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PROTECTIVE HELMETS OF NATO AND OTHER COUNTRIES

Lawrence R. McManus

Army Natick Laboratories
Natick, Massachusetts

January 1973

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PROTECTIVE ~~HEADGEAR~~ HELMETS OF NATO AND OTHER COUNTRIES

by

Lawrence R. McManus

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U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts 01760

FOREWORD

At the meeting of the NATO Combat Clothing and Equipment Working Party held in Copenhagen 23-26 June 1970, the U.S. delegate was given the responsibility of preparing and forwarding a questionnaire on protective headgear to each NATO member. This task was incorporated into the U.S. Army Materiel Command Five Year Personnel Armor System Technical Plan which expanded the scope of the survey to include other than NATO Countries.

This report tabulates and summarizes the questionnaires received from participating countries, as well as the data received from other non-classified sources.

The author wishes to thank personnel in the countries involved for their excellent cooperation in forwarding the questionnaires promptly It is hoped that this report will compensate for their time and effort.

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13. ABSTRACT

This report presents the latest and universal state-of-the-art in protective headgear technology and helmet suspension system design. The data is presented in tabular form obtained from questionnaires sent to NATO countries. Information on helmets from other countries was obtained from other non-classified sources. The report is divided into eight sections: Infantry Helmets; Flight Helmets; Combat Vehicle Crewman Helmets; Parachutist Helmets; Other Protective Headgear; Ballistic Methods and Data; New Developments on Protective Headgear; and Past and Present Helmets of Non-NATO Countries.

ii-f

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ii-c

TABLE OF CONTENTS

	Page
List of Tables	iv
List of Figures	v,vi,vii
Abstract	viii
Introduction	1
Section I, Infantry Helmets	2
Section II, Flight Helmets	29
Section III, Combat Vehicle Crewman Helmets	35
Section IV, Parachutists Helmets	49
Section V, Other Protective Headgear	63
Section VI, Ballistic Methods and Data	71
Section VII, New Developments on Protective Headgear	76
Section VIII, Past and Present Helmets on Non-Nato Countries	85

LIST OF TABLES

	Page
Results of Questionnaire on Infantry Helmet	5
Results of Questionnaire on Flight Helmet	30
Results of Questionnaire on CVC Helmet	37
Results of Questionnaire on Parachutist's Helmet	51

LIST OF FIGURES

Figure		Page
I - 1a	Infantry Helmet (Front), Denmark	10
I - 1b	Infantry Helmet (Side), Denmark	11
I - 2a	Infantry Helmet (Side), France	12
I - 2b	Infantry Helmet (Inside), France	13
I - 3a	Infantry Helmet (Front), Germany	14
I - 3b	Infantry Helmet (Side), Germany	15
I - 3c	Infantry Helmet (Inside), Germany	16
I - 4a	Infantry Helmet (Front), Italy	17
I - 4b	Infantry Helmet (Side), Italy	18
I - 4c	Infantry Helmet (Suspension), Italy	19
I - 5a	Infantry Helmet (Front), Netherlands	20
I - 5b	Infantry Helmet (Side), Netherlands	21
I - 5c	Infantry Helmet (Inside Shell), Netherlands	22
I - 5d	Infantry Helmet (Inside Liner), Netherlands	23
I - 6a	Infantry Helmet (Side), United Kingdom	24
I - 6b	Infantry Helmet (Suspension), United Kingdom	25
I - 6c	Infantry Helmet (Ring Suspension), United Kingdom	26
I - 7a	Infantry Helmet (Side), U. S. A.	27
I - 7b	Infantry Helmet (Liner and Suspension), U. S. A.	28
II - 1	Flight Helmet, U. S. A.	34

LIST OF FIGURES

Figure		Page
III - 1	Liner Radio Vehicle, France	41
III - 2	CVC Helmet, Germany	42
III - 3a	CVC Helmet (Front), Italy	43
III - 3b	CVC Helmet (Inside), Italy	44
III - 4a	CVC Helmet (Front), Netherlands	45
III - 4b	CVC Helmet (Inside), Netherlands	46
III - 5	CVC Helmet, United Kingdom	47
III - 6	CVC Helmet, U. S. A.	48
IV - 1	Paratrooper's Helmet (Inside), Germany	56
IV - 2a	Paratrooper's Helmet (Front), Italy	57
IV - 2b	Paratrooper's Helmet (Side), Italy	58
IV - 2c	Paratrooper's Helmet (Inside), Italy	59
IV - 2d	Paratrooper's Helmet (Suspension), Italy	60
IV - 3a	Paratrooper's Helmet (Side), United Kingdom	61
IV - 3b	Paratrooper's Heomet (Inside), United Kingdom	62
V - 1a	Para-Rescue Helmet (Front), Canada	64
V - 1b	Para-Rescue Helmet (Side), Canada	65
V - 2a	Riot Helmet, Netherlands	66
V - 2b	Riot Helmet (Side), Netherlands	67
V - 2c	Riot Helmet (Inside), Netherlands	68
V - 3a	E.O.D. Helmet, U. S. A.	69
V - 3b	E.O.D. Helmet (And Ensemble), U. S. A.	70

LIST OF FIGURES

Figure		Page
VII - 1a	Modified M-1 Chin Strap, U. S. A.	82
VII - 1b	Modified Standard "A" Suspension, U. S. A.	83
VII - 1c	Welson-Davis Suspension, U. S. A.	84
VIII - 1a	Infantry Helmet (Front), Czechoslovakia	87
VIII - 1b	Infantry Helmet (Side), Czechoslovakia	88
VIII - 1c	Infantry Helmet (Inside), Czechoslovakia	89
VIII - 2a	World War II (Front), Germany	91
VIII - 2b	World War II (Side), Germany	92
VIII - 2c	World War II (Inside), Germany	93
VIII - 3a	Infantry Helmet (Front), Japan	95
VIII - 3b	Infantry Helmet (Side), Japan	96
VIII - 3c	Infantry Helmet (Inside), Japan	97
VIII - 3d	Infantry Helmet, WW II, Japan	98
VIII - 4a	Pre-WW II (Front), Netherlands	100
VIII - 4b	Pre-WW II (Side), Netherlands	101
VIII - 4c	Pre-WW II (Inside), Netherlands	102
VIII - 5a	World War II (Front), Russia	104
VIII - 5b	World War II (Side), Russia	105
VIII - 5c	World War II (Inside), Russia	106
VIII - 5d	Post WW II (Front), Russia	107
VIII - 5e	Post WW II (Side), Russia	108
VIII - 5f	Post WW II (Inside), Russia	109

HELMETS

PROTECTIVE ~~HEADGEAR~~ OF NATO AND OTHER COUNTRIES

INTRODUCTION:

In the report of the meeting of the NATO Combat Clothing and Equipment Working Party held in Copenhagen 23-26 June 1970, the US delegate was given the responsibility of composing and forwarding a questionnaire on protective headgear to each NATO member. (Annex N. Action List. Serial 16) This task was incorporated into the US Army Materiel Command Five-Year Personnel Armor System Technical Plan which expanded the scope of the survey to include other than NATO Countries.

The participating countries include: Australia, Belgium, Canada, Denmark, France, Germany, Greece, Netherlands, Norway, Italy, United Kingdom, and The United States of America.

This report presents the results of the questionnaires received as of this date, and the US Army Natick Laboratories will update this report annually if warranted. The updated annexes will be distributed to all participating countries.

The report is divided into eight sections as follows: Section II Infantry Helmets; Section II, Flight Helmets; Section III, Combat Vehicle Crewmen Helmets; Section IV, Parachutist's Helmets; Section V, Other Protective Headgear; Section VI, Ballistic Methods and Data; Section VII, New Developments on Protective Headgear; and Section VIII, Past and Present Helmets of Other Countries.

Since the methods of determining ballistic resistance differed so greatly from country to country, it was not practicable to report ballistic data in tabular form with other results of the questionnaire. Therefore, the ballistic methods and data were extracted from the questionnaire responses and are reported independently in Section VI.

OBJECTIVE:

The objective of this report is to present the latest and universal state-of-the-art in protective headgear technology and helmet suspension system design.

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SECTION I

INFANTRY HELMETS

Table I presents the results of the questionnaires on infantry helmets. It is to be noted that five other countries use the United States M-1 Steel Shell and Liner. These countries are Australia, Belgium, Canada, Greece, and Norway.

Of the seven countries reporting distinct infantry helmets five countries have helmets of the same general silhouette; namely Denmark, France, Germany, Netherlands, and the United States. They differ slightly in some contours and presented target area but generally resemble each other in silhouette (See Figures I-1, I-2, I-3. I-5 and I-7). Italy and the United Kingdom, however, have helmets which are quite distinctive from those of other nations and from each other (See Figures I-4 and I-6).

Liners are used in the helmet systems by only four nations. Germany has a fixed liner-suspension combination whereas Denmark, France, and the United States have separate and removable liners. The USA. M-1 liner, compression molded from resin bonded ballistic nylon is the only liner that provides significant increased ballistic protection to the helmet system.

Overall weight of the medium size helmet systems range from 1140 grams for the Italian model to 1500 grams for the French. The four nations using liners report an overall weight within 100 grams of each other. Except for Denmark which reported "no complaints" from the field for their helmet system, all other nations expressed a troop preference for a lighter helmet.

Apparently all nations address the problem of transient deformation and/or denting of their helmet system because all report a helmet "off-set" i.e., distance of innermost surface of the helmet or liner from the head. The "off-set" distances range from 15 to 24 mm.

All countries except Denmark report normal field of vision (90° or more) horizontally to the left and right and vertically down. Denmark reports 45° horizontally to the left and the right. Most countries report the field of vision vertically up to be 45° or more except the United States and Denmark which report 15 and 20 degrees, respectively.

The most prominent problem or complaint registered by troops is that the helmet is too heavy and lacks stability. This complaint is prevalent over the entire weight range of the helmet systems.

The suspension systems for infantry helmets are of two basic designs with modifications. The two basic designs are the six point cradle suspension with adjustable headband as used in the USA M-1 helmet liner, and the presized rigid headband covered with leather as in the case of the German and Italian helmets or the utilization of a knitted sock as in the British helmet.

The six point cradle suspension is used by Denmark and France in addition to the other countries using the USA M-1 helmet and liner. Denmark's suspension is identical to that of the M-1 and the French is similar except that a draw string is used at the apex of the suspension for head height adjustability.

It should be noted that the six point cradle suspension now classified Standard A by the United States Army is a removable system. Six clips are attached (equally spaced) to the suspension; corresponding studs are affixed to the nylon liners, (See Figure I-7b). The advantages of the removable suspension system are: easier fit and adjustment outside of the liner; and a capability for removing and washing the suspension and the ease of replacement of the suspension as a unit.

The presized rigid headband suspension system as used in the German infantry helmet consists of the following:

A polyethylene skull cap approximately 5mm thick is affixed to the center of the crown of the steel shell by means of a bolt and threaded washer. An expanded rubber pad, approximately 7.5 cm diameter is attached to the skull cap to protect the head from the bolt attaching assembly. Five evenly spaced polyethylene strips approximately 5.5 cm long extend from the edge of the skull cap and to which is attached a 19 mm wide spring steel headband. This headband can be adjusted in back by a stud and slot arrangement to provide three increments in sizing. The steel headband is covered with leather which extends to form the head cover. Head height is adjusted by means of a draw string at the apex of the leather head cover. Additional padding is provided at the headband by means of a thin (3 mm) layer of expanded polyurethane adhered to the leather.

The Italian infantry helmet has a non-adjustable spring steel headband which is covered with leather similar to that of the German, with a draw string height adjustment at the apex and additional padding is provided at the headband by means of a felt material. The suspension system is attached to the steel shell by riveting to a second steel band which extends about three-fourths of the way around the inside of the helmet (open in front) and approximately 7.5 cm up

from the back rim of the helmet. Five steel strips extend from this band to which the spring steel headband is attached.

The infantry helmet submitted by the United Kingdom uses a presized rigid headband fabricated of expanded rigid plastic to which is attached a knitted nylon sock for the head cover. The suspension system is attached to the steel shell at the crown by means of a lift-the-dot fastener which secures a vulcanized fiber "spider". The six legs of the "spider" extend down and are fastened to the headband by means of the lift-the-dot fasteners. Foamed plastic wedges are attached to the end of each leg which keeps the headband a given distance from the sides of the helmet.

Nations using the six point cradle suspension system which provides universal fitting issue only one helmet large enough to cover all heads.

Germany, on the other hand, provides three sizes of helmets, each with a headband adjustable to three sizes, thus providing a nine size fitting system. Italy issues one size helmet with the headband fitted to the individual soldier. The United Kingdom has one size helmet and seven presized headbands.

