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**TITLE**  
A COMPARISON OF THE CASUALTY PRODUCING POWER OF S AND H DISPERSED BY EXPLOSION

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SUMMARY

A COMPARISON OF THE CASUALTY PRODUCING  
POWER OF S AND H DISPERSED BY EXPLOSION

- (1) Two double day bombs charged S and H respectively were functioned on contiguous layouts.
- (2) The vapour and droplet concentrations of H amounted to from 6 to 38 mgm<sup>3</sup> and the vapor and droplet concentration of S amounted to from 14 to 97 mgm<sup>3</sup>.
- (3) Casualties were produced among animals and lesions on humans by the H cloud. With one exception, no lesions in animals or humans resulted from the S cloud.
- (4) The chemical analysis for the S cloud gave values that from laboratory experience, should have produced lesions.
- (5) Under the conditions used in this experiment, H was more effective than S in producing lesions.

for *Hm Banett*  
(S.L. Davies)  
Chief Superintendent,  
Experimental Station.

Classification / Designation  
Changé to / Remplacé par u/w  
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49-07620

INTERNAL REPORT  
SES  
2

EXPERIMENTAL STATION  
SUFFIELD, ALBERTA

SUFFIELD INTERNAL REPORT NO. 2

A COMPARISON OF THE CASUALTY PRODUCING  
POWER OF S AND H DISPERSED BY EXPLOSION

INTRODUCTION

This report presents the results of an experiment (Field Experiment 65) in which two Doubleday bombs charged S and H respectively were functioned simultaneously on contiguous layouts. The Doubleday bomb was chosen as a means of dispersal in order to obtain as much as possible of the charging in the form of fine droplets or vapour.

EXPERIMENTAL PROCEDURE

One Doubleday bomb was charged with 2.91 litres of S (dyed 1% Waxoline Green). The other bomb was charged with 2.91 litres of H.T. (dyed 1% Rhodamine G). The bursting charge in both bombs consisted of 723 g of 30/70 CE/TNT and 170 g of CE. The bombs were emplaced nose downwards buried in the ground to about 1/3 of their length and were detonated electrically with #8 detonating caps on identical layouts about 600 yards apart.

Each layout comprised two sampling lines, one 50 yards from the bomb with 11 positions spaced 5 yards apart and the second 70 yards from the bomb with 15 positions 5 yards apart. At each position the following were placed:

- (a) 1 goat in a slit trench in such a position that only the head projected. The animal's head faced upwind.
- (b) 1 rabbit in a box at ground level placed so that the head faced upwind.
- (c) 2 injectors and 3 bubblers at each position on the 50 yard lines.  
1 injector and 1 bubbler at each position on the 70 yard lines

Impactors were distributed along both lines. Behind alternate positions on each line sand-bag shelters were erected. Behind each shelter two observers crouched until the bombs were fired. Immediately following the explosion, the observers sprang into position, one man between each pair of sampling points, where they remained for two minutes. The men wore battle dress, respirators at the gas position, skeleton webbing, and steel helmets. They had been rehearsed in the procedure of personal decontamination and told to apply it if necessary. They were dismissed from their positions within 5 minutes of zero time and marched 3 miles. They changed their clothing four hours after exposure. Examinations of the observers were made at 24 hrs and 48 hrs.

The animals were removed within 5 minutes of zero and were examined at 24 hours, 48 hours, 112 hours, and 15 days.

On the front lines, separate bubblers were operated to collect vapour only and vapour plus droplets from zero to zero plus 2 minutes. Vapour samples were obtained by having one bubbler at each position facing downwind with the inlet tube fitted with a funnel. The vapour plus droplet samples were collected in bubblers facing upwind. An additional sample was taken at each point on the front lines from zero plus 2 minutes to zero plus 10 minutes, as a measure of the degree of ground contamination, it being assumed that by 2 minutes that the initial cloud would have passed.

Contamination of the craters was measured.

