frac{1}{2}$			
1,500	1,640	9 $\frac{1}{2}$				4,500	4,921	20 $\frac{1}{2}$			
2,000	2,187	12 $\frac{1}{2}$				5,000	5,468	23 $\frac{1}{2}$			
2,500	2,734	15 $\frac{1}{2}$				5,500	6,015	27 $\frac{1}{2}$			
3,000	3,280	19 $\frac{1}{2}$				5,900	6,452	30 $\frac{1}{2}$			
3,100	3,390	21									
CHARGE No. 2.						CHARGE No. 6.					
2,500	2,734	14				1,000	1,094	3 $\frac{1}{2}$			
3,000	3,280	17 $\frac{1}{2}$				1,500	1,640	5 $\frac{1}{2}$			
3,500	3,828	21 $\frac{1}{2}$				2,000	2,187	7 $\frac{1}{2}$			
3,600	3,937	22 $\frac{1}{2}$				2,500	2,734	9 $\frac{1}{2}$			
CHARGE No. 3.						3,000	3,280	11 $\frac{1}{2}$			
2,900	3,171	15 $\frac{1}{2}$				3,500	3,828	13 $\frac{1}{2}$			
3,000	3,280	15 $\frac{1}{2}$				4,000	4,374	15 $\frac{1}{2}$			
3,500	3,828	18 $\frac{1}{2}$				4,500	4,921	17 $\frac{1}{2}$			
4,000	4,374	22 $\frac{1}{2}$				5,000	5,468	19 $\frac{1}{2}$			
4,200	4,593	24 $\frac{1}{2}$				5,500	6,015	21 $\frac{1}{2}$			
CHARGE No. 4.						6,000	6,562	23 $\frac{1}{2}$			
1,000	1,094	4 $\frac{1}{2}$				6,500	7,109	26			
1,500	1,640	7 $\frac{1}{2}$				7,000	7,655	28 $\frac{1}{2}$			
2,000	2,187	9 $\frac{1}{2}$				7,500	8,202	31 $\frac{1}{2}$			
2,500	2,734	12 $\frac{1}{2}$				7,800	8,530	34 $\frac{1}{2}$			
3,000	3,280	14 $\frac{1}{2}$				CHARGE No. 7.					
3,500	3,828	17 $\frac{1}{2}$				6,500	7,109	24 $\frac{1}{2}$			
4,000	4,374	20 $\frac{1}{2}$				7,000	7,655	26 $\frac{1}{2}$			
4,500	4,921	23 $\frac{1}{2}$				7,500	8,202	29 $\frac{1}{2}$			
5,000	5,468	26 $\frac{1}{2}$				8,000	8,749	32 $\frac{1}{2}$			
5,100	5,577	29 $\frac{1}{2}$				8,500	9,296	36 $\frac{1}{2}$			

Charge No. 4 should always be used in preference to Charges Nos. 1, 2 and 3, when using *Dopp. Z. 92 lg. Brlg.*

APPENDIX XI.

RANGE TABLE.

(15 cm.) Heavy Field Howitzer '13.

ADDENDUM TO PROVISIONAL RANGE TABLE.

(15 cm.) Heavy Field Howitzer '13.

Range.		1912 Pattern Shell (Long Shell) with <i>Dopp</i> , Z. 15 Fuze.			
		Angle of elevation.	Fuze setting.	Angle of descent.	Time of flight.
metres.	yards.	° /	secs.	° /	secs.

CHARGE No. 6, 1.2 kg. W.P. (10 × 10 × 1½).

1,000	1,094	3 00	4½	3 45	3.1
1,500	1,640	4 30	6½	5 26	5.0
2,000	2,187	6 04	8½	7 11	6.9
2,500	2,734	7 45	10½	9 07	8.8
3,000	3,280	9 30	12½	11 11	10.7
3,500	3,828	11 22	14½	13 26	12.6
4,000	4,374	13 22	16½	15 52	14.6
4,500	4,921	15 37	19½	18 34	16.9
5,000	5,468	18 04	21½	21 37	19.3
5,500	6,015	20 49	23½	24 56	21.9
6,000	6,562	23 56	26½	28 52	24.8
6,500	7,109	27 45	29½	33 13	28.3
7,000	7,655	33 07	33½	40 30	32.6
7,500	7,983	38 30	37½	46 56	36.9

CHARGE No. 7, 1.35 kg. W.P. (10 × 10 × 1½).

6,500	7,109	23 45	27½	29 52	25.6
7,000	7,655	27 11	30½	34 19	29.0
7,500	8,202	31 19	33½	39 22	33.0
8,000	8,749	37 07	37½	46 41	38.2
8,200	8,968	42 30	41½	52 19	42.5

APPENDIX XII.

RANGE TABLE.

(15 cm.) Long Heavy Field Howitzer '13.

EXTRACTS FROM PROVISIONAL RANGE TABLE.

(15 cm.) Long Heavy Field Howitzer '13.*

1912 Pattern Shell (Long Shell)†

Range.		Angle of elevation.		Angle of descent.		Time of flight.	Remaining velocity.
metres.	yards.	°	'	°	'	secs.	f.s.
Charge No. 1, 0.57 kg. (1.3 lbs.).						M.V. = 630 f.s.	
100	109	0	45	0	49	0.6	627
500	547	3	49	3	56	2.6	613
1,000	1,094	7	49	8	11	5.4	597
1,500	1,640	12	19	12	52	8.2	581
2,000	2,187	17	22	18	15	11.4	571
2,500	2,734	23	26	25	11	15.2	558
3,000	3,281	32	19	36	22	20.5	548
3,100	3,390	35	26	40	22	22.4	545
Charge No. 2, 0.63 kg. (1.4 lbs.).						M.V. = 679 f.s.	
2,200	2,406	16	34	17	30	11.6	627
2,500	2,734	19	26	20	45	13.6	617
3,000	3,281	25	19	27	30	17.5	604
3,500	3,828	34	37	38	07	23.3	590
3,600	3,937	38	04	42	37	25.3	590
Charge No. 3, 0.71 kg. (1.6 lbs.).						M.V. = 735 f.s.	
2,600	2,843	17	00	18	07	13.1	650
3,000	3,281	20	22	22	11	15.6	636
3,500	3,828	25	30	28	26	19.1	620
4,000	4,374	33	22	37	41	24.6	610
4,200	4,593	40	04	45	56	28.5	613
Charge No. 4, 0.81 kg. (1.8 lbs.).						M.V. = 814 f.s.	
600	656	2	49	2	45	2.5	797
1,000	1,094	4	41	4	45	4.1	784
1,500	1,640	7	11	7	26	6.3	768
2,000	2,187	9	49	10	26	8.5	751
2,500	2,734	12	41	13	41	10.0	732
3,000	3,281	15	49	17	15	13.6	712
3,500	3,828	19	26	21	22	16.5	692
4,000	4,374	23	52	26	45	19.7	669
4,500	4,921	30	07	34	26	24.2	656
4,900	5,359	39	52	45	22	30.9	653
Charge No. 5, 0.95 kg. (2.1 lbs.).						M.V. = 899 f.s.	
3,900	4,265	17	26	19	41	16.7	748
4,000	4,374	18	07	20	26	17.3	745
4,500	4,921	21	45	24	45	20.3	725
5,000	5,468	26	07	30	15	23.6	709
5,500	6,015	31	52	37	07	27.8	699
5,900	6,452	41	34	48	45	34.5	705

* This is the most modern German 15 cm. howitzer.