TABLE I

RESULTS OF QUESTIONNAIRE ON INFANTRY HELMET

COUNTRY

Question Number	Category	Belgium	Denmark	France	Germany	Italy	Netherlands	U.K.	U.S.A.*
	Helmet designation	American	M-48	Toutes armes	1A-1	Model 33	Infantry	Mark IV	M-1
1	Helmet composition	Hadfield steel	Non-magnetic manganese steel	Non-magnetic manganese steel	Special steel	Special steel	Manganese steel	Hadfield steel	Hadfield steel
2	Liner required	Yes	Yes M/59	Yes	Yes	No	Yes	No	Yes
3	Liner composition	Plastic	Polyamide	Polyamide	Polyethylene skull cap	N/A	Polycarbonate	N/A	Resin bonded ballistic nylon
4	Helmet forming process	Pressed	Pressed & hardened	Deep stamping	Deep drawn 5 Steps	Drawing 9 Steps	Drawing	Pressing	Deep draw forming
5	Liner forming process		Injection molded		Injection molded	N/A	Injection molded	N/A	Match metals molds compression molding

*Australia Canada, Greece, & Norway use USA M-1

TABLE I (con't)

INFANTRY HELMET

COUNTRY

Question Number	Category	Belgium	Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
6	Weight of helmet system medium	1450 g	1400 g	1500 g	1400 g	1140 g	1180 (steel shell only)	1200 g	1450 g
7	Estimated surface area	1170 cm^2	1200 cm^2	1000 cm^2		1257 cm^2		1100 cm^2	1170 cm^2
8	Helmet offset from head	15 mm	20 mm	20 mm	15-20 mm	15 mm	32 mm	24 mm	15 mm
9	Field of vision No. of Degrees horiz left/ horiz rt. vert up/ vert down	Normal	45/45 20/Nor	90/90 45/50	Nor/ Nor 45/Nor	Nor/Nor 60/Nor	Nor/Nor 20/Nor	33/33 47/Nor	100/100 15/60
10	Acoustical problems	None	None	None reported	None reported	Resonance	Earcups cannot be fitted	None reported	Reso-nance/ radio
11	Incompati-bility problems	None	None	None reported	None known	W/Telephone, eyeglasses, magnetic devices, gas mask	Communication problems (ear cups)	W/56 Re-sponses Brim causes a no. of incompat-ibilities	W/Field radio

TABLE I (con't)

INFANTRY HELMET

COUNTRY

Question Number	Category	Belgium	Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
12			SEE SECTION VI BALLISTICS						
13	Unsatis-factory reports	None	None	Desire increased protection	None	None	None	None	Too heavy, unstable
14	Medical problems	None	None	None	None	Headaches, skin abrasions	None	None reported	None
15	Troop comments	None	None	Too big, unstable, cumbersome	Rain runs down neck Nape unpro-tected Winter/Ears touch rim and freeze	Hot during day/cold at night	None	Too heavy, unstable, headaches	Heavy, unstable
16	How well liked	No complaints	No complaints	Same as #15	Improve lining & fit Increase ballistic protection & Reduce weight	Prefer lighter, more stable, helmet	Normal	Unpopular	Acceptable

TABLE I (con't)

INFANTRY HELMET

COUNTRY

Question Number	Category	Belgium	Denmark	France	Germany	Italy	Netherlands	U.K.	U.S.A.
17	Type of suspension system	6 Point cradle USA M-1	6 Point cradle USA M-1	6 Point cradle w/head-band	P.E: skull cap, spring steel band w/leather cover	Spring steel band w/leather cover	6 Point cradle w/head-band	Rigid foam plastic headband w/knitted sock	6 Point cradle w/head-band
18	Materials used in suspension	USA M-1	USA M-1	Cotton webbing	Polyethylene spring steel, leather	Spring steel coat, leather felt	Cotton webbing, Leather headband	Nylon knitted sock Vulcanized fiber, foam plastic	Cotton webbing, Leather headband
19	How suspension adjusted	USA M-1	USA M-1	Draw string at apex, adjustable headband	Stud & slot on steel band, Draw string at apex	Draw string at apex, Non-adjustable headband	Drawstring at apex, adjustable headband	Presized non-adjustable	Adjustable straps and headband
20	Discomfort problems w/ suspension	None	None	None	Thin interior padding, chin straps irritate neck		None	None reported	None
21	Determination of correct size	USA M-1	USA M-1	Adjustment of suspension (Universal size)	Individual fit		Individual adjustment of suspension system	Individual fit	Individual adjustment of suspension, Universal size

TABLE I (con't)

INFANTRY HELMET

COUNTRY

Question Number	Category	Belgium	Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
22	No. of sizes used	One	One	One	3 Helmets 3 Headbands, Adjustable to 3 sizes	One	One	1 Helmet 7 Headbands	One
23	Auxillary uses of helmet	Basin	Basin, Digging, Base plate for 60 mm mortar	Basin, Digging, Seat cooking	None	None	Wash basin	Water container	Basin, Digging, Seat, Cooking

Figure I - 1a
Denmark
Infantry Helmet (Front)

Figure I - 1b
Denmark
Infantry Helmet (Side)

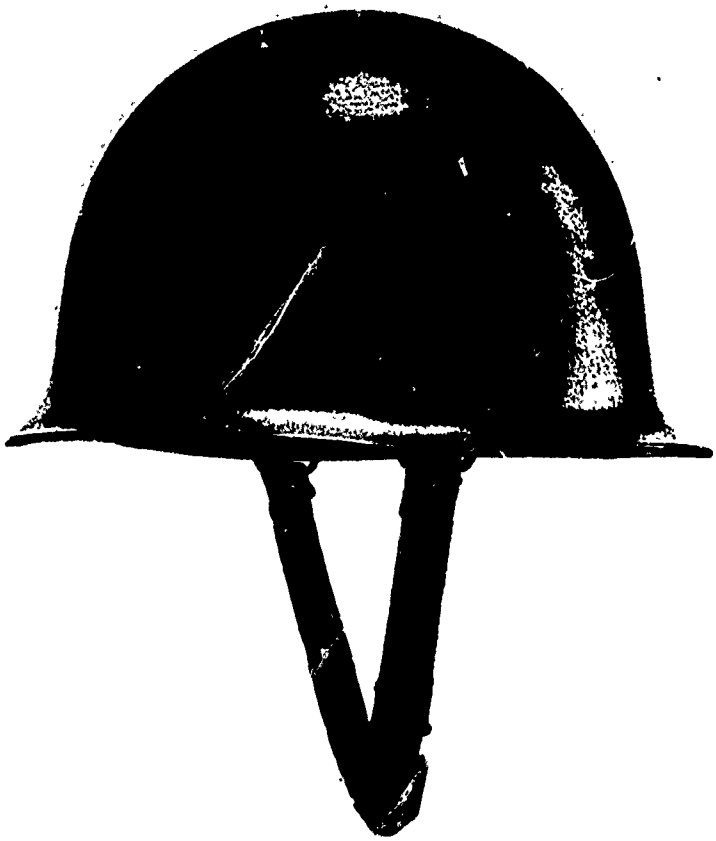

Figure I - 2a
France
Infantry Helmet (Side)

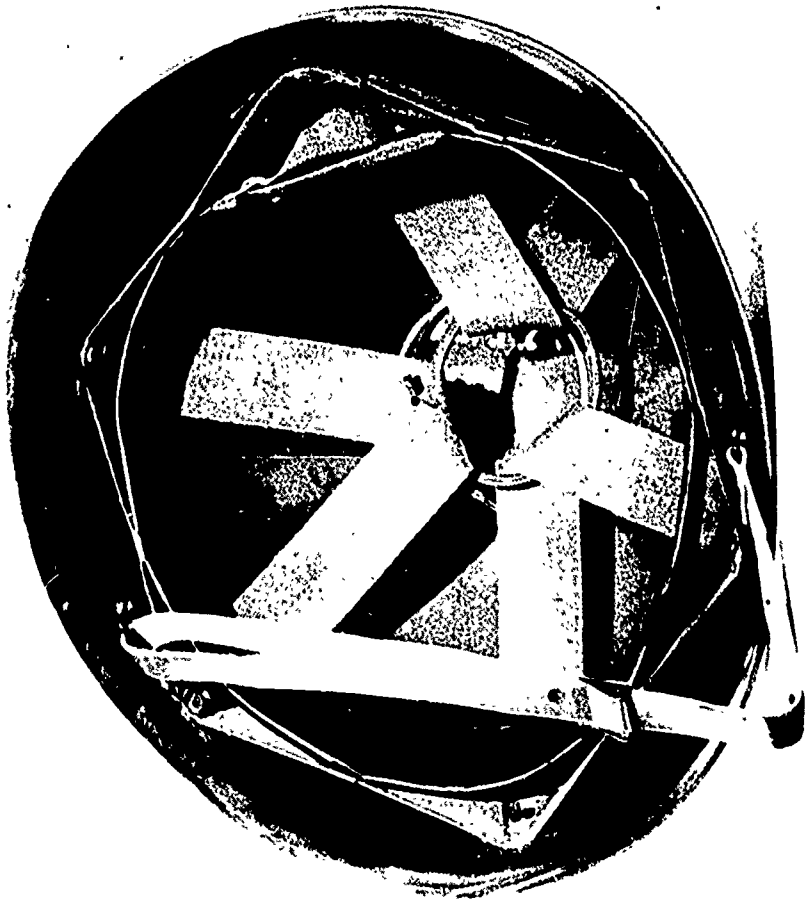

Figure I - 2b
France
Infantry Helmet (Inside)

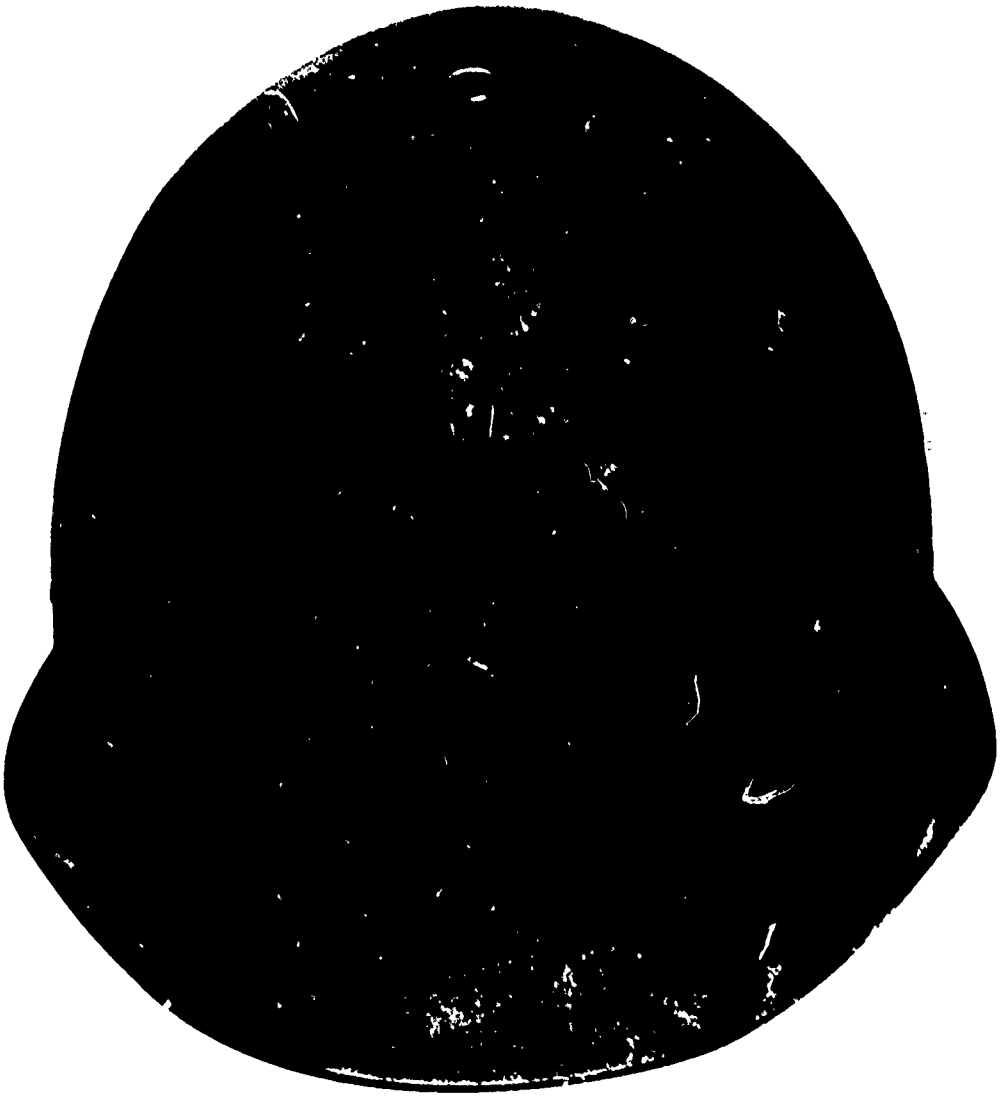

Figure I - 3a
Germany
Infantry Helmet (Front)

Figure I - 3b
Germany
Infantry Helmet (Side)