### RESULTS

The meteorological conditions prevailing at the time of the trial are set forth in Appendix I. The results of the chemical sampling are shown in Appendix II; In Appendix III are shown the results obtained with the impactors and on the assessment of the initial cloud; these are compared with the results of chemical sampling carried out at the same positions. A Table showing the weight percentage distribution according to diameter of drops collected on the impactors. (Average of all impactor positions, Appendix IV) is included

The path of the visible cloud from the bomb charged S passed over the layout bracketting both lines of observers. None of the observers or goats developed lesions. One rabbit on the extreme periphery of the 70 yard line showed a mild conjunctivitis with purulent discharge and oedema of the lids. One goat was killed by a fragment and one goat died, showing, however, no lesions attributable to S.

The cloud from the bomb charged H passed over about 2/3 of the layout, missing the left extremities of both lines. Five men developed lesions; two on the front and 3 on the back rows. Six goats and five rabbits developed eye lesions. The physiological results are shown in Appendix V.

### DISCUSSIONS AND CONCLUSIONS

The droplet concentrations of H calculated from the results of the impactor samples are in reasonable agreement with those obtained from the chemical samples: in the middle portion of the front line these were of the order of 70 mgm/m<sup>3</sup>. On the S layout, however, the impactors gave droplet concentrations of the order of 15 mgm/m<sup>3</sup> whereas the chemical sampling gave results between 250 and 400 mgm./m.<sup>3</sup>. This difference may, perhaps, have been due to trapping of small liquid droplets on the funnels and subsequent evaporation at the comparatively high vapour pressure of S. In addition, both the vapour and droplet concentrations found by chemical sampling were much greater on the S layout than on the H.

There is a striking discrepancy between the physiological effects produced by the S cloud and the measured concentration. Significant concentrations varying from 51 - 97 mgm<sup>3</sup> were found at 8 of the 11 points on the 50 yard line by chemical analysis, yet no physiological effects were produced. Unless the S was decomposed by explosion, this result is difficult to explain in view of the effects

that have been noted in laboratory experiments. The results obtained in Suffield Internal Report No. 1 suggest that this discrepancy cannot be explained by differences in the distribution of charging from the two bombs. Further there is no reason to doubt the analytical results although it might be pointed out that the method of analysis employed (7th Interim Report on S) would fail to distinguish between S and decomposition products of the material. It may be concluded, however, that under the admittedly artificial conditions used in this experiment, S is much less effective than H as regards its ability to produce casualties.

HMB/HR

for *Hm Barrett*  
(E. L. Davies),  
Chief Superintendent,  
Experimental Station.

APPENDIX I

Meteorological Conditions

Time: 1230 hours M.D.T. 15-10-42

Wind velocity at 2 metres: 7.1 m.p.h.

Wind ratio 1.14

Air temperature: 58°F.

Surface temperature: 60°F.

Relative humidity: 45%

Gy = 0.38, Gz = 0.28

Temperature difference, 39 feet minus 4.5 feet: - 1.4°F.

Sunshine almost nil. 10-10 Altocumulus with lower scattered stratocumulus.



APPENDIX II

CHEMICAL SAMPLING RESULTS.

All sampling by bubblers 8 inches high.

All concentrations in mg./m<sup>3</sup>

50 yard line

Position	H			Z to Z + 2			S			Z + 2 to Z + 10	
	Without funnels	With funnels	Diff.	Without funnels	With funnels	Diff.	Without funnels	With funnels	Diff.	H	S
1	0	0	0	14	3	11				0	2
2	6	5	1	74	60	14				6	0,2
3	16	9	7	51	28	23				3	5
4	9	7	2	62	-	-				4	6
5	12	-	-	78	46	32				1	8
6	38	-	-	87	66	21				5	6
7	20	15	5	75	59	16				5	6
8	15	17	?	90	35	55				5	5
9	20	13	7	97	65	32				7	11
10	0.4	0.4	0	13	44	?				0.4	1
11	0	0	0	29	19	10				0	1

Sample withdrawn from S-bomb 1 hour prior to firing contained 0.37% of solid material.