† This range table will serve as a guide when firing the '83, '88, '96, '12 n/A., '14 and '14A Pattern Shell.

[P.T.O.]

CHARGE No. 6, 1.2 kg. (2.6 lbs.). M.V. = 1,060 f.s.

Range.		Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
metres.	yards.	° '	° '	secs.	f.s.
4,800	5,249	16 56	19 56	18.2	823
5,000	5,468	18 04	21 22	19.2	814
5,500	6,015	21 00	25 15	22.0	791
6,000	6,562	24 22	29 26	25.2	774
6,500	7,109	28 30	34 34	28.9	768
7,000	7,655	34 22	41 30	33.4	768
7,200	7,874	38 34	46 22	36.4	771

CHARGE No. 7 (NORMAL CHARGE), 1.35 kg. (3.0 lbs.). M.V. = 1,145 f.s.

1,000	1,094	2 22	2 26	2.9	1,086
1,500	1,640	3 41	3 56	4.4	1,053
2,000	2,187	5 04	5 30	6.1	1,020
2,500	2,734	6 34	7 19	7.9	987
3,000	3,280	8 07	9 15	9.7	955
3,500	3,828	9 49	11 26	11.6	919
4,000	4,374	11 45	14 00	13.6	886
4,500	4,921	13 56	16 52	15.8	853
5,000	5,468	16 19	20 07	18.3	823
5,500	6,015	18 56	23 41	20.9	800
6,000	6,562	21 49	27 26	23.7	787
6,500	7,109	25 00	31 19	26.7	784
7,000	7,655	28 30	35 37	29.9	787
7,500	8,202	32 52	40 56	34.1	797
7,900	8,640	39 34	49 00	39.2	810

CHARGE No. 8, 1.5 kg. (3.3 lbs.). M.V. = 1,237 f.s.

6,900	7,546	24 34	32 07	27.5	794
7,000	7,655	25 15	32 56	28.1	794
7,500	8,202	28 52	37 30	31.4	804
8,000	8,749	33 19	42 37	35.5	814
8,500	9,296	41 04	51 45	43.5	846

This range table was fired in December, 1916.

Remarks.

1. Charge No. 7 is the normal charge, but to economise wear in the gun the smallest charge consistent with the task should always be used.

2. The maximum range of the 1913 pattern heavy field howitzer, viz., 9,296 yards, is also obtained with the *long 1913 pattern heavy field howitzer*, but with less gas pressure (13.8 tons per square inch as against 15.7).

EXTRACTS FROM RANGE TABLE No. 19.
21 cm. Mortar.*

Range.		1896 n/A. Pattern Shell (Long Shell).									
		Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.		
metres.	yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.		
CHARGE No. 1, 1.5 kg. (3.3 lbs.). M.V. = 610 f.s.											
1,500	1,640	12 22	13 30	8.7	581	...	...	...	...		
2,000	2,187	17 37	19 04	11.7	574	...	...	...	...		
2,800	2,515	...	...	...	...	66 30	68 56	34.1	577		
2,500	2,734	23 41	25 37	15.3	568	64 00	66 30	33.4	574		
3,000	3,281	32 22	34 52	20.3	561	55 49	58 30	31.0	571		
3,200	3,500	38 22	41 07	23.4	561	50 00	52 45	28.8	571		
CHARGE No. 2, 1.6 kg. (3.5 lbs.). M.V. = 640 f.s.											
2,500	2,734	21 00	22 41	14.4	594	66 30	69 04	35.5	600		
3,000	3,281	27 30	29 45	18.3	587	63 00	62 56	33.8	597		
3,500	3,828	38 37	41 37	24.8	584	49 07	52 00	29.7	594		
CHARGE No. 3, 1.7 kg. (3.7 lbs.). M.V. = 666 f.s.											
2,700	2,953	20 52	22 37	14.9	617	66 30	69 11	36.9	620		
3,000	3,281	24 07	26 11	17.0	610	63 19	66 07	36.1	620		
3,500	3,828	31 41	34 22	21.6	607	56 19	59 19	33.9	620		
3,800	4,156	39 04	42 15	26.2	604	48 37	51 41	30.6	613		
CHARGE No. 4, 1.8 kg. (4.0 lbs.). M.V. = 695 f.s.											
2,900	3,171	20 45	22 34	15.5	636	66 34	69 26	38.5	643		
3,000	3,281	21 45	23 37	16.1	636	65 37	68 30	38.3	643		
3,500	3,828	27 26	29 56	19.8	630	60 11	63 15	36.5	643		
4,000	4,374	36 07	39 19	25.4	627	51 41	54 56	33.3	640		
4,100	4,484	39 00	42 22	27.4	627	48 22	51 37	31.8	636		
CHARGE No. 5, 1.9 kg. (4.2 lbs.). M.V. = 722 f.s.											
3,100	3,390	20 37	22 30	16.0	659	66 37	69 37	40.0	666		
3,500	3,828	24 34	26 49	18.6	653	62 49	65 56	38.9	666		
4,000	4,374	31 00	33 52	22.8	646	56 41	60 04	36.6	663		
4,400	4,812	39 52	43 26	28.4	646	48 00	51 26	32.7	656		
CHARGE No. 6, 2.0 kg. (4.4 lbs.). M.V. = 748 f.s.											
3,300	3,609	20 34	22 30	16.4	679	66 37	69 45	41.3	686		
3,500	3,828	22 15	24 22	17.6	676	64 52	68 07	40.8	686		
4,000	4,374	27 19	30 04	21.2	669	60 00	63 22	39.1	686		
4,500	4,921	34 52	38 15	26.2	663	53 00	56 37	36.3	682		
4,700	5,140	39 41	43 26	29.5	663	48 04	51 41	33.8	679		
CHARGE No. 7, 2.1 kg. (4.6 lbs.). M.V. = 774 f.s.											
3,500	3,828	...	...	...	...	66 45	70 00	42.8	709		
4,000	4,374	...	...	...	...	62 30	66 00	41.4	705		
4,100	4,484	25 37	28 15	20.7	689	...	...	...	...		
4,500	4,921	30 19	33 26	23.0	686	57 11	60 52	38.6	702		
5,000	5,468	39 56	43 52	30.4	682	47 52	51 41	35.0	695		

* This is the old original pattern 21 cm. Mortar on non-recoil carriage.

(n 13641)

[Range Table continued overleaf.]

APPENDIX XIII.
RANGE TABLE.
21 cm. Mortar.*

EXTRACTS FROM RANGE TABLE No. 19—(continued from page 480).
21 cm. Mortar.