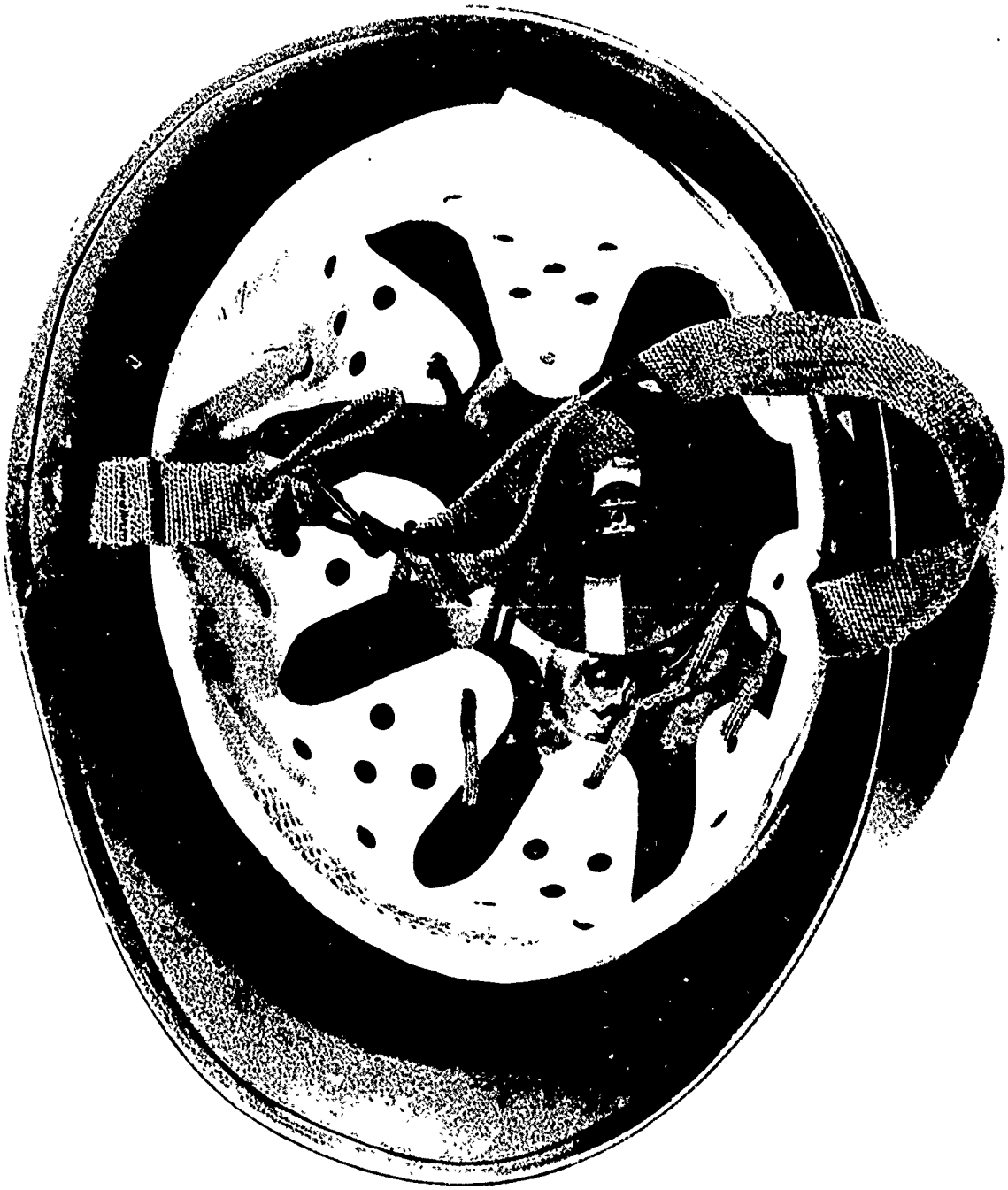

Figure I - 3c
Germany
Infantry Helmet (Inside)

Figure I - 4a
Italy
Infantry Helmet (Front)

Figure I - 4b
Italy
Infantry Helmet (Side)

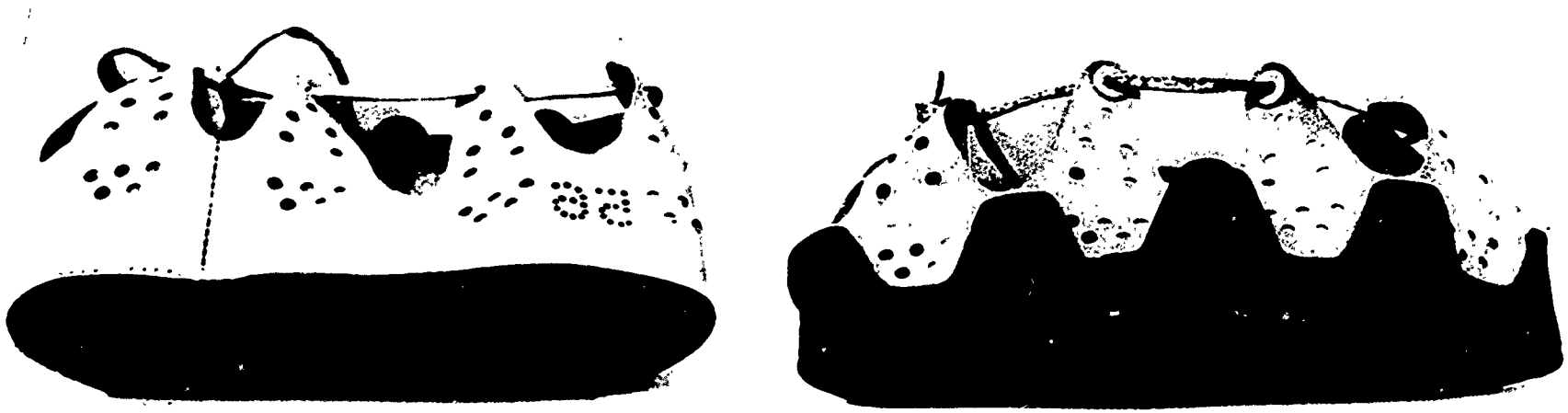

Figure I - 4c
Italy
Infantry Helmet (Suspension)

Figure I - 5a
Netherlands
Infantry Helmet (Front)

Figure I - 5b
Netherlands
Infantry Helmet (Side)

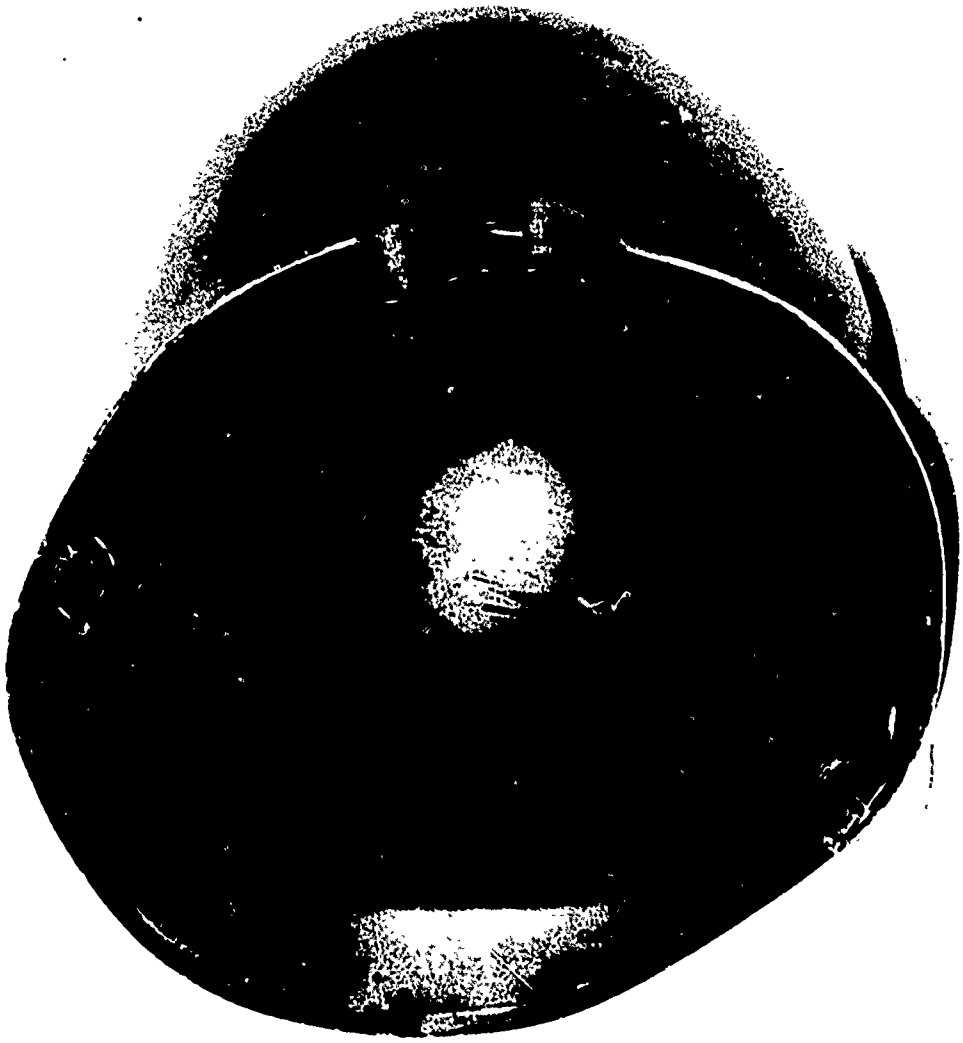

Figure I - 5c
Netherlands
Infantry Helmet (Inside Shell)

Figure I - 5d
Netherlands
Infantry Helmet (Inside Liner)

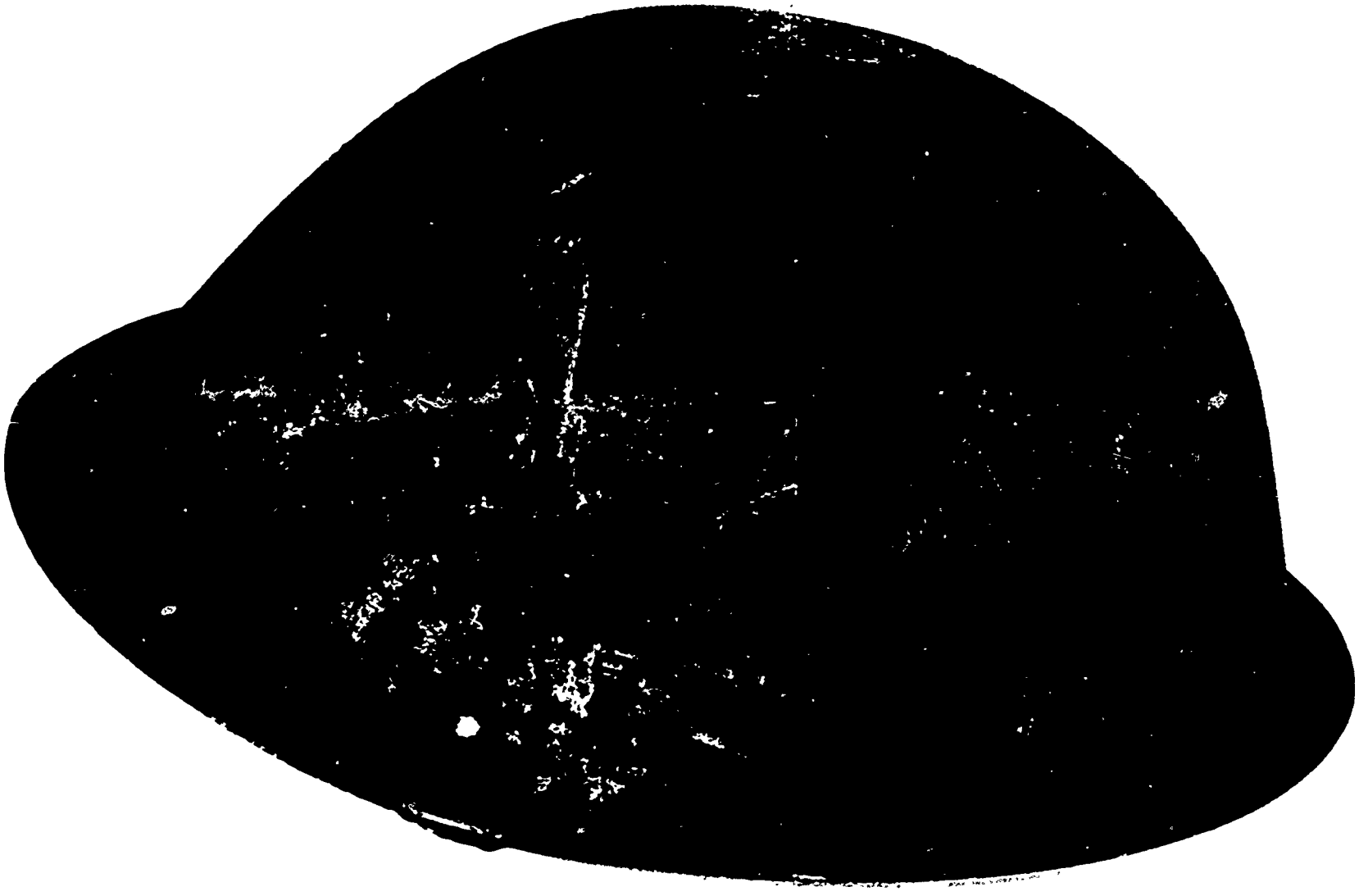

Figure I - 6a
United Kingdom
Infantry Helmet (Side)