70 yard line

5 yards apart

Time Z to Z + 10

Position	H	S
1	0	-
2	0	0.6
3	0	0.7
4	0	0.9
5	0	0.8
6	1	1
7	1	3
8	2	5
9	1	4
10	4	6
11	3	5
12	5	7
13	4	7
14	1	6
15	0	7

APPENDIX III

Assessment of Initial Cloud

This was obtained from the impactors with the following results, corrected for efficiency of collection of the samples. The figures in the column headed "gms./m.<sup>2</sup>" were obtained directly from the impactor samples. These were converted into Mgm./m.<sup>3</sup> on the assumption that as the droplet cloud was some 32 yards wide and probably of a similar order of depth, then with a wind velocity of 7.1 m.p.h., the time of passage could be taken as approximately 10 seconds. For comparison the concentration of droplets calculated from the chemical samples are also recorded, the same assumption of a 10 second time of passage being made.

Position	S.			H.		
	grams/m <sup>2</sup>	Mgm./m <sup>3</sup> Imp.	Chem.	Grams/m <sup>2</sup>	Mgm./m <sup>3</sup> Imp.	Chem.
<u>50 yard line:</u>						
3	0.21	6.6	280	0.77	24	84
Between 4 & 5	0.36	11	380	2.16	65	24
6	0.62	19	250	2.4	77	-
Between 7 & 8	0.43	13	430	2.4	74	60
9	0.065	2	380	0.068	1.9	84
<u>70 yard line</u>						
3	0.0091	0.24	-	0.0093	0.2	-
Between 4 & 5	0.0026	0.08	-	0.044	1.3	-
6	0.0089	0.24	-	0.32	9.6	-
Between 7 & 8	0.0018	0.06	-	0.16	4.8	-
9	0.025	0.78	-	0.52	15.8	-
Between 10 & 11	0.031	1.1	-	0.68	19.0	-
12	0.038	1.2	-	2.4	7.5	-
Between 13 & 14	0.047	1.4	-	0.20	6.0	-

APPENDIX IV

DROP-SIZE DISTRIBUTION

Average Over Whole of Front

Drop diam.      % by wt.      % by wt.  
in      /      Front Line      Rear Line

H Layout

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0-10	1.8	1.8
10-20	15.2	17.2
20-30	19.0	21.0
30-40	17.0	18.0
40-50	14.0	14.0
50-60	11.0	11.0
60-70	9.0	7.0
70-80	6.0	4.0
80-90	4.0	2.2
90-100	2.0	1.8
100-110	1.0	2.0

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S Layout

0-10	2	15
10-20	20	31
20-30	28	24
30-40	23	15
40-50	16	13
50-60	8.5	2
60-70	2.3	-

APPENDIX V

PHYSIOLOGICAL OBSERVATIONS

on FIELD EXPERIMENT NO. 65

H Layout

<u>Observer</u>	<u>Position</u>	<u>Descriptions of lesions</u>
WALKER OH	B 14	<u>24 hours.</u> Sharp burns (E -) on right side of neck below margin of facepiece with pin-point vesication.
CRABISH J.F.	B 13	<u>48 hours.</u> Vesication more marked. <u>24 hours.</u> Burn (E) on right side of neck below margin of facepiece. <u>48 hours.</u> No change.
REINBOLDT F.	A 8	<u>24 hours.</u> Right side of neck, below the line of facepiece involved by 2` sharp burns (E-) with pin point vesicant which extended from the Adam's apple to right ear. The adjacent part of the right cheek was also red and swollen. Right armpit involved by a vapour burn(E). Burn (E) on back of right hand. <u>48 hours.</u> Lesions more marked. Vesicles larger and swelling of both sides of face very obvious. Oedema of eyelids. Burn in armpit more marked. Scrotum and penis showed slight redness. Admitted to hospital. <u>72 hours.</u> Gradual subsidence of lesions.
STADNICK P.	A 7	<u>24 hours.</u> This man had identical lesions with <u>REINBOLDT</u> except the armpit was not involved. <u>48 hours.</u> Lesions more marked. Right ear markedly vesicated. One vesicle 1 cm. in diameter on back of right hand with pronounced pin-point vesication.
DEVINE C.B.	B 10	<u>24 hours.</u> Mild burns (E) on right side of neck. <u>48 hours.</u> Burn more marked (E-) with pin-point vesicles.

APPENDIX V (cont.)