Range.		1896 n/A. Pattern Shell (Long Shell).							
		Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
metres.	yards.	°	'	secs.	f.s.	°	'	secs.	f.s.
CHARGE No. 8, 2.2 kg. (4.8 lbs.). M.V. = 800 f.s.									
3,700	4,046	...	...	...	...	66	45	70	07
4,000	4,374	...	...	...	...	64	30	68	00
4,300	4,703	25	11	27	52	...	...	...	...
4,500	4,921	27	08	30	04	60	07	63	49
5,000	5,468	33	30	37	04	54	04	58	00
5,300	5,796	39	34	43	41	47	37	51	37
CHARGE No. 9, 2.3 kg. (5.1 lbs.). M.V. = 827 f.s.									
3,900	4,265	...	...	...	...	66	45	70	19
4,000	4,374	...	...	...	...	66	04	69	41
4,500	4,921	...	...	...	...	62	22	66	11
4,600	5,031	25	34	28	22	...	...	...	...
5,000	5,468	29	41	33	00	57	41	61	41
5,500	6,015	37	11	41	22	50	26	54	37
5,600	6,124	39	41	44	04	47	45	51	56
CHARGE No. 10, 2.4 kg. (5.3 lbs.). M.V. = 853 f.s.									
4,200	4,593	...	...	...	...	66	15	69	52
4,500	4,921	...	...	...	...	64	07	67	52
4,800	5,249	25	11	27	56	...	...	...	...
5,000	5,468	26	52	29	52	60	07	64	03
5,500	6,015	32	26	36	00	54	52	59	07
5,900	6,452	39	52	45	00	47	03	51	37
CHARGE No. 11, 2.5 kg. (5.5 lbs.). M.V. = 876 f.s.									
4,400	4,812	...	...	...	...	66	15	69	49
4,500	4,921	...	...	...	...	65	34	69	15
5,000	5,468	...	...	...	...	62	00	66	00
5,100	5,577	25	37	28	34	...	...	...	...
5,500	6,015	29	18	32	37	57	37	61	42
6,000	6,562	35	41	40	00	51	11	55	30
6,200	6,780	40	45	46	15	45	22	50	15
CHARGE No. 12, 2.6 kg. (5.7 lbs.). M.V. = 899 f.s.									
4,600	5,031	...	...	...	...	66	19	70	11
5,000	5,468	...	...	...	...	63	45	67	37
5,300	5,796	25	15	28	11	...	...	...	...
5,500	6,015	26	49	30	00	59	49	64	00
6,000	6,562	31	49	35	30	54	45	59	34
6,500	7,109	41	30	47	07	44	45	50	22
CHARGE No. 13, 2.7 kg. (5.9 lbs.). M.V. = 925 f.s.									
4,700	5,140	...	...	...	...	66	52	70	49
5,000	5,468	...	...	...	...	65	04	69	07
5,500	6,015	25	00	28	00	61	34	65	52
6,000	6,562	29	04	32	37	57	26	62	04
6,500	7,109	34	37	39	00	51	52	56	49
6,700	7,327	38	30	43	37	47	37	53	07
CHARGE No. 14, 2.8 kg. (6.2 lbs.). M.V. = 945 f.s.									
6,500	7,109	31	30	35	26	...	...	...	...
7,000	7,655	39	49	46	00	...	...	...	...
CHARGE No. 15, 2.9 kg. (6.4 lbs.). M.V. = 968 f.s.									
6,700	7,327	31	07	34	52	...	...	...	...
7,000	7,655	34	37	38	52	...	...	...	...
7,200	7,874	38	15	44	00	...	...	...	...

Not applicable to
1881 Pattern
Shell.

RANGE TABLE.
21 cm. Mortar.

APPENDIX XIII.

EXTRACTS FROM RANGE TABLE No. 19.

21 cm. Mortar.*

Range.		1888, 1914 and 1914A Pattern Shell (Short Shell).							
		Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.
metres.	yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
CHARGE No. 1, 1.5 kg. (3.3 lbs.). M.V. = 676 f.s.									
1,500	1,640	10 11	11 22	7.9	623	...	...	...	...
2,000	2,187	14 22	16 11	10.6	607	...	...	...	...
2,500	2,734	19 07	21 37	13.9	594	...	...	...	...
2,600	2,843	...	...	...	...	66 15	70 15	36.8	607
3,000	3,281	25 04	28 30	17.7	581	61 07	65 49	35.1	597
3,500	3,828	34 22	39 04	23.1	574	51 22	56 41	31.5	587
3,600	3,937	38 15	43 19	25.3	574	48 00	53 22	30.0	584
CHARGE No. 2, 1.8 kg. (4.0 lbs.). M.V. = 771 f.s.									
3,200	3,500	...	...	...	...	66 37	71 11	41.5	676
3,300	3,600	20 15	23 19	16.5	650	...	...	...	...
3,500	3,828	22 04	25 30	17.8	646	63 45	68 45	40.6	669
4,000	4,374	27 45	32 07	21.8	636	57 45	63 22	38.4	659
4,500	4,921	37 52	43 41	28.2	630	47 37	53 52	33.7	640
CHARGE No. 3, 2 kg. (4.4 lbs.). M.V. = 833 f.s.									
3,700	4,046	...	...	...	...	66 15	71 15	44.3	718
4,000	4,374	...	...	...	...	63 41	69 04	43.4	712
4,100	4,484	22 56	26 49	19.8	679	...	...	...	...
4,500	4,921	26 49	31 26	22.8	678	58 37	64 37	41.5	702
5,000	5,468	34 15	40 07	27.8	666	51 15	57 52	37.9	686
5,100	5,577	36 45	42 56	29.4	666	48 52	55 41	36.7	682

* This is the old original pattern 21 cm. Mortar on non-recoil carriage.

APPENDIX XIV.
RANGE TABLE.
21 cm. Mortar.

EXTRACTS FROM RANGE TABLE No. 19—(continued from page 482).

21 cm. Mortar.