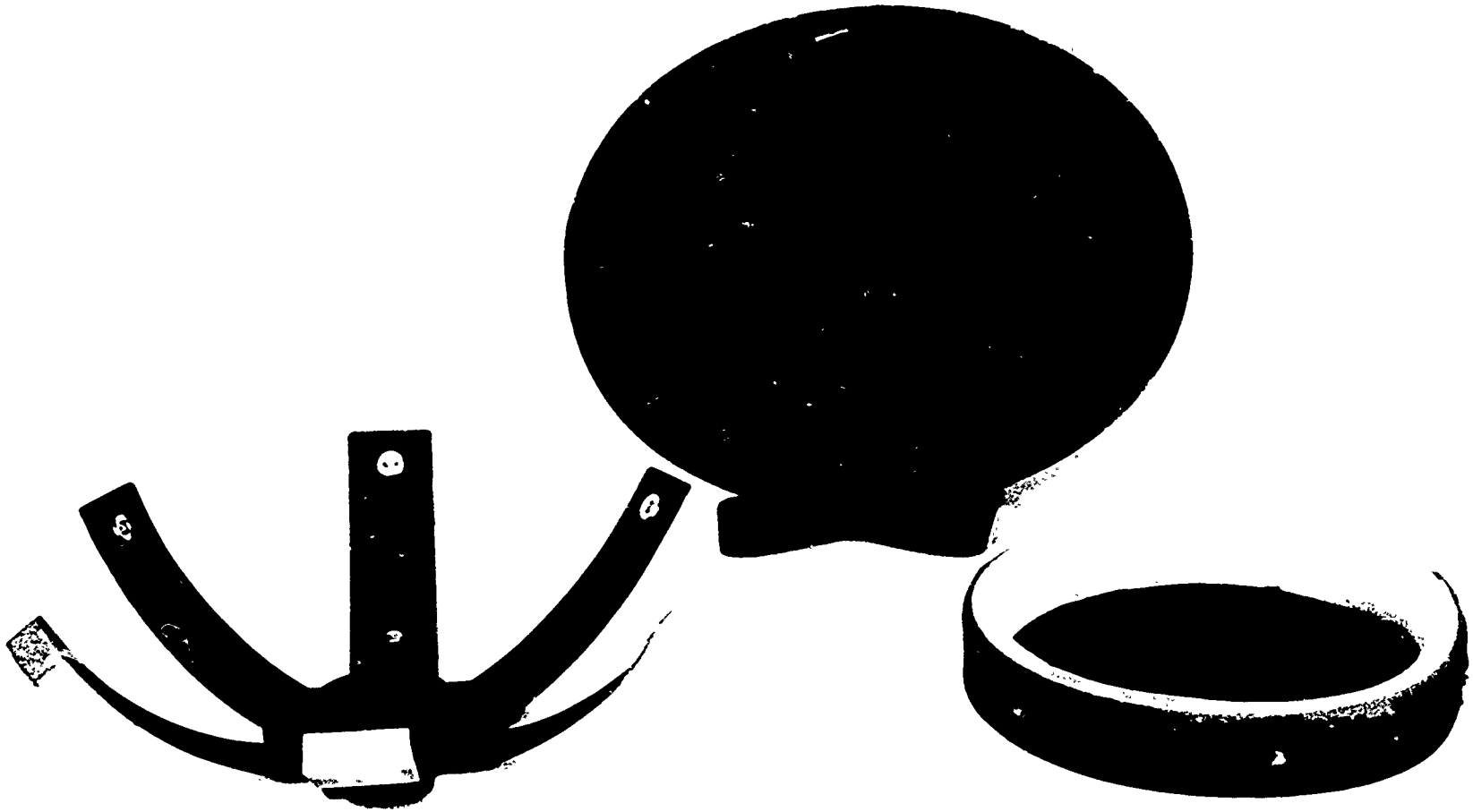

Figure I - 6b
United Kingdom
Infantry Helmet (Suspension)

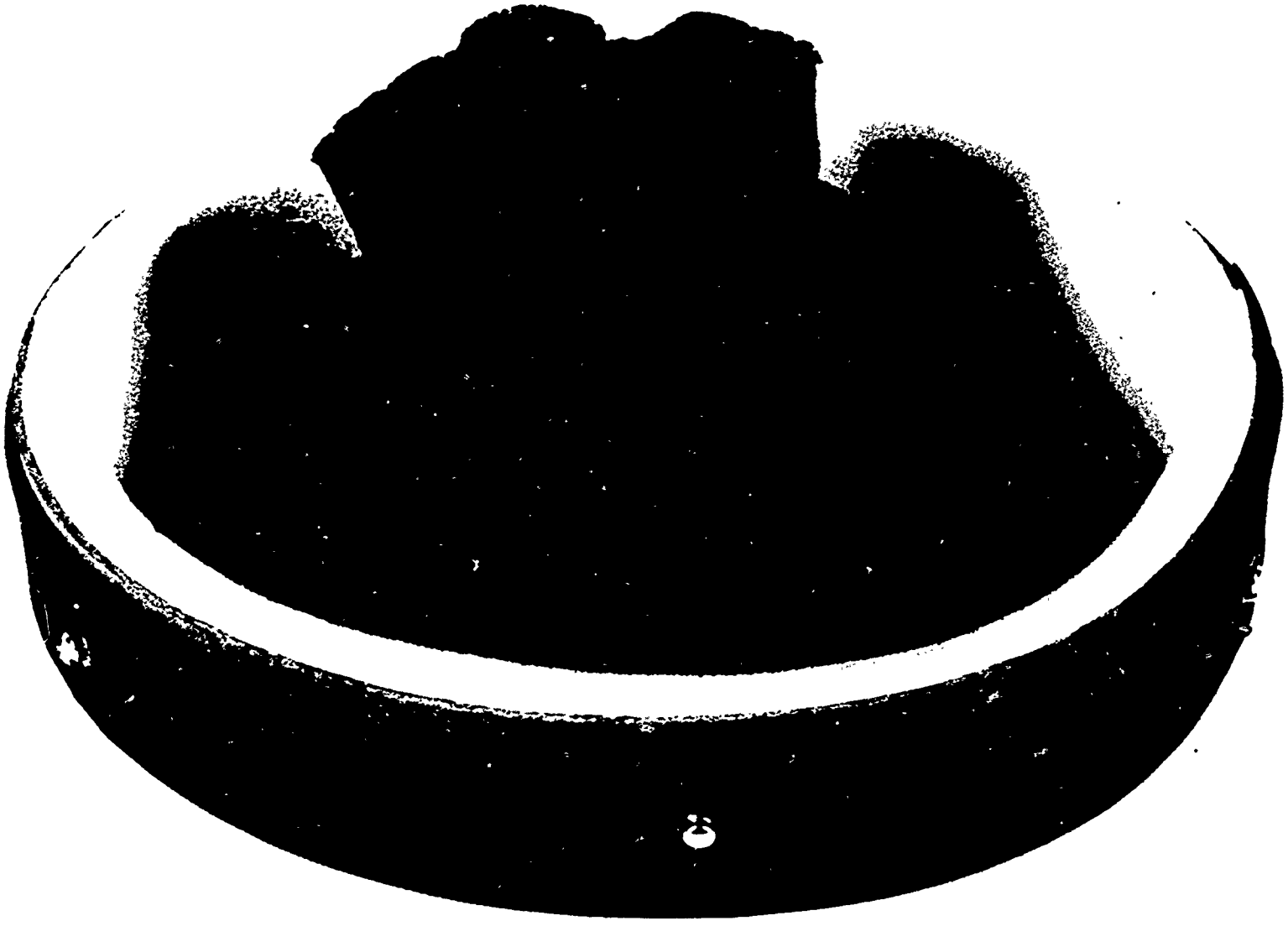

Figure I - 6c
United Kingdom
Infantry Helmet (Ring Suspension)

Figure I - 7a
U. S. A.
Infantry Helmet (Side)

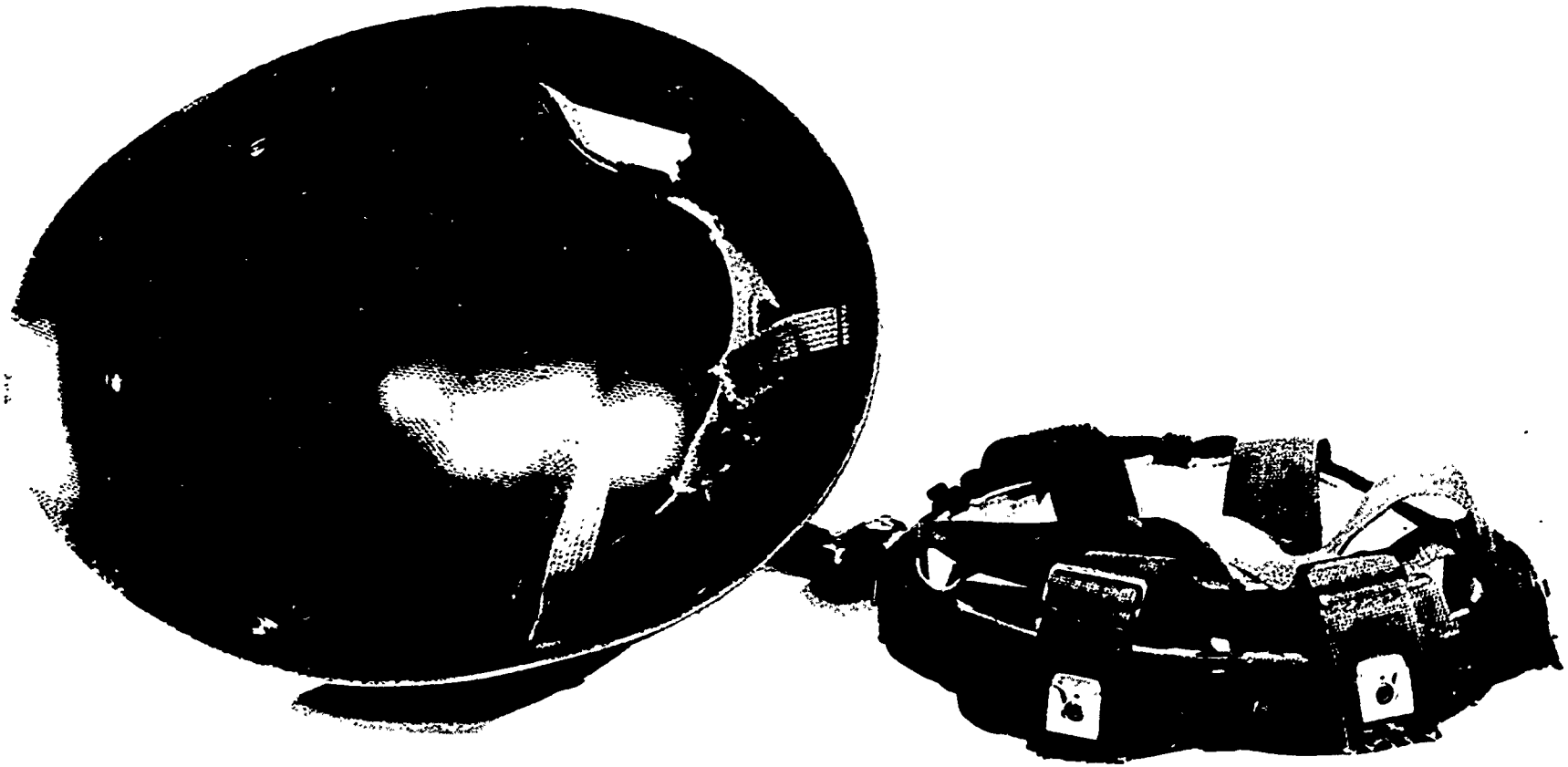

Figure I - 7b
U. S. A.
Infantry Helmet (Liner and Suspension)

SECTION II

FLIGHT HELMETS

Flight Helmets referred to in the questionnaire meant protective headgear as worn by pilots and crews of helicopters and fixed wing aircraft. Some countries interpreted the flight helmet as pertaining to airborne or paratroops and, therefore, did not forward information on protective headgear as worn by pilots and crews. Consequently, this deficiency in the questionnaire resulted in the many gaps reflected in Table II.

It is hoped that specific information on protective headgear as utilized by pilots and crews of helicopters and fixed wing aircraft will be assimulated and forwarded to the US Army Natick Laboratories for inclusion in the annual update of this report.