H Layout

Lesions of Animals

<u>No. of animal</u>	<u>Position</u>	<u>Description of lesions.</u>
65	B 13	<u>24 hours.</u> <u>Left eye.</u> Oedema of lids, purulent discharge, marked conjunctivitis and corneal infiltration. <u>Right Eye.</u> Slight conjunctival reaction. <u>112 hours.</u> No change.
55	A 7	<u>24 hours</u> <u>Left Eye.</u> Slight conjunctival reaction. <u>Right Eye.</u> Profuse purulent discharge, oedema of lids, corneal infiltration and swelling. <u>112 hours.</u> No change.
98	B 14	<u>24 hours</u> <u>Left Eye.</u> Swelling of lids. Conjunctivitis. Purulent discharge. <u>Right Eye.</u> Normal. <u>112 hours.</u> <u>Left Eye.</u> Swelling and infiltration of cornea. Profuse purulent discharge. <u>Right Eye.</u> Normal.
95	A 6	<u>24 hours.</u> <u>Left Eye.</u> Oedema of lids, purulent discharge, marked conjunctivitis and swelling of oedema. <u>Right Eye.</u> Normal.  <u>112 hours.</u> Unchanged.
No Number	A 8	<u>24 hours</u> <u>Left Eye.</u> Purulent discharge. Swelling of the lids with marked conjunctivitis. <u>Right Eye.</u> Mild conjunctivitis. <u>112 hours.</u> Unchanged.
78	A 2	<u>24 hours</u> <u>Left Eye.</u> Normal. <u>Right Eye.</u> Slight oedema of lids, mild conjunctivitis. <u>112 hours.</u> No change.

APPENDIX V (cont.)

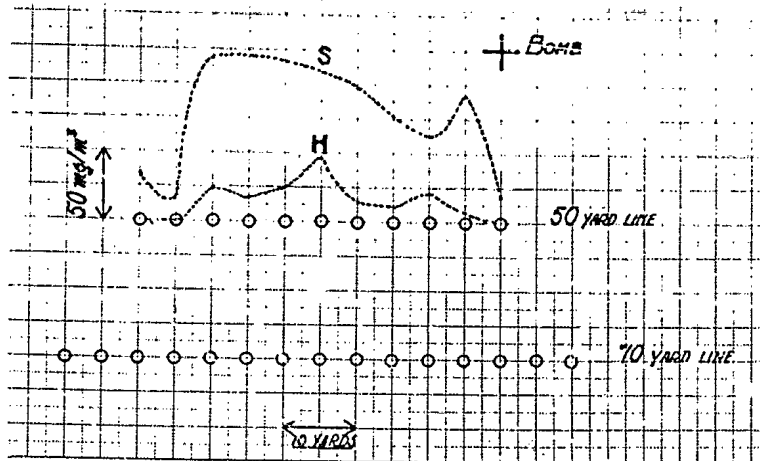
Lesions of Animals - Rabbits

<u>No. of Rabbit</u>	<u>Layout</u>	<u>Description of Lesions</u>
585	A 5	<u>24 hours.</u> <u>Left Eye.</u> Normal. <u>Right Eye.</u> Swelling and inflammation of lids. Conjunctivitis. <u>112 hours.</u> <u>Left Eye.</u> Mild conjunctivitis. <u>Right Eye.</u> Unchanged.
168	A 4	<u>24 hours</u> <u>Left Eye.</u> Normal <u>Right Eye.</u> Swelling of lids, discharge, and conjunctivitis. Infiltration of cornea.
160	A 8	<u>24 hours.</u> <u>Left Eye.</u> Normal. <u>Right Eye.</u> Swelling of lids. Purulent discharge with conjunctivitis. <u>112 hours</u> No change.
590	A 7	<u>24 hours</u> <u>Left Eye.</u> Purulent discharge. Some oedema of lids. Conjunctivitis. <u>Right Eye.</u> Normal.
151	A 9	<u>24 hrs. and 112 hrs.</u> As for rabbit 572.
593	B 14	<u>24 hours.</u> <u>Left Eye</u> Normal. <u>Right Eye.</u> Swelling of lids. Purulent discharge, conjunctivitis, swelling of cornea.
152	A 6	<u>27 hours</u> <u>Left Eye.</u> Normal. <u>Right Eye.</u> Slight discharge. Mild conjunctivitis. The only animal affected on the S layout was rabbit No. 572 situated on extreme edge of line B. After 24 hours left eye was involved by severe conjunctivitis with discharge and oedema of the lids. The right eye was normal. After 48 and 112 hours, the appearances were unchanged.