Range.		1888, 1914 and 1914A Pattern Shell (Short Shell).							
		Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.
metres.	yards.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
CHARGE No. 4, 2.1 kg. (4.6 lbs.). M.V. = 863 f.s.									
3,900	4,285	...	...	...	...	66 22	71 34	45.7	738
4,000	4,375	...	...	...	...	65 37	70 56	45.4	735
4,500	4,921	...	...	...	...	61 26	67 22	43.9	728
4,600	5,031	25 04	29 34	23.0	689	56 00	62 34	41.5	715
5,000	5,468	29 15	34 34	25.2	686	46 07	53 15	36.4	696
5,500	6,015	40 00	46 49	32.6	686	...	...	...	...
CHARGE No. 5, 2.3 kg. (5.1 lbs.). M.V. = 925 f.s.									
4,400	4,812	...	...	...	...	66 00	71 30	48.4	778
4,500	4,921	...	...	...	...	65 19	70 56	48.1	774
5,000	5,468	...	...	...	...	61 30	67 45	46.6	768
5,200	5,687	25 49	30 52	24.0	719	...	...	...	...
5,500	6,015	28 37	34 19	26.3	715	56 45	63 37	44.4	758
6,000	6,562	36 00	42 52	31.9	715	49 30	56 56	40.6	738
6,100	6,671	38 45	45 56	33.8	719	46 07	53 37	38.6	732
CHARGE No. 6, 2.5 kg. (5.5 lbs.). M.V. = 983 f.s.									
4,800	5,249	...	...	...	...	66 11	71 52	50.9	814
5,000	5,468	...	...	...	...	64 49	70 45	50.4	810
5,500	6,015	...	...	...	...	61 15	67 45	48.9	801
5,700	6,234	25 45	31 11	25.1	748	...	...	...	...
6,000	6,562	28 22	34 22	27.3	741	57 15	64 19	46.9	791
6,500	7,109	34 30	41 30	32.3	741	51 15	58 49	43.7	774
6,700	7,327	39 22	46 52	35.8	748	46 30	54 19	40.8	764
CHARGE No. 7, 2.7 kg. (6.0 lbs.). M.V. = 1,047 f.s.									
5,200	5,687	...	...	...	...	66 07	72 04	53.0	846
5,500	6,015	...	...	...	...	64 22	70 34	52.4	840
6,000	6,562	...	...	...	...	61 04	67 52	50.9	833
6,300	6,890	26 52	32 56	27.2	768	...	...	...	...
6,500	7,109	28 37	35 04	28.7	764	57 07	64 30	48.8	820
7,000	7,655	34 15	41 34	33.3	768	51 26	59 22	45.6	807
7,200	7,874	37 52	45 37	36.2	771	48 04	56 07	43.5	797
CHARGE No. 8, 2.8 kg. (6.2 lbs.). M.V. = 1,076 f.s.									
6,900	7,546	30 22	37 22	30.7	774	...	...	...	...
7,000	7,655	31 26	38 37	31.6	774	...	...	...	...
7,500	8,202	38 30	46 34	37.3	784	...	...	...	...
CHARGE No. 9, 2.9 kg. (6.4 lbs.). M.V. = 1,102 f.s.									
7,200	7,874	31 00	38 22	31.8	784	...	...	...	...
7,500	8,202	34 34	42 30	34.8	787	...	...	...	...
7,800	8,530	40 30	49 00	39.6	801	...	...	...	...
CHARGE No. 10, 3 kg. (6.6 lbs.). M.V. = 1,132 f.s.									
7,400	8,093	30 41	38 19	32.1	791	...	...	...	...
7,500	8,202	31 41	39 30	33.0	794	...	...	...	...
8,000	8,749	39 30	48 15	39.6	807	...	...	...	...
CHARGE No. 11, 3.1 kg. (6.8 lbs.). M.V. = 1,158 f.s.									
7,600	8,312	30 34	38 34	32.6	801	...	...	...	...
8,000	8,749	35 15	43 56	36.6	807	...	...	...	...
8,200	8,968	39 15	48 19	40.0	817	...	...	...	...

APPENDIX XIV.
RANGE TABLE.
(21 cm.) Mortar.

Range.		Charge No. 1. 2.6 kg. (5.7 lbs.).				Charge No. 2. 2.9 kg. (6.4 lbs.).			
		Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	
metres.	yards.	°	'	secs.	f.s.	°	'	secs.	
0	0	...	...	...	M.V. 679	...	...	...	
2,700	2,953	67	30	38.0	627	...	...	...	
3,000	3,281	64	04	37.0	623	...	...	...	
3,100	3,390	...	...	...	...	67	30	40	
3,500	3,828	57	15	34.7	617	63	45	39	
3,800	4,156	50	45	32.6	610	...	...	...	
4,000	4,374	...	...	...	...	58	07	37	
4,500	4,921	...	...	...	...	47	52	32	
5,000	5,468	...	...	...	...	...	...	...	
5,500	6,015	...	...	...	...	...	...	...	
5,700	6,234	...	...	...	...	...	...	...	
6,000	6,562	...	...	...	...	...	...	...	
6,500	7,109	...	...	...	...	...	...	...	
6,600	7,218	...	...	...	...	...	...	...	
1,500	1,640	10	22	7.1	650	...	...	...	
2,000	2,187	14	15	10.1	636	...	...	...	
2,500	2,734	18	37	13.5	623	...	...	...	
3,000	3,281	23	45	17.0	613	...	...	...	
3,100	3,390	...	...	...	...	20	19	15	
3,500	3,828	30	41	21.0	607	24	07	18	
3,800	4,156	37	00	24.1	607	...	...	...	
4,000	4,374	...	...	...	...	29	52	22	
4,500	4,921	...	...	...	...	39	52	27	
5,000	5,468	...	...	...	...	...	...	...	
5,100	5,577	...	...	...	...	...	...	...	
5,300	5,796	...	...	...	...	...	...	...	
5,500	6,015	...	...	...	...	...	...	...	
5,700	6,234	...	...	...	...	...	...	...	
6,000	6,562	...	...	...	...	...	...	...	
6,500	7,109	...	...	...	...	...	...	...	
6,600	7,218	...	...	...	...	...	...	...	

* This is the 1910 pattern 21 cm. Mortar, a

EXTRACTS FROM RANGE TABLE No. 22.

RANGE TABLE.

Mortar.*

Mortar.*

1896 n/A. Pattern 21 cm. Shell (Long Shell).

		Charge No. 3. 3.2 kg. (7.0 lbs.).				Charge No. 4. 3.5 kg. (7.7 lbs.).				Charge No. 5. 3.9 kg. (8.6 lbs.).			
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.	
f.s. M.V. 738	°	'	secs.	f.s. M.V. 791	°	'	secs.	f.s. M.V. 846	°	'	secs.	f.s. M.V. 919	
...	...	...	...	...	...	...	...	...	...	...	...	...	
673	...	...	...	...	...	...	...	...	...	...	...	...	
666	67 30	70 22	43.1	712	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
663	63 22	66 41	41.8	709	67 11	70 22	46.7	758	...	...	...	...	
656	58 22	62 07	39.9	702	63 26	67 00	44.5	751	67 49	71 19	49.3	810	
...	50 15	54 15	36.0	695	59 11	63 07	42.6	745	64 41	68 34	48.2	807	
...	...	...	...	...	52 52	57 11	39.5	738	60 56	65 07	46.6	800	
...	...	...	...	...	48 11	52 34	37.0	732	...	...	...	...	
...	...	...	...	...	...	...	...	...	56 30	61 00	44.4	794	
...	...	...	...	...	...	...	...	...	49 22	54 11	40.3	784	
...	...	...	...	...	...	...	...	...	46 37	51 26	38.8	778	
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
663	...	...	...	...	...	...	...	...	...	...	...	...	
656	...	...	...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	...	...	...	
650	24 11	26 19	19.4	695	...	...	...	...	...	...	...	...	
650	29 22	32 04	23.0	689	24 04	26 26	20.8	732	...	...	...	...	
...	37 19	40 49	28.2	686	28 07	31 00	24.1	728	...	...	...	...	
...	40 37	44 19	30.0	689	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	24 37	27 26	22.7	781	
...	...	...	...	...	34 22	37 56	28.4	725	26 07	29 07	23.9	778	
...	...	...	...	...	38 37	42 30	31.2	728	...	...	...	...	
...	...	...	...	...	...	...	...	...	30 26	34 00	27.2	774	
...	...	...	...	...	...	...	...	...	36 45	41 00	32.1	774	
...	...	...	...	...	...	...	...	...	39 07	43 34	33.9	774	

With angles of elevation above 45°.