TABLE II

RESULTS OF QUESTIONNAIRE ON FLIGHT HELMET

Question Number	Category	COUNTRY						
		Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.*
	Helmet designation	USA-P4A USA-HGU2A/P MIL-H-26671B (USAF)						SPH-4
1	Helmet composition							Glass fabric, Epoxy resin
2	Liner required							Partial cranium cover
3	Liner composition							Expanded polystyrene beads
4	Helmet forming process							Bag molding
5	Liner forming process							Expanded bead in mold

*Australia & Norway indicated use of USA Flight helmets

TABLE II (con't)

FLIGHT HELMET

Question Number	Category	COUNTRY						
		Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
6	Weight of helmet system medium							1580 g
7	Estimated surface area							1700 cm^2
8	Helmet offset from head							19 mm
9	Field of vision No. of Degrees Horiz left/ Horiz rt Vert up/ Vert down							
10	Acoustical problems							Unknown
11	Incompatibi-lity problems							Eyeglasses cause acoustical leakage

TABLE II (con't)

FLIGHT HELMET

Question Number	Category	COUNTRY						
		Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
12	Ballistic resistance							No requirement
13	Unsatisfac-tory reports							Visor housing breaks at low temperature (Artic)
14	Medical problems							Unknown
15	Troop comments							None reported
16	How well liked							Accepted
17	Type of suspension system							6 Point cradle
18	Materials used in suspension							Nylon/ cotton, leather

TABLE II (con't)

FLIGHT HELMET

Question Number	Category	COUNTRY						
		Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
19	How suspension adjusted							Adjustable straps & headband
20	Discomfort problems w/ suspension							Unknown
21	Determination of correct size							Individual fitting
22	Number of sizes used							Three
23	Auxilary uses of helmet							Unknown

Figure II - 1
U. S. A.
Flight Helmet

SECTION III

COMBAT VEHICLE CREWMAN HELMET

Table III shows that Australia, Canada, Greece Norway and the United States use or are evaluating the U.S.A.-CVC Helmet.

Denmark is evaluating the Amplivox-Military Helmet Type DA 2680 which is of British origin.

France uses the Toutes Armes helmet with a radio-vehicle liner. The liner (See Figure III-1) is designed with ear cut-outs to make it compatible with ear phones and other communication equipment. The liner with suspension system weighs 425 grams and is injection molded of polyamide. The suspension used in the radio-vehicle liner is the same 6-point cradle system as used in the infantry helmet liner Model 1951. The liner is provided with a 12.5 mm wide leather chin strap adjusted by means of a sliding pressure clip.

The CVC Helmet presently used by Germany is a close fit fabric helmet padded with expanded polyurethane with a weight of 480 grams (See Figure III-2). The ear phone receptacles are made of plastic and are hinged at the top by means of cotton webbing. The receptacles are capable of being lifted and snapped on top of the head by means of fabric tabs, thus exposing the ears. The chin strap is of 19 mm wide cotton webbing that snap fastens on one side and is adjustable on the other side by means of a double "D" ring assembly. The helmet is available in ten sizes.

The Italian vulcanized cotton fiber helmet is a relatively close fitting helmet (See Figure III-3a, b, c). The leather suspension system permits head height adjustments by means of a draw string at the apex of the leather head cover. Limited adjustment is provided at the back of the helmet by means of an elasticized strap and snap fasteners which draws the helmet in towards the nape of the head. The helmet weighs 725 grams, permits normal vision, and is available in three sizes.

The Netherlands CVC Helmet is a close fitting, injection molded, polypropylene unit that weighs 210 grams but has a surface area of only 250 square centimeters. One size helmet is issued and fitting is accomplished by adjustable straps in front and back as well as via the adjustable chin strap. This helmet is not liked by the troops primarily because of its non-military appearance.

The United Kingdom's AVC Crewman's helmet presently under evaluation is molded from laminated fiberglass (See Figure III-5). The helmet offers full coverage of the head and provides concussion protection but limited ballistic protection. The helmet weighs 1360 grams and the outer surface area is estimated as 1650 square centimeters. The helmet is designed to maintain a 35 mm "head off-set". The helmet restricts horizontal vision to 26.5° left and right respectively.

The United States CVC Helmet is bag molded of ballistic nylon fabric impregnated with modified phenolic resin. It weighs 1250 grams and the outer surface area is 1310 square centimeters. It is designed to accomodate a communication box on the left side of the helmet (See Figure III-6). The suspension system, a six point cradle assembly, maintains a minimum of 19 mm "head off-set". The field of vision horizontally is 90° left and right respectively. However, verticle vision upward is restricted to 25°. The helmet offers limited ballistic protection. Although this helmet is accepted in the field its major deficiencies are ineffective noise attenuation and incompatibility with fire control and sighting devices. The helmet is issued in three sizes.

TABLE III

RESULTS OF QUESTIONNAIRE ON COMBAT VEHICLE CREWMAN HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Netherlands	U.K.	U.S.A.*
	Helmet designation	Amplivox-Mil. Type DA 2680	Toutes armes	CVC-VTL8405-077	Tanker's fiber helmet	NSN-8415-17-711-0633	AFV Crewman	CVC
1	Helmet composition		Steel	Fabric-polyurethane	Vulcanized Cotton	Polypropylene	Laminated fiberglass w/foam padding	Ballistic nylon,
2	Liner required		Yes Model 1965 radio-vehicle	No	No	No	No	Crown lined
3	Liner composition		Polyamide	N/A	N/A	N/A	N/A	Expanded elastomeric plastic
4	Helmet forming process		SEE TABLE I	Textile fabrication	Drawn from sheet material	Injection molded	Molding	Bag molded
5	Liner forming process		Injection molded	N/A	N/A	N/A	N/A	Shaped from flat stock

*Australia Canada Greece & Norway use or are evaluating the USA-CVC

TABLE III (con't)

COMBAT VEHICLE CREWMAN HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Netherlands	U.K.	U.S.A.
6	Weight of helmet system Medium		Liner, 425 g Helmet, 1200 g	480 g	725 g	210 g	1360 g	1250 g
7	Estimated surface area		SEE TABLE I		1200 cm^2	250 cm^2	1650 cm^2	1310 cm^2
8	Helmet offset from head		20 mm	None	8 mm	None	35 mm	19 mm
9	Field of vision No. of degrees Horiz left/ Horiz Rt Vert up/ Vert down		SEE TABLE I	Normal	Normal	Normal	26.5°/ 26.5°/ 72.5°/ Normal	90°/90° 25°/60°
10	Acoustical problems		Not reported	Not reported	None	None	Field experience limited	Noise attenuation ineffective
11	Incompatibility problems		Not reported	Not reported	None	None	Limited experience	W/Fire control & sighting device

TABLE III (con't)

COMBAT VEHICLE CREWMAN HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
12	Ballistic resistance		SEE SECTION VI					
13	Unsatis-factory reports		Not reported	Not reported	None	Non-military appearance	Limited experience	Too tight fitting
14	Medical problems		Not reported	Not reported	None	None	Limited experience	Noise
15	Troop comments		Not reported	Not reported	None	Non-military appearance	Limited experience	As above
16	How well liked		Not reported	Not reported	Accepted	Not liked	Too early	Accepted
17	Type of suspension system		6 Point cradle	Close fit	Padded leather	Close fit	Foam padding w/ concussion harness	6 Point cradle

TABLE III (con't)

COMBAT VEHICLE CREWMAN HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
18	Materials used in suspension		Cotton webbing, leather headband	N/A	Padded leather	Leather chin strap	Foam padding harness	Cotton webbing, Leather headband
19	How suspension adjusted		Draw string at apex Adjustable headband	Non-adjustable	Draw string and elastic strap	Adjustable strap front and back	Not reported	Adjustable straps and headband
20	Discomfort problems w/suspension		Not reported	Not reported	None	None	Not reported	None
21	Determina-of correct size		Individual fitting Universal size	Individual fit	Anthro-pometric measure	Individual fit Universal size	Not reported	Individual fit
22	No. of sizes		One	Ten	Three	One	Not reported	Three
23	Auxiliary uses of helmet		None reported	Not reported	None	None	None	None

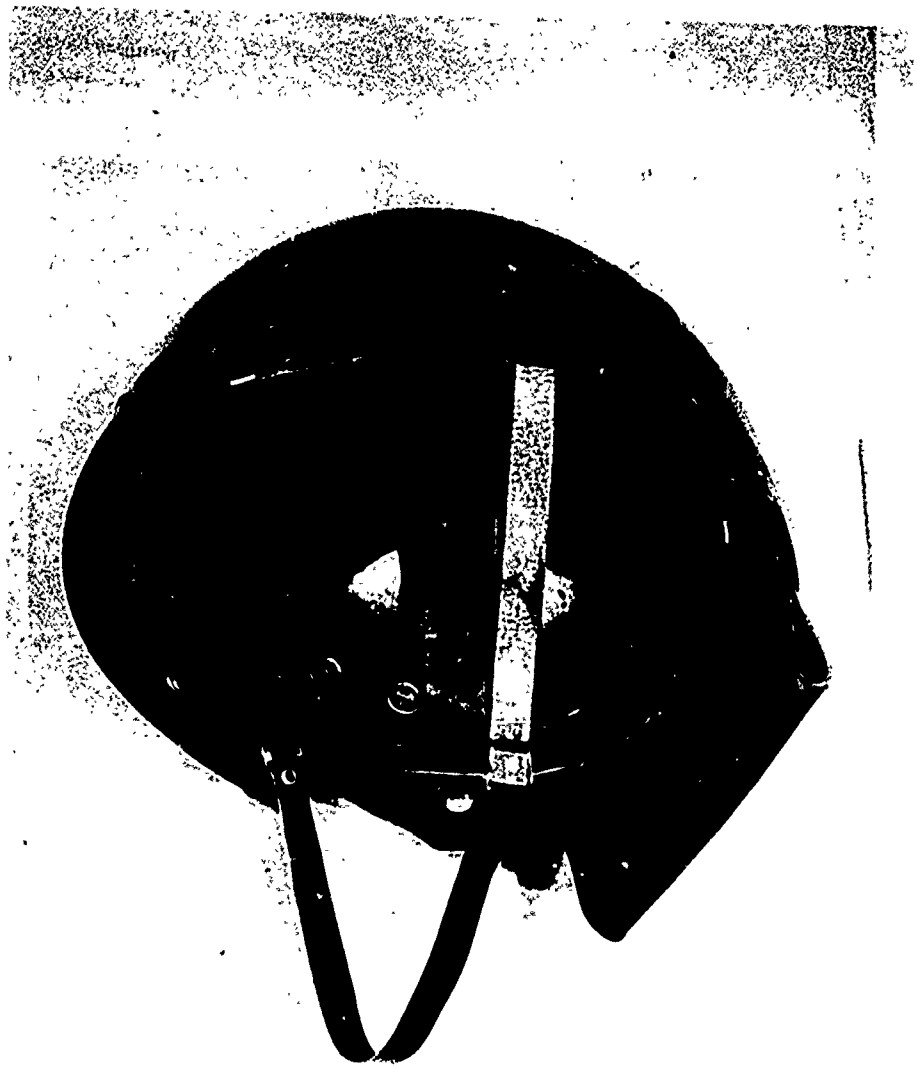

Figure III - 1
France
Liner Radio Vehicle

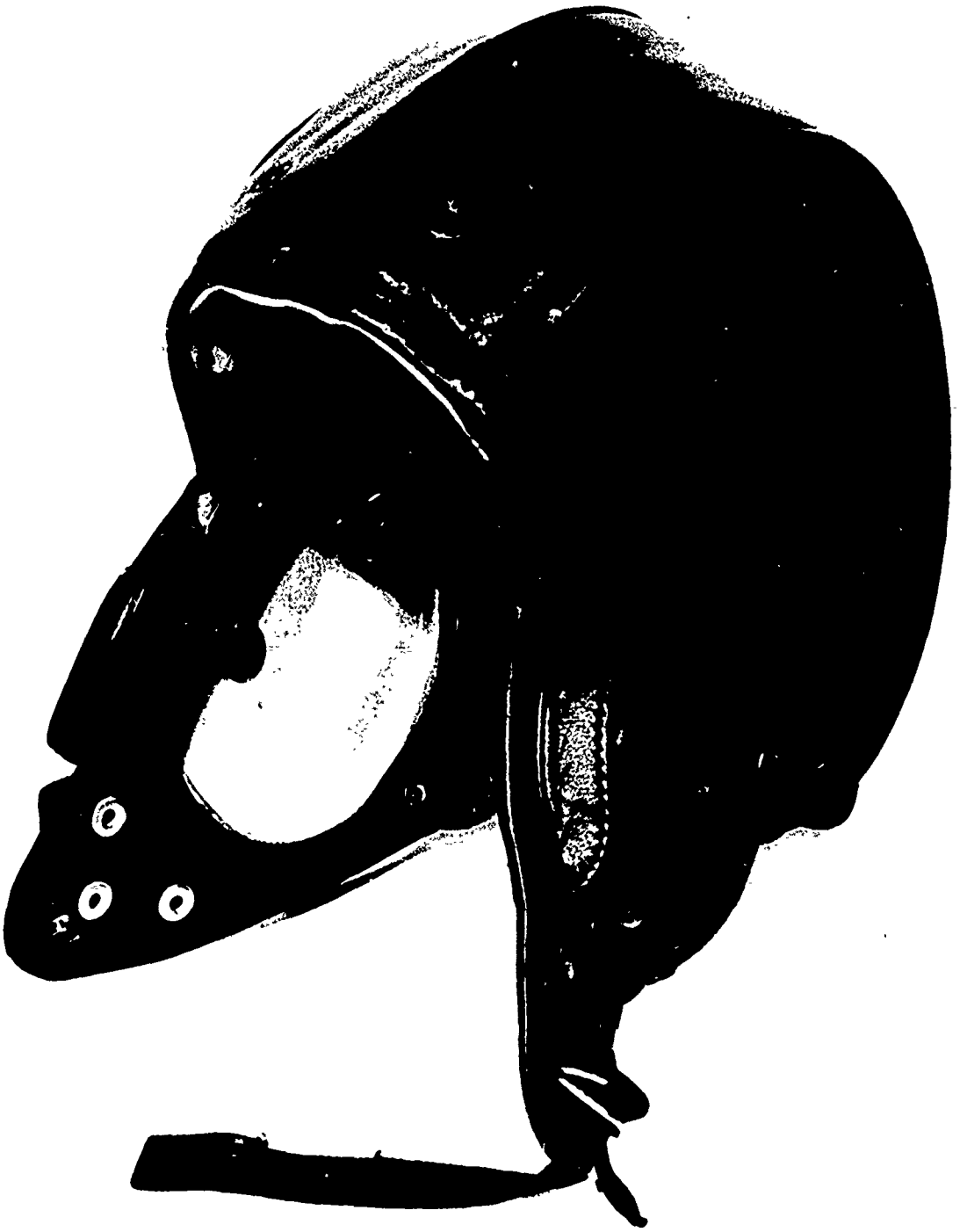

Figure III - 2
Germany
CVC Helmet

Figure III - 3a
Italy
CVC Helmet (Front)