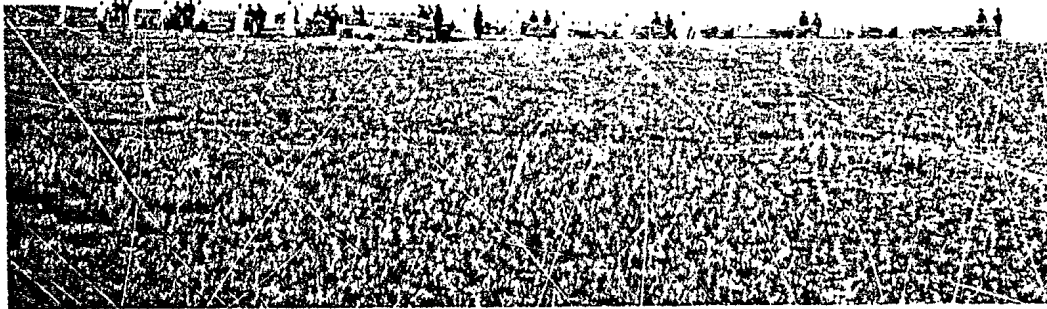
Key: "A" refers to the 50 yard line and "B" to the 70 yard line. The positions are numbered from the right facing source.

NOTE: THE DOTTED LINES INDICATE BY THEIR HEIGHT ABOVE THE 50 YARD LINE THE CONCENTRATIONS OF S/H AT POSITIONS ON THE 50 YARD LINE.

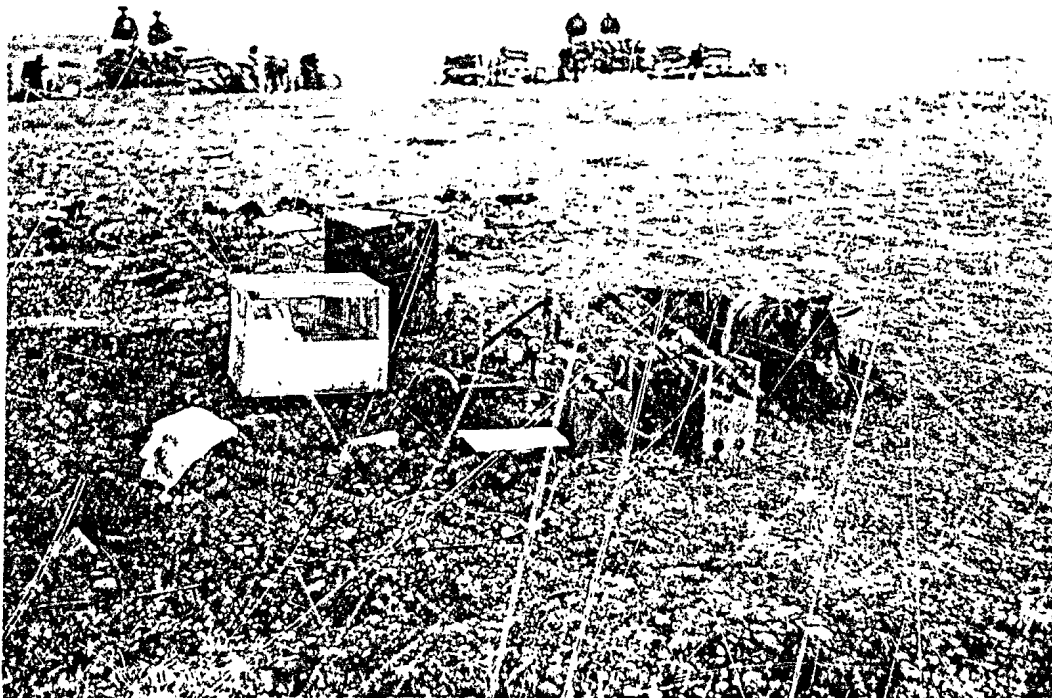
EXPERIMENT 65



3-c-8-269-1



1-L-1-237-1



1-L-1-237-2

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