With angles of elevation below 45°.

modern piece, as distinct from the old original pattern which is called "21 cm. Mortar."

[Range Table continued overleaf.]

EXTRACTS FROM RANGE TABLE No. 22—(continued from
Mortar.*

Range.		1896 n/A. Pattern 21 cm. Shell (Long Shell).											
		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.).			
		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.	
metres.	yards.	°	'	secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	
0	0	...	...	...	M.V. 991	...	...	...	M.V. 1,089	...	...	...	...
5,100	5,577	67 52	71 41	52.7	866	...	...	...	...	...	...	...	...
5,500	6,015	65 37	69 41	51.9	863	...	...	...	...	...	...	...	...
5,800	6,343	...	...	...	...	87 41	72 00	57.1	928	...	...	...	...
6,000	6,562	62 30	66 52	50.6	856	66 52	71 19	56.8	925	...	...	...	...
6,100	6,671	...	...	...	...	...	...	...	...	67 45	72 22	59.7	...
6,500	7,109	58 49	63 34	48.9	850	64 22	69 11	55.8	922	65 56	70 52	58.3	...
7,000	7,655	54 07	59 11	46.3	840	61 37	66 45	54.5	915	63 34	68 49	57.3	...
7,400	8,093	47 52	53 07	42.6	827	...	...	...	...	...	...	...	...
7,500	8,202	...	...	...	...	58 22	63 40	52.9	909	60 52	66 30	56.0	...
8,000	8,749	...	...	...	...	54 11	59 56	50.5	896	57 41	63 37	54.2	...
8,400	9,186	...	...	...	...	48 56	55 00	46.8	882	...	...	...	...
8,500	9,296	...	...	...	...	...	...	...	...	53 34	59 52	51.6	...
8,900	9,733	...	...	...	...	...	...	...	...	47 15	53 49	47.1	...
9,000	9,843	...	...	...	...	...	...	...	...	...	...	...	...
9,400	10,280	...	...	...	...	...	...	...	...	...	...	...	...
6,100	6,671	25 19	28 41	25.0	817	...	...	...	...	...	...	...	...
6,500	7,109	28 11	32 00	27.4	814	...	...	...	...	...	...	...	...
6,900	7,546	...	...	...	...	25 11	29 26	26.9	846	...	...	...	...
7,000	7,655	32 41	37 00	31.0	814	25 45	30 07	27.4	846	...	...	...	...
7,500	8,202	41 30	46 30	37.5	820	29 04	33 52	30.4	846	...	...	...	...
8,000	8,749	...	...	...	...	33 15	38 37	34.0	846	30 07	35 41	32.2	...
8,400	9,186	...	...	...	...	...	...	...	...	...	...	...	...
8,500	9,296	...	...	...	...	41 00	46 52	40.4	860	34 15	40 22	36.1	...
8,900	9,733	...	...	...	...	...	...	...	...	40 22	46 49	41.4	...
9,000	9,843	...	...	...	...	...	...	...	...	...	...	...	...
9,400	10,280	...	...	...	...	...	...	...	...	...	...	...	...

* This is the 1910 pattern 21 cm. Mortar, a modern piece, as distinct from the old original pattern

(= 13641)

APPENDIX XV.

RANGE TABLE.

Mortar.*

page 484).

		Charge No. 9. 5·6 kg. (12·3 lbs.).				
Remain- ing velocity.	Angle of elevation.	Angle of descent.	Time of flight.	Remain- ing velocity.		
f.s.	° /	° /	secs.	f.s.		
M.V. 1,138	...	...	...	M.V. 1,203	With angles of elevation above 45°.	
...	...	...	...	...		
...	...	...	...	...		
...	...	...	...	...		
951	...	...	...	...		
948	67 34	72 41	60·9	981		
945	65 30	70 56	60·1	978		
...	...	...	...	...		
938	63 07	68 56	59·1	971		
928	60 30	66 45	57·7	964		
...	...	...	...	...	With angles of elevation below 45°.	
919	57 22	64 00	56·0	955		
899	...	...	...	...		
...	53 22	60 26	53·8	942		
...	46 45	54 15	48·2	922		
...	...	...	...	...		
...	...	...	...	...		
...	...	...	...	...		
...	...	...	...	...		
860	...	...	...	...		
...	30 04	36 45	33·1	866		
863	30 45	37 34	33·7	869		
879	...	...	...	...		
...	35 07	42 22	37·8	879		
...	41 41	49 19	43·5	899		

in which is called "21 cm. Mortar."

EXTRACTS FROM RANGE TABLE No. 22.

RANGE TABLE.

Mortar.*

Mortar.*

Range.		1888, 1914 and 1914A Pattern 21 cm. Shell (Short She l).															
		Charge No. 2. 2.9 kg. (6.4 lbs.).				Charge No. 3. 3.2 kg. (7.0 lbs.).				Charge No. 4. 3.5 kg. (7.7 lbs.).				Charge No. 5. 3.9 kg. (8.6 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.	Angle of elevation.	Angle of descent.	Time of flight.	Remaining velocity.
		° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.	° /	° /	secs.	f.s.
metres.	yards.																
0	0	...	...	...	M.V. 794	...	...	...	M.V. 853	...	...	...	M.V. 912	...	...	...	M.V. 991
1,500	1,640	7 37	8 19	6.4	745	...	...	...	...	...	...	...	...	...	...	...	...
2,000	2,187	10 30	11 30	8.9	725	...	...	...	...	...	...	...	...	...	...	...	...
2,500	2,734	13 34	15 00	11.4	705	...	...	...	...	...	...	...	...	...	...	...	...
3,000	3,281	17 00	18 56	14.0	689	...	...	...	...	...	...	...	...	...	...	...	...
3,500	3,828	20 45	23 07	16.9	676	...	...	...	...	...	...	...	...	...	...	...	...
4,000	4,374	25 19	28 22	20.3	666	...	...	...	...	...	...	...	...	...	...	...	...
4,500	4,921	31 11	35 07	24.4	659	25 04	28 30	21.3	741	...	...	...	...	...	...	...	...
4,900	5,359	40 30	45 37	30.4	663	...	...	...	...	...	...	...	...	...	...	...	...
5,000	5,468	...	...	...	...	29 56	34 11	25.2	732	25 00	28 52	22.6	732	...	...	...	...
5,500	6,015	...	...	...	...	38 19	43 45	31.8	725	29 22	33 56	26.1	735	...	...	...	...
5,700	6,234	...	...	...	...	...	...	...	...	...	...	...	...	25 15	29 49	24.4	764
6,000	6,562	...	...	...	...	...	...	...	...	35 49	41 26	31.2	735	27 31	32 30	26.3	761
6,100	6,671	...	...	...	...	...	...	...	...	37 56	43 49	32.9	728	...	...	...	...
6,500	7,109	...	...	...	...	...	...	...	...	...	...	...	...	32 15	38 00	30.1	761
6,900	7,546	...	...	...	...	...	...	...	...	...	...	...	...	38 30	45 04	34.9	763

* This is the 1910 pattern 21 cm. Mortar, a modern piece, as distinct from the old original pattern which is called "21 cm. Mortar."