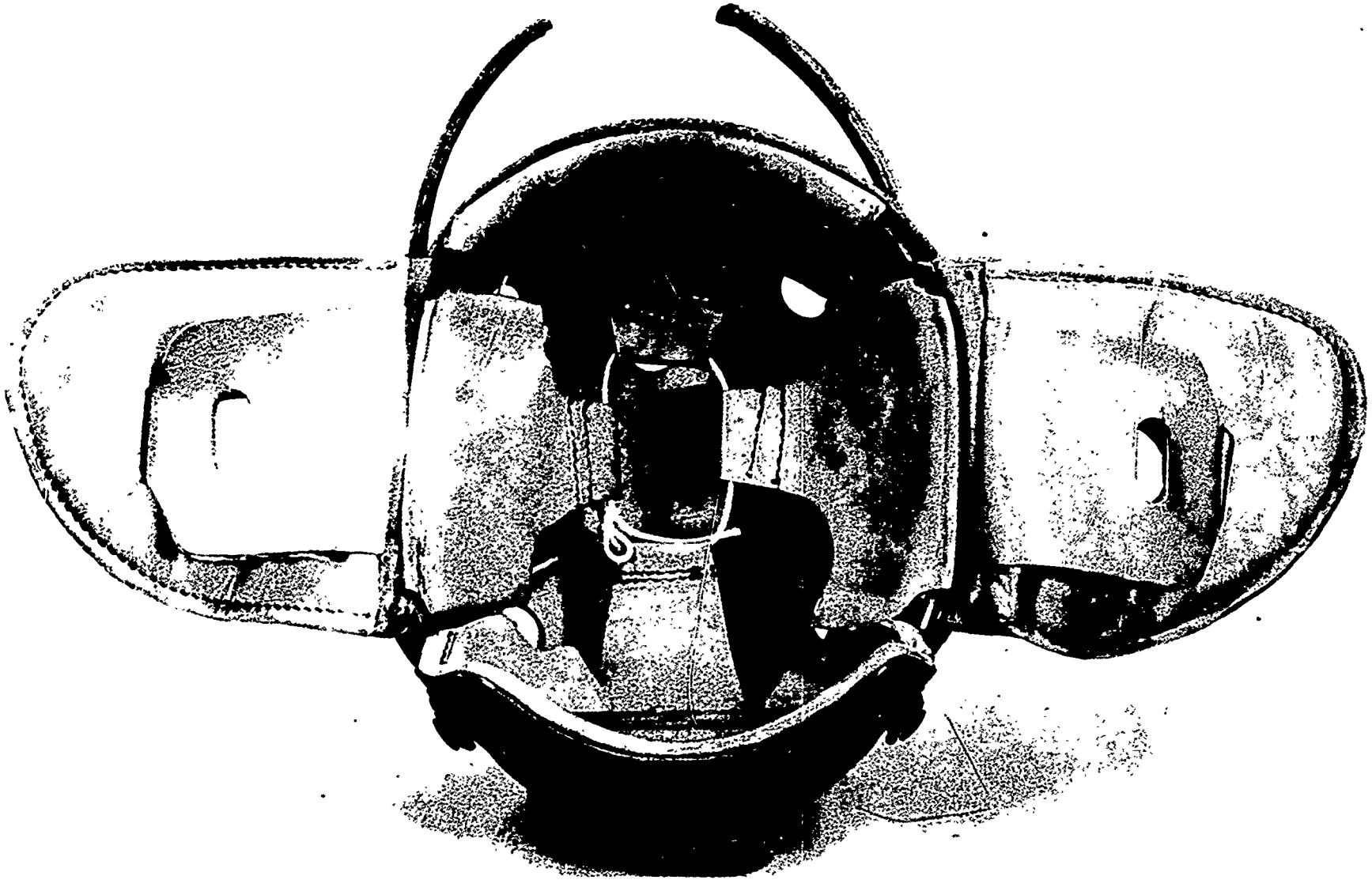

Figure III - 3b
Italy
CVC Helmet (Inside)

Figure III - 4a
Netherlands
CVC Helmet (Front)

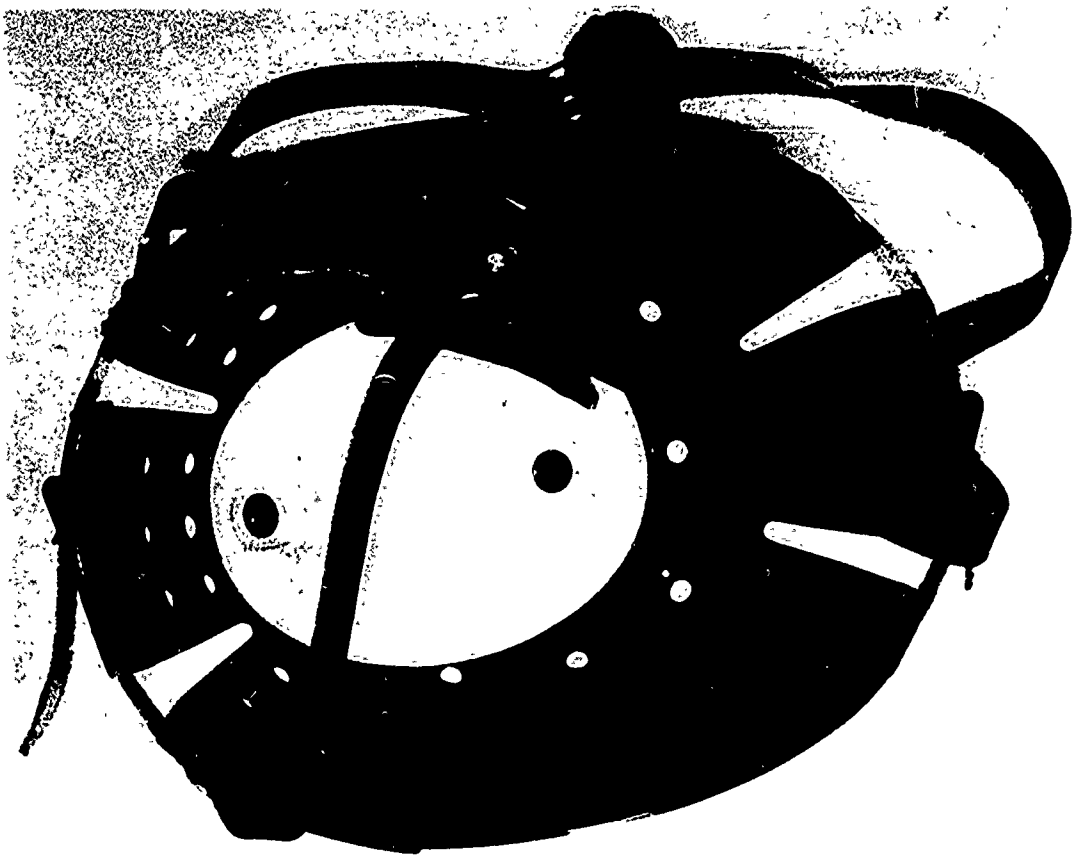

Figure III - 4b
Netherlands
CVC Helmet (Inside)

Figure III - 5
United Kingdom
CVC Helmet

Figure III - 6
U. S. A.
CVC Helmet

SECTION IV

PARACHUTIST HELMET

Table IV presents the data on Parachutist helmets submitted by four nations; Germany, Italy, the United Kingdom and the United States.

The German airborne steel helmet shell is the same as that used by the German infantry. The suspension system consists of a polyethylene ring approximately 31 mm wide and 4 mm thick at the base tapering to about 1.5 mm across the width of the ring. This ring fits the inside circumference of the steel shell in a plane approximately 2.5 mm from the rear center rim. To this ring are riveted three non-adjustable suspension straps 40 mm wide which effectively provides a six point head retaining suspension. The head cover consists of a stiff leather band covered with a flexible soft leather that is adjustable for height by means of a draw string at the apex. The headband is spaced away from the polyethylene ring by ten foam rubber pads. The pads are adhered to the leather headband and laced to the polyethylene ring by means of a plastic mono-filament. The pads are 34 mm square and are 9 mm thick (4 pads) in the rear of the helmet and 13 mm thick (6 pads) in the front portion of the helmet.

Four spring steel attachment tabs are riveted to the polyethylene ring and the ring is attached to the steel shell by means of nuts and bolts, one attachment on each side and two attachments in the back of the helmet.

The leather chin strap consists of two straps that cross in the back and attach to each side of another strap going under the chin. The straps are attached to the steel shell on the same four bolts that hold the suspension system. (See Figure IV-1). The helmet is issued in three sizes and the suspension system in ten sizes.

The Italian parachutist's helmet (See Figure IV-2a, b, c, d) consists of a steel shell with a steel band covered with padded leather and riveted to the shell in four places. The leather extends towards the crown in eight symmetrical petal-like sections. Each section is backed with about 28 mm thick foam plastic padding. The crown has a 13.7 cm diameter foam plastic pad which is approximately 4 cm thick at the apex. A 12.5 cm rolled pad is affixed to the front edge of the helmet. The chin cup assembly attaches to the steel band by means of a three point attachment. The helmet weighs 1150 g and is estimated to have a 980 cm^2 surface area.

The United Kingdom has developed a lightweight parachutist's helmet molded from resin bonded ballistic nylon (See Figure IV-3). The helmet weighs 1000 g and has a surface area of 1150 cm^2. The helmet is close fitting and padded with expanded polystyrene. The head "off-set" is maintained at 31 mm. Horizontal vision is reported as 31° left and right respectively. This helmet will be issued in 7 or 8 sizes.

The United States uses the M-1 steel shell with a Type II nylon parachutist liner. The Type II liner differs from the Type I by the addition of a chin strap assembly that forms an open cup at the chin (See Figure IV-4). The strap is attached to the liner at the ear area in "y" fashion. Buckles are attached to the leg of the "y" to which the open chin cup is fastened. The chin cup has four eyelets on each side for adjustment. The chin strap on the M-1 steel shell has an extension which snaps to the inside of the liner securing the helmet and liner together. The suspension system is the same six point cradle and nape strap assembly as used in the M-1 Infantry Helmet. The helmet and liner are issued in one size.

TABLE IV

RESULTS OF QUESTIONNAIRE ON PARACHUTIST'S HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.*
	Helmet designa-tion			Aircrew helmet (Airborne)	Model 42		Para-chutist light-weight	Parachutist
1	Helmet composi-tion			Special steel	Special steel		Resin bonded ballistic nylon	Hadfield steel
2	Liner required			No	No		No	Yes
3	Liner composi-tion			N/A	N/A		N/A	Resin bonded ballistic nylon
4	Helmet forming process			Deep draw 5 Steps	Drawing 9 Steps		Molding	Deep drawing

*Canada uses USA M-1

TABLE IV (con't)

PARACHUTIST HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Nether-lands	U.K.	U.S.A.
5	Liner forming process			N/A	N/A		N/A	Compression molding
6	Weight of helmet system Medium			1400 g	1150 g		1000 g	1500 g
7	Estimated surface area				980 cm^2		1150 cm^2	1170 cm^2
8	Helmet offset from head			15-20 mm	25 mm		31 mm	15-20 mm
9	Field of vision No. of Degrees Horiz left/			Normal Normal 45°/ Normal	Normal Normal 60°/ Normal		31°/ 31° 42°/ Normal	100° 100° 15°/ 60°

TABLE IV (con't)

PARACHUTIST HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Netherlands	U.K.	U.S.A.
10	Acoustical problems			None	Resonance		New None reported	Resonance
11	Incompatibility problems			With headphones	W/Telephone, Eyeglasses, Magnetic devices, Gas mask		New, None reported	With field radio
12	Ballistic resistance			SEE SECTION VI OF REPORT				
13	Unsatisfactory reports			None	None		New, None reported	Heavy; Unstable
14	Medical problems			None	Headaches Skin Abrasion		New, None reported	None
15	Troop comments			None	Hot in day cold at night		New, None reported	Heavy, Unstable

TABLE IV (con't)

PARACHUTIST HELMET

COUNTRY

Question Number	Category	Denmark	France	Germany	Italy	Netherlands	U.K.	U.S.A.
16	How well liked			No complaints Combine Airborne & Infantry	Prefer lighter & more stable helmet		New No comments	Prefer more concussion
17	Type of suspension system			Headband leather cover with drawstring	Steel headband with padded leather		Integral Expanded polystyrene padding	6 Point Cradle
18	Materials used in suspension			Polyethylene, Leather, Cotton webbing, Foam rubber	Steel band, Leather, Foam rubber		Expanded Polystyrene	Cotton webbing, Leather headband
19	How suspension adjusted							
20	Discomfort problems with suspension			None	Pressure at temporal & throat area		New None reported	None

TABLE IV (con't)

PARACHUTIST HELMET

Question Number	Category	COUNTRY						
		Denmark	France	Germany	Italy	Netherlands	U.K.	U.S.A.
21	Determina- of correct size			Individual fitting	Anthropometric measurement		Individual fit	Individual adjustment of suspension
22	No. of sizes used			3 helmets 10 suspensions	Two		7 or 8	One
23	Auxiliary uses of helmet			None	None		None	Basin, Seat, Digging tool

Figure IV - 1
Germany
Paratrooper's Helmet (Inside)

Figure IV - 2a
Italy
Paratrooper's Helmet (Front)

Figure IV - 2b
Italy
Paratrooper's Helmet (Side)

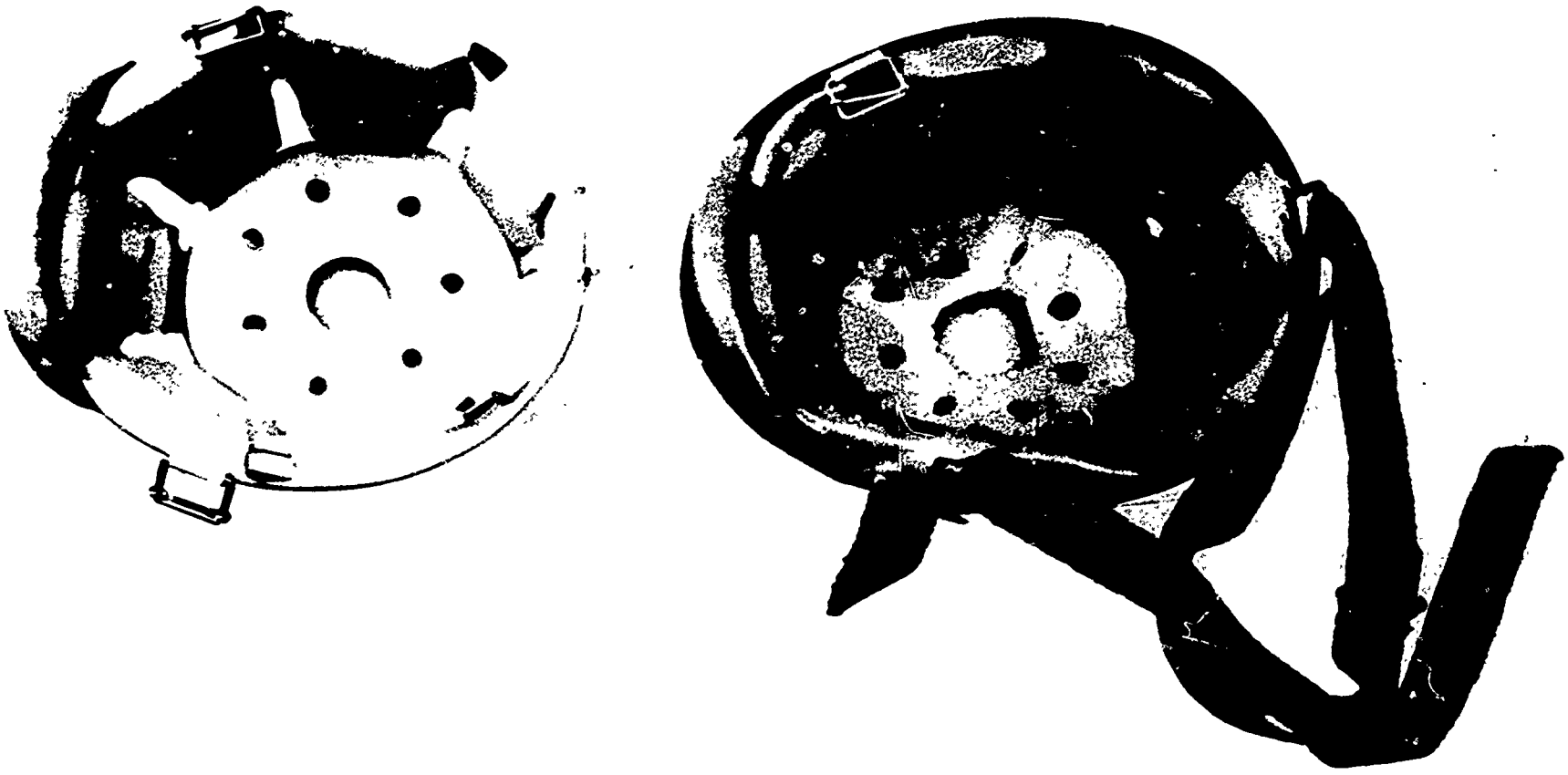

Figure IV - 2c
Italy
Paratrooper's Helmet (Inside)

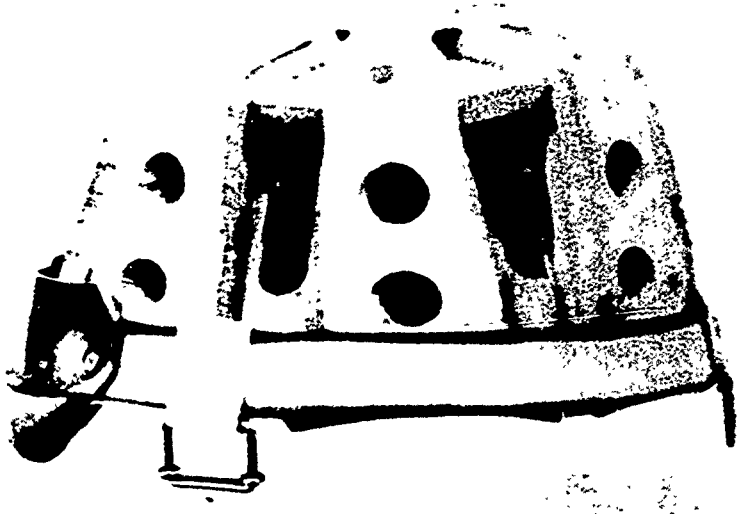

Figure IV - 2d
Italy
Paratrooper's Helmet (Suspension)

Figure IV - 3a
United Kingdom
Paratrooper's Helmet (Side)

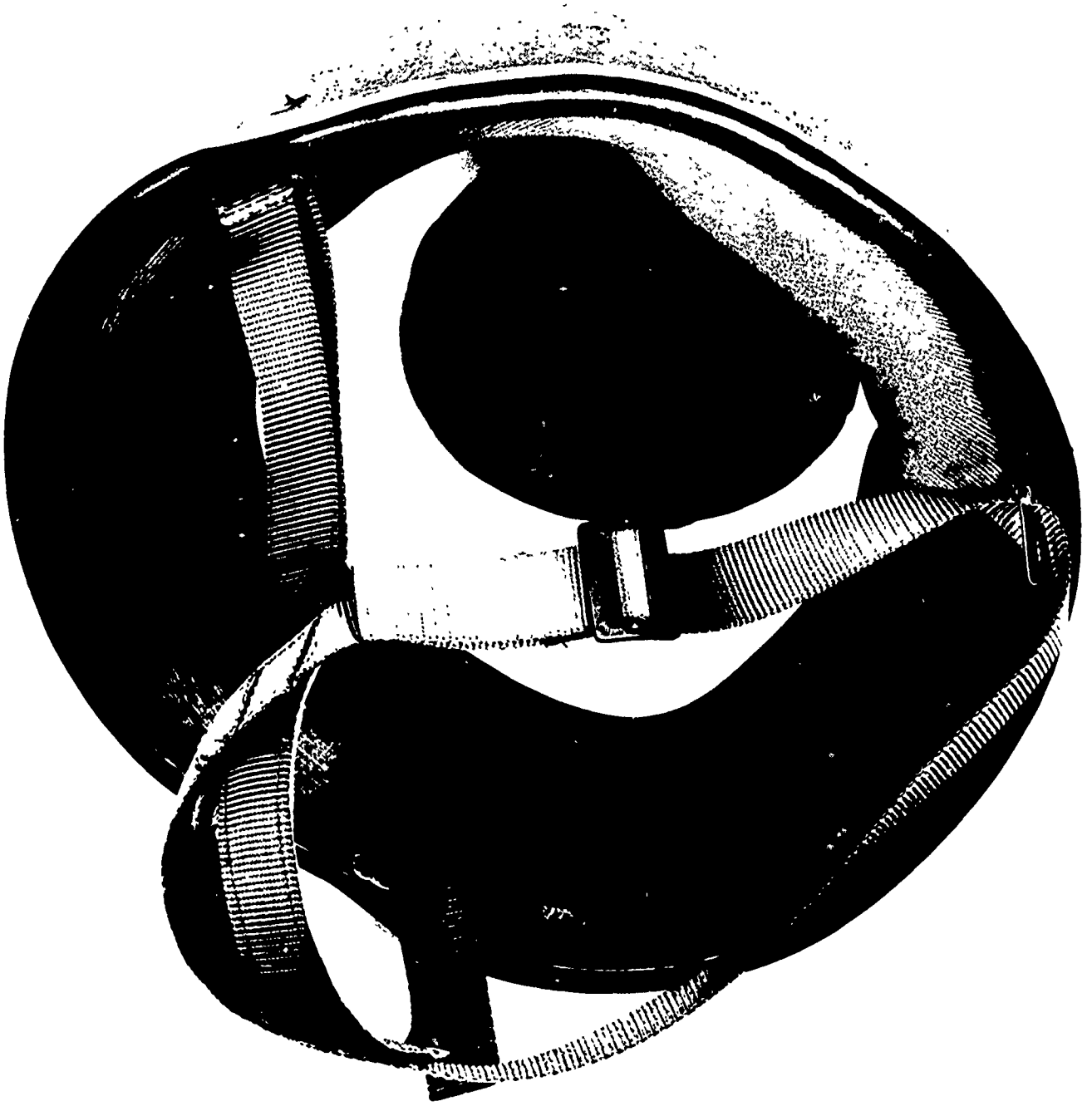

Figure IV - 3b
United Kingdom
Paratrooper's Helmet (Inside)

SECTION V

OTHER PROTECTIVE HEADGEAR

CANADA

Figures V-1a and V-1b represent Para-rescue helmet submitted by Canada. The helmet is fabricated of fiber reinforced plastic, weighs approximately 1200g and the outer surface area is estimated as 1125 cm^2. The head off-set is reported as 6mm. Vision is normal in all directions. No problems are reported with this helmet. The helmet is not designed to provide ballistic protection. Canada reported that their troops find this helmet very acceptable. The helmet is close fitting and is provided in individual sizes.

NETHERLANDS

A riot helmet sent by the Netherlands is depicted in Figure V-2. Unfortunately, the questionnaire with the data on this helmet was not received. The helmet appears to be an all plastic item and to be individually sized.

UNITED STATES OF AMERICA

Figures V-3a and V-3b show a spin-molded polycarbonate helmet (0.25mm thick) used with the Explosive Ordinance Disposal Ensemble. The helmet is 32.5cm in diameter; weighs 1360g and is attached to the ensemble by a 30cm diameter neck ring.