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[Range Table continued overleaf.]

APPENDIX XVI.

RANGE TABLE.

Mortar.*

EXTRACTS FROM RANGE TABLE No. 22—(continued from page 486).

Mortar.*

Range.		1888, 1914, and 1914A Pattern 21 cm. Shell (Short Shell).															
		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.	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.
metres.	yards.	°	'	secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	f.s.	°	'	secs.	f.s.
0	0	...	...	...	M.V. 1,073	...	...	...	M.V. 1,191	...	...	...	M.V. 1,250	...	...	...	M.V. 1,332
6,300	6,890	25	11	30 30	25.7	787	...	...	...	...	...	...	...	...	...	...	...
6,500	7,109	26	26	32 00	26.9	787	...	...	...	...	...	...	...	...	...	...	...
7,000	7,655	30	15	36 34	30.3	791	...	...	...	...	...	...	...	...	...	...	...
7,300	7,983	...	...	...	...	27 19	34 22	29.6	807	...	...	...	...	...	...	...	...
7,500	8,202	36 07	43 15	35.1	797	28 41	36 00	30.8	807	...	...	...	...	...	...	...	...
7,700	8,421	41 45	49 19	38.8	804	...	...	...	...	...	...	...	...	...	...	...	...
7,900	8,640	...	...	...	...	...	...	...	...	29 52	38 22	32.7	810	...	...	...	...
8,000	8,749	...	...	...	...	32 52	40 56	34.7	814	30 41	39 19	33.5	814	...	...	...	...
8,100	8,858	...	...	...	...	...	...	...	...	...	...	...	...	29 49	39 30	33.2	804
8,500	9,296	...	...	...	...	41 26	50 22	42.0	833	35 37	44 56	38.1	823	33 00	43 11	36.4	814
8,800	9,624	...	...	...	...	...	...	...	...	41 49	51 30	43.3	846	...	...	...	...
9,000	9,843	...	...	...	...	...	...	...	...	...	...	...	...	39 15	49 52	41.8	843
9,100	9,952	...	...	...	...	...	...	...	...	...	...	...	...	41 49	52 30	43.9	856

* This is the 1910 pattern 21 cm. Mortar, a modern piece, as distinct from the old original pattern which is called "21 cm. Mortar."

RANGE TABLE.

Russian 10 cm. Gun.

EXTRACTS FROM RANGE TABLE FOR RUSSIAN 10 cm. GUN ('77 Pattern).

Calibre—"42 Linien"—10·67 cm.—4·2 inches.

German 1914 Pattern 10 cm. Gun H.E. Shell, with *H.Z. 14 Vorst.* Fuze. (Fitted with a thicker driving band.)

Range.		Small Russian Charge, 1 '14-1'26 kg. (2'51 lbs.-2'78 lbs.). M.V. = 1,378 f.s.			Large Russian Charge, 1 '65-1'88 kg. (3'64 lbs.-4'14 lbs.).			Small German Charge, 1 kg. (2'2 lbs.). M.V. = 1,119 f.s.			Large German Charge, 2 kg. (4'4 lbs.).			Range.	
		Angle of elevation.	Angle of descent.	Time of flight.	Angle of elevation.	Angle of descent.	Time of flight.	Angle of elevation.	Angle of descent.	Time of flight.	Angle of elevation.	Angle of descent.	Time of flight.		
metres.	yards.	° /	° /	secs.	° /	° /	secs.	° /	° /	secs.	° /	° /	secs.	yards.	metres.
500	547	0 37	0 45	1'3	0 22	0 30	1'1	1 07	1 19	1'6	...	...	...	547	500
1,000	1,094	1 37	1 56	2'6	1 04	1 22	2'2	2 26	2 49	3'2	...	...	...	1,094	1,000
1,500	1,640	2 37	3 15	4'0	1 52	2 30	3'4	3 52	4 34	4'9	...	...	...	1,640	1,500
2,000	2,187	3 49	4 49	5'5	2 45	3 45	4'8	5 26	6 28	6'7	...	...	...	2,187	2,000
2,500	2,734	5 04	6 34	7'0	3 41	5 11	6'3	7 15	8 41	8'5	...	...	...	2,734	2,500
3,000	3,281	6 30	8 26	8'8	4 45	6 49	7'9	9 07	11 04	10'5	...	...	...	3,281	3,000
3,500	3,828	8 00	10 37	10'6	6 00	8 41	9'7	11 04	13 37	12'5	...	...	...	3,828	3,500
4,000	4,374	9 34	12 56	12'6	7 22	10 49	11'4	13 11	16 26	14'7	...	...	...	4,374	4,000
4,500	4,921	11 22	15 26	14'6	8 52	13 07	13'3	15 26	19 22	16'9	...	...	...	4,921	4,500
5,000	5,468	13 15	18 07	16'8	10 26	15 37	15'2	17 52	22 37	19'3	...	...	...	5,468	5,000
5,500	6,015	15 07	20 52	19'0	12 00	18 07	17'2	20 34	26 07	21'8	...	...	...	6,015	5,500
6,000	6,562	17 19	23 56	21'3	13 41	20 37	19'2	23 34	30 07	24'8	12 52	20 15	18'5	6,562	6,000
6,500	7,109	19 45	27 22	23'8	15 30	23 22	21'3	27 15	34 45	28'1	14 45	23 07	20'6	7,109	6,500
7,000	7,655	22 34	31 04	26'5	17 30	26 19	23'6	32 00	40 30	32'2	16 41	26 07	22'9	7,655	7,000
7,400	8,093	...	...	...	...	...	...	37 45	46 56	37'0	...	...	...	8,093	7,400
7,500	8,202	25 37	35 07	29'5	19 37	29 34	26'1	...	...	...	18 41	29 07	25'5	8,202	7,500
8,000	8,749	29 11	39 41	33'0	22 11	33 04	28'8	...	...	...	21 04	32 34	28'3	8,749	8,000
8,500	9,296	35 34	47 00	37'8	25 15	37 15	31'9	...	...	...	23 45	36 22	31'2	9,296	8,500
8,600	9,405	38 15	49 52	39'2	...	...	...	...	...	...	...	...	...	9,405	8,600
9,000	9,843	...	...	...	28 45	41 45	35'6	...	...	...	27 07	40 52	34'6	9,843	9,000
9,500	10,389	...	...	...	33 41	47 30	40'4	...	...	...	31 34	46 19	39'0	10,389	9,500
9,700	10,608	...	...	...	36 19	50 26	43'0	...	...	...	...	...	...	10,608	9,700
9,900	10,827	...	...	...	...	...	...	...	...	...	37 37	53 00	44'5	10,827	9,900

EXTRACTS FROM PROVISION FOR RUSSIAN 15

Calibre = 15.24 cm. =

German 1912 Pattern* 15 cm. H.E. Shell (L

Range.		Half Charge, 3.6 kg. (7.9 lbs.).		
		Angle of elevation.	Angle of descent.	Time of flight
metres.	yards.	° ' "	° ' "	sec.
M.V. = 1,286 f.s.				
500	547	0 56	1 19	1
1,000	1,094	1 52	2 34	2
1,500	1,640	3 00	3 49	4
2,000	2,187	4 15	5 11	5
2,500	2,734	5 37	6 45	7
3,000	3,281	7 19	8 19	9
3,500	3,828	9 15	10 07	11
4,000	4,374	11 26	12 22	13
4,500	4,921	13 52	15 04	15
5,000	5,468	16 22	18 15	17
5,500	6,015	19 04	21 49	19
6,000	6,562	22 00	25 52	22
6,500	7,109	25 22	30 41	24
7,000	7,655	29 37	36 19	27
7,500	8,202	36 07	42 45	30
8,000	8,749	...	...	...
8,500	9,296	...	...	...
9,000	9,843	...	...	...
9,500	10,389	...	...	...
10,000	10,936	...	...	...
10,500	11,483	...	...	...
11,000	12,030	...	...	...
11,500	12,577	...	...	...
12,000	13,124	...	...	...

* This range table will also serve as a guide for the German 1912 Pattern H.E. Shell (Short Shell).

† The full charge should only be used in special circumstances.

(B 13641)

APPENDIX XVIII.

RANGE TABLE.

Russian 15 cm. Gun.

AL RANGE TABLE

cm. GUN.

6 inches.

ong Shell) with *Gr. Z. 04* Fuze.

Full Charge.† 7.2 kg. (15.9 lbs.).			
Angle of elevation.	Angle of descent.	Time of flight.	
° ' "	° ' "	secs.	
M.V.= 2,050 f.s.			
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de, when firing the German 1914

when necessitated by tactical

APPENDIX XIX.

RANGE TABLE.

Russian 15 cm. Long Gun.

EXTRACTS FROM RANGE TABLE No. 26 (Ia and Ib).

Russian 15 cm. Long Gun.

Calibre = 15.24 cm. = 6 inches.

Range.		Russian 41 kg. Shrapnel.							
		Ia.				Ib.			
		Half charge—3.26-3.37 kg. (7.19-7.43 lbs.)				Full charge—6.46-6.78 kg. (14.24-14.95 lbs.)			
		Russian propellant.				Russian propellant.			
		Angle of elevation.	Angle of descent.	Fuze setting.*	Time of flight.	Angle of elevation.	Angle of descent.	Fuze setting.*	Time of flight.
metres.	yards.	° /	° /	seconds (graduations).	seconds (time).	° /	° /	seconds (graduations).	seconds (time).
M.V. = 1,516 f.s.					M.V. = 1,942 f.s.				
500	547	0 19	0 30	1 3	1 2	— 0 04	0 04	1 2	1 2
1,000	1,094	1 15	1 45	2 7	2 5	0 30	0 45	2 5	2 3
1,500	1,640	2 11	3 19	4 2	3 9	1 04	1 41	3 9	3 6
2,000	2,187	3 19	4 52	5 7	5 4	1 45	2 37	5 4	4 9
2,500	2,734	4 22	6 34	7 4	6 9	2 30	3 41	6 9	6 3
3,000	3,281	5 37	8 19	9 2	8 6	3 22	5 00	8 6	7 7
3,500	3,828	7 04	10 11	11 1	10 5	4 22	6 19	10 3	9 2
4,000	4,374	8 30	12 19	13 3	12 3	5 22	7 52	12 3	10 8
4,500	4,921	10 04	14 41	15 6	14 2	6 34	9 37	14 3	12 3
5,000	5,468	11 45	17 22	18 1	16 3	7 49	11 37	16 3	14 0
5,500	6,015	13 45	20 15	20 7	18 5	9 07	13 49	18 5	15 8
6,000	6,562	15 52	23 19	23 2	21 1	10 41	16 19	20 7	17 8
6,500	7,109	18 22	26 45	26 0	24 1	12 19	19 04	23 1	20 1
7,000	7,656	21 11	30 37	28 7	27 4	14 00	22 04	25 6	22 7
7,500	8,202	24 11	35 07	31 7	30 3	15 52	25 15	28 2	25 8
8,000	8,749	27 26	39 52	34 8	34 7	17 52	28 26	30 9	29 2
8,500	9,296	31 26	45 19	38 2	38 7	20 04	31 52	33 6	32 7
9,000	9,843	37 22	52 26	42 8	44 0	22 37	35 22	36 5	36 4
9,100†	9,952	39 07	54 19	44 0	45 4	...	...	...	...
9,500	10,389	...	...	...	...	25 37	39 26	39 7	40 4
10,000	10,936	...	...	...	...	29 30	43 52	43 5	44 9
10,100	11,046‡	...	...	...	...	30 30	44 52	44 4	45 9
10,500	11,483	...	...	...	...	35 22	50 00	...	50 6
10,700	11,702§	...	...	...	...	39 19	54 00	...	54 0

* Length of fuze to burst shrapnel 66 yards short of target.

† Maximum range with time and percussion fuze with half charge.

‡ Maximum range with time fuze and full charge.

§ Maximum range with percussion fuze and full charge.

[Range Table continued overleaf.]

APPENDIX XIX.

RANGE TABLE.

Russian 15 cm. Long Gun.

EXTRACTS FROM RANGE TABLE No. 26 (IIa and IIb).—(continued from page 490).

Russian 15 cm. Long Gun.

Calibre = 15.24 cm. = 6 inches.

Range.		Russian 35.6 kg. Shrapnel.							
		IIa.				IIb.			
		Half charge—3.26-3.37 kg. (7.19-7.43 lbs.)				Full charge—6.46-6.78 kg. (14.24-14.95 lbs.)			
		Russian propellant.				Russian propellant.			
		Angle of elevation.	Angle of descent.	Fuze setting.*	Time of flight.	Angle of elevation.	Angle of descent.	Fuze setting.*	Time of flight.
metres.	yards.	° ' "	° ' "	seconds (graduations).	seconds (time).	° ' "	° ' "	seconds (graduations).	seconds (time).
M.V. = 1,575 fs.					M.V. = 2,044 fs.				
500	547	0 19	0 26	1.3	1.3	0 04	0 04	1.3	1.1
1,000	1,094	1 19	1 34	2.7	2.7	0 30	0 34	2.5	2.3
1,500	1,640	2 15	2 52	4.2	4.2	1 04	1 19	3.9	3.5
2,000	2,187	3 19	4 22	5.7	5.7	1 49	2 19	5.4	4.9
2,500	2,734	4 26	6 00	7.4	7.3	2 41	3 34	6.9	6.3
3,000	3,281	5 49	7 56	9.2	9.0	3 37	5 07	8.6	7.7
3,500	3,828	7 19	10 07	11.1	10.7	4 41	6 56	10.3	9.2
4,000	4,374	8 56	12 30	13.3	12.6	5 52	8 56	12.3	10.7
4,500	4,921	10 45	15 15	15.6	14.5	7 19	11 15	14.3	12.3
5,000	5,468	12 41	18 15	18.1	16.8	8 49	13 49	16.3	14.2
5,500	6,015	14 56	21 41	20.7	19.5	10 26	16 38	18.5	16.3
6,000	6,562	17 34	25 30	23.2	22.5	12 11	19 26	20.7	18.7
6,500	7,109	20 41	29 37	25.9	26.0	14 07	22 30	23.1	21.6
7,000	7,655	24 34	34 26	28.7	29.8	16 19	25 52	25.6	24.7
7,200†	7,874	26 26	36 45	29.9	31.4	...	...	...	...
7,500	8,202	29 30	40 37	...	34.2	18 49	29 41	28.2	27.9
7,800†	8,530	...	...	...	...	20 34	32 15	29.8	29.8
8,000	8,749	37 22	52 00	...	...	21 49	34 04	...	31.2
8,100‡	8,858	40 11	55 00	...	42.8	...	...	...	...
8,500	9,296	...	...	...	...	25 37	39 11	...	34.8
9,000	9,843	...	...	...	...	30 41	45 37	...	38.9
9,475‡	10,362	...	...	...	...	40 00	55 15	...	44.6

* Length of fuze to burst shrapnel 66 yards short of target.

† Maximum ranges with time fuze.

‡ Maximum ranges with percussion fuze.

EXTRACTS FROM RANGE TABLE No. 3

Russian 20·3 cm. Howitzer '77.

Calibre = 20·3 cm. = 8 inches.

Range.		German 20·3 cm. Shell.						
		Charge No. 2. 1·5 kg. (3·3 lbs.).			Charge No. 3. 2·25 kg. (5·0 lbs.).			Charge No. 4. 3·0 kg. (6·6 lbs.).
		Angle of elevation.	Angle of descent.	Time of flight.	Angle of elevation.	Angle of descent.	Time of flight.	Angle of elevation.
metres.	yards.	° /	° /	secs.	° /	° /	secs.	° /
500	547	3 34	3 52	2·5	...	...	...	...
1,000	1,094	7 07	7 52	5·2	...	...	...	...
1,500	1,640	10 56	12 26	7·9	...	...	...	...
2,000	2,187	15 04	17 34	10·8	...	...	...	...
2,500	2,734	19 37	23 22	14·0	...	...	...	...
3,000	3,281	25 15	30 19	17·7	13 15	16 15	12·6	...
3,500	3,828	33 30	39 56	22·4	16 11	19 41	15·1	...
3,600	3,937	36 15	43 22	23·5	...	...	...	...
4,000	4,374	...	...	...	19 26	23 19	18·0	...
4,500	4,921	...	...	...	23 11	27 30	21·2	...
5,000	5,468	...	...	...	27 34	32 30	24·9	17 41
5,500	6,015	...	...	...	33 04	39 52	29·4	20 15
5,700	6,234	...	...	...	36 00	44 30	31·5	...
6,000	6,562	...	...	...	...	...	...	23 07
6,300	6,890	...	...	...	...	...	...	...
6,500	7,109	...	...	...	...	...	...	26 34
7,000	7,655	...	...	...	...	...	...	30 49
7,400	8,093	...	...	...	...	...	...	37 00
7,500	8,202	...	...	...	...	...	...	...
8,000	8,749	...	...	...	...	...	...	...
8,500	9,296	...	...	...	...	...	...	...
8,700	9,515	...	...	...	...	...	...	...
		M.V. = 686 f.s.			M.V. = 886 f.s.			M.

APPENDIX XX.

RANGE TABLE.

Russian 20'3 cm. Howitzer.

16.

Charge No. 4.
3.75 kg. (8.3 lbs.).

Charge No. 5.
3.75 kg. (8.3 lbs.).

Angle of descent.	Time of flight.	Angle of elevation.	Angle of descent.	Time of flight.
° /	secs.	° /	° /	secs.
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
...	...	...	...	...
21 15	19.0	...	...	...
24 19	21.4	...	...	...
...	...	...	...	...
27 49	24.3	...	...	...
...	...	...	...	...
31 56	27.7	20 07	24 04	23.5
37 30	32.0	21 00	25 11	24.5
45 30	36.2	23 22	28 11	27.4
...	...	...	...	...
...	...	26 00	31 37	30.8
...	...	29 00	35 30	34.8
...	...	33 45	41 19	39.6
...	...	37 26	46 37	41.8

V. = 1,070 f.s.



EXTRACTS FROM RANGE TABLE FOR NEW PATTERN LIGHT "MINENWERFER" (I.M.W. n./A.).

Calibre = 7.6 cm. = 2.99 inches.

RANGE TABLE.

New Light Minenwerfer.

1916 Pattern H.E. Shell.
(Only *l. Spr. M. 16* and *16a.*)

Light Minenwerfer Shell.
(*l. Spr. M., l. Spr. M. 16* and *16a.*)

Charge No. 2.				Charge No. 3.				Charge No. 4.				Charge No. 5.			
Range.		Angle of elevation.	Time of flight.	Range.		Angle of elevation.	Time of flight.	Range.		Angle of elevation.	Time of flight.	Range.		Angle of elevation.	Time of flight.
metres.	yards.	° ' "	secs.	metres.	yards.	° ' "	secs.	metres.	yards.	° ' "	secs.	metres.	yards.	° ' "	secs.
300	328	74 15	17	450	492	73 00	19	700	763	69 00	22	900	984	68 30	23
350	383	71 30	17	500	547	71 00	19	750	820	67 30	22	950	1,039	67 00	23
400	437	68 30	17	550	601	69 00	19	800	875	65 45	22	1,000	1,094	65 30	23
450	492	65 30	16	600	656	66 45	19	850	930	63 45	21	1,050	1,148	63 45	23
500	547	62 30	16	650	711	64 30	19	900	984	61 30	21	1,100	1,203	61 45	23
550	601	59 15	15	700	765	62 15	19	950	1,039	59 15	20	1,150	1,258	59 30	22
600	656	55 30	15	750	820	59 30	18	1,000	1,094	56 30	20	1,200	1,312	56 45	22
650	711	50 30	14	800	875	56 45	18	1,050	1,148	52 45	19	1,250	1,367	53 15	21
670	733	47 00	14	850	930	53 00	16	1,100	1,203	45 00	18	1,300	1,422	45 00	19
				900	984	46 45	16								

APPENDIX XXII.

RANGE TABLE.

Heavy Flügel-Minenwerfer.

PROVISIONAL RANGE TABLE.

24 cm. Heavy Flügel-Minenwerfer.

Heavy H.E. Bomb with Vanes.

Calibre = 24 cm. = 9.45 inches.

Range.		Elevation.	
		With full charge of 1.76 lbs.	With reduced charge of 1.1 lbs.
metres.	yards.	degrees.	degrees.
1,200	1,312	50	...
1,150	1,258	54	...
1,100	1,203	57½	...
1,050	1,148	60½	...
1,000	1,094	62½	...
950	1,039	64½	...
900	984	66½	...
850	930	68	...
800	875	69½	...
750	820	71	...
700	765	72	52½
650	711	74	58
600	656	75	61½
550	601	...	65½
500	547	...	68
450	492	...	71
400	437	...	73

Note.—The traversing arc is graduated from 0 (centre) to 50 (right and left). Each graduation = $\frac{1}{640}$ th part of $360^\circ = 33.75$ minutes, or the angle subtended by 1 metre at 100 metres.

1 graduation = a correction of 1 per cent. = 4 metres at 400 metres, 9 metres at 900 metres, &c.

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