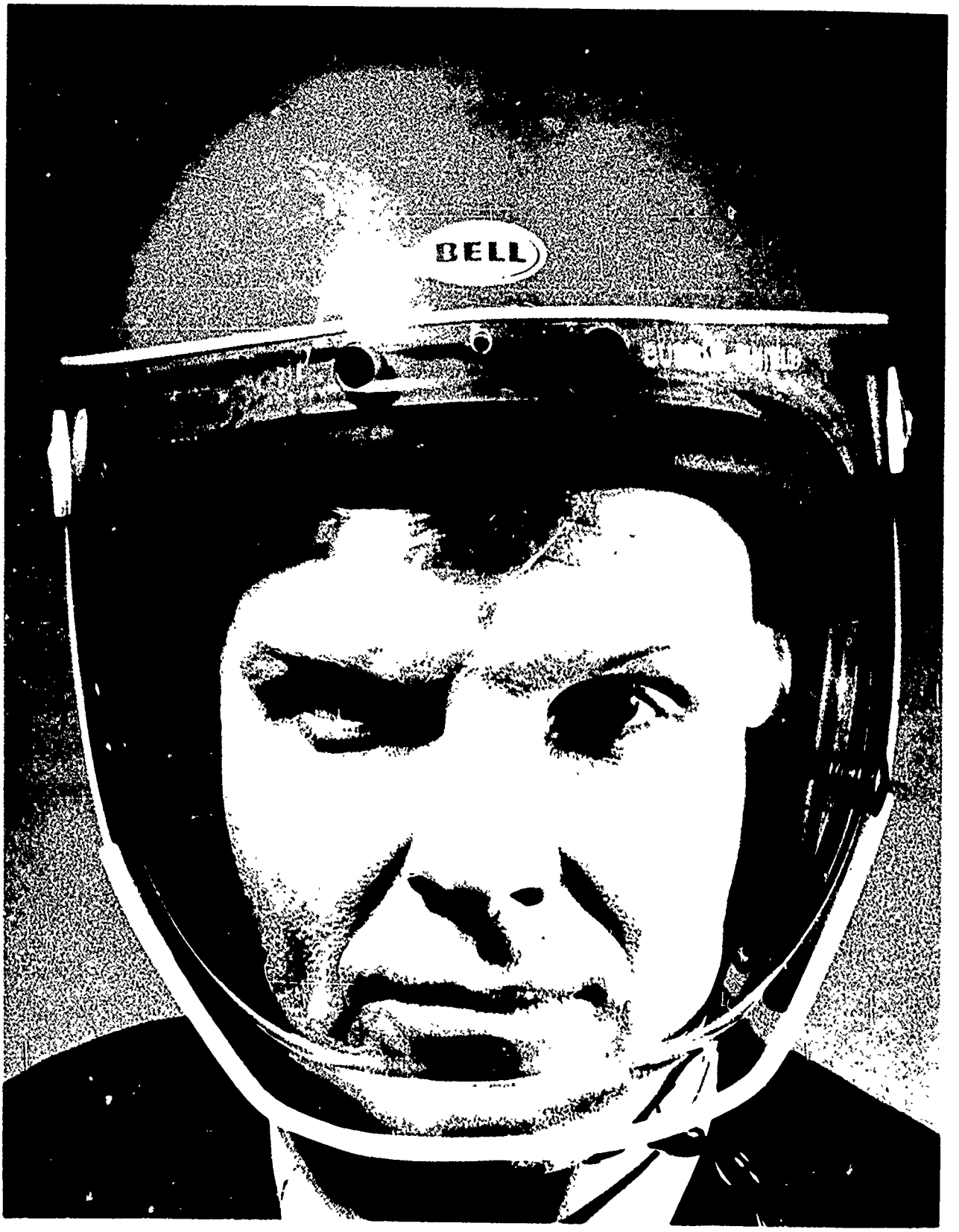

Figure V - 1a
Canada
Para-Rescue Helmet (Front

Figure V - 1b
Canada
Para-Rescue Helmet (Side)

Figure V - 2a
Netherlands
Riot Helmet

Figure V - 2b
Netherlands
Riot Helmet (Side)

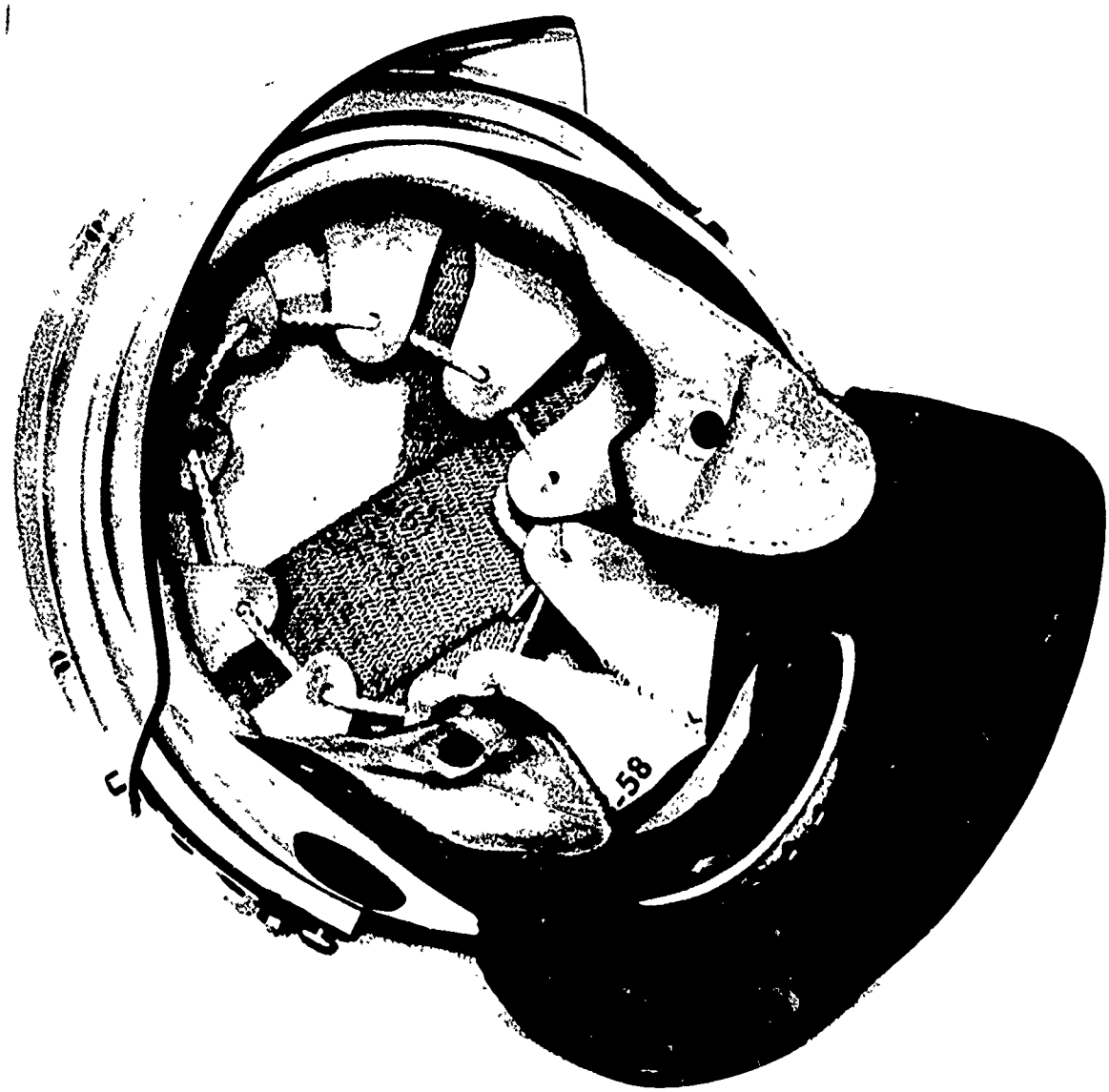

Figure V - 2c
Netherlands
Riot Helmet (Inside)

Figure V - 3a
U. S. A.
E. O. D. Helmet

Figure V - 3b
U. S. A.
E. O. D. Helmet (And Ensemble)

SECTION VI

BALLISTIC METHODS AND DATA

A. Belgium

Method: - The lightest helmets will be chosen for test. The tests will be done in the installations and with approval of the administration. The helmets to be tested will be completely finished. Two projectiles having the ballistic characteristics defined below will be fired at each helmet at a place to be designated by the receiver. No perforation or complete fracture of the plate will be permitted. The degree or depth of impact, measured by means of a gauge will not be more than 38 mm, only impacts found to be more than 5 cm from the lower edge on the front of the helmet and more than 2.5 cm from the lower edge of the sides will be taken into consideration. The validity of the tests, the acceptance or rejection of the lot will be in accordance with and conform to the following:

Criteria: - No perforations or complete fracture of the helmet - depth to be no more than 38 mm.

Results: - Infantry Helmet - passes

Effects of Firing	V 220 m/sec	V 222 m/sec
perforations or complete tears or lacerations or penetrations greater than 38 mm.	Valid test lot rejected	Test not valid
no perforations, no complete tear or lacerations, no penetrations greater than 38 mm.	Test not valid	Test valid Lot accepted

If the tests prove to be non valid, one will utilize additional helmets just at the point of obtaining a number of valid impacts.

Ballistic characteristics of the bullet utilized: lead bullet with a copper jacket (or case) - caliber .45 (11.45 mm) - Weight: 230 grains (14.9 g).

B. Denmark

Method: The shooting test is carried out at a distance of 5 mm with pistol M/49 (Neuhausen); ammunition with the following data is used:

Caliber: 9mm cartridge M/41
Projectile: Lead core with brass-jacket
Weight of Projectile: 8.5 gr.
Striking Velocity: 310 m/sec.
Impact Velocity: 41.5 kg./m/

Criteria: No cracks or penetrations must occur, and impression depth must not exceed 30 mm.

Results: Infantry Helmet - passes

C. France

No method submitted

D. Germany

Method: The helmet is fired at from a range of 5 m using an automatic pistol USI, Caliber 9mm soft core.

Criteria: Impact energy 62 Kgm - 3 Kgm

Results: Infantry Helmet - passes
Parachutist's helmet - passes
Combat Vehicle Crewman - no requirements

E. Italy

Method: The helmet is subjected to the fire of an automatic Baretta carbine, Caliber 9mm, Model 4 modified, with cartridge for a regular bullet Caliber 9mm. Weight of bullet: 7.45 grains. For shots fired at the brim area, the impact energy shall be 26.6-29.6 Kgm. For shots fired at the top and sides of the helmet the impact energy shall be 29-32.5 Kgm.

Criteria: There will be no dent exceeding 15 mm depth, nor cracks nor penetration.

Results: Infantry Helmet - passes
Parachutist's Helmet - passes
CVC Helmet - No requirement (impact only 1 Kg - 1m)

F. United Kingdom:

Method: Ballistic limits (V_{50}) are determined in accordance with the method outlined for the ballistic method of the U.S.A.

Criterion: V_{50} limits at zero obliquity for 17 grain fragment simulator.

Results: Infantry Helmet - 1000 ft/sec (Ballistic requirements are not specified in Specification since the steel and thickness are specified).

AFV Helmet - 890 ft/sec
Parachutist Helmet - 1130 ft/sec

G. United States of America

Method:

1. Objective: To determine ballistic resistance of fragmentation protective materials with Caliber .22 17-grain fragment simulator.

2. Equipment:

a. Gun mount - The gun mount must be suitable for firing the Caliber .22 gun.

b. Test sample mounting - The armor test sample shall be mounted in a frame. The armor test sample shall be secured in the vertical position, perpendicular to line-of-flight of projectile. The frame supports and clamps must be capable of retaining the sample and withstanding the shock resulting from the ballistic impact. The test sample mounting must be capable of adjustment for moving the sample in the vertical or horizontal directions so that the point of impact can be located anywhere on the sample, and rotation on the vertical axis so that zero degree obliquity impacts can be achieved anywhere on the sample.

c. Weapon - A Caliber .22 weapon shall be used.

d. Projectile - The projectile to be used in Caliber .22 fragment simulator.

e. Witness Plate - The witness plate shall be 2024-T3 or 2024-T4 aluminum alloy sheet, 0.020-inch thick and shall be a minimum of 11" X 14" in size.

f. Velocity measuring equipment

(1) Chronograph - an electronic counter type chronograph measuring to at least the nearest microsecond.

(2) Detectors - Either high-velocity liminline screens, or electrical contact screens which either open or close an electric circuit by passage of the projectile through the detector.

g. Propellant - Any propellant which is standard for the weapon may be used. A projectile velocity - propellant charge curve for the weapon shall be determined before any testing is performed. This curve is required to provide a basis for selecting a powder charge to achieve a desired velocity.

3. Procedure:

a. Areal density must have been previously determined on the test samples before they are tested ballistically.

b. A test round will be fired through a witness plate to determine the exact position of impact. Three additional rounds shall be fired verifying the appropriate projectile velocity-propellant charge curve for the weapon being used. The last of these rounds shall be at the estimated V_{50} limit for the sample being tested and shall be called the reference velocity and the charge the reference charge. From the curve, the increments to and decrements from the referenced propellant charge to yield approximate velocity changes, at the reference velocity of 100 ft/sec and 50 ft/sec shall be determined and recorded. These shall be the only increments used during test.

c. The sample is mounted, the point of impact and obliquity is determined.

d. The first round is loaded with the reference propellant charge and fired into the sample, and the reading on the chronograph recorded. The velocity is computed and recorded.

e. The witness plate is examined for penetration. A complete penetration is recorded when any light can be seen through the witness plate. If no light is visible through the witness plate, a partial penetration is recorded.

f. If the first round fired yields a complete penetration, for the second round use a propellant charge equal to that of the first minus the propellant decrement for 50 to 100 ft/sec in an attempt to obtain a partial penetration. If the first round yields a partial penetration, use a propellant charge for the second round equal to that

of the first round plus a propellant increment for 50 to 100 ft/sec in an attempt to obtain a complete penetration.

g. Continue firing using this up (on partial penetration) and down (on complete penetration) method until at least five complete and five partial penetrations having a velocity spread not greater than 12.5 ft/sec is obtained.

h. The ballistic limit (V_{50}) is calculated by taking the arithmetic mean of the five lowest velocities producing complete penetration and the five highest velocities producing partial penetrations, provided the velocity spread for the ten rounds is not greater than 125 ft/sec.

<u>Criterion:</u> V_{50} limits at zero obliquity for 17 grain fragment simulator.

<u>Results:</u> Infantry helmet V_{50} = 1350 ft/sec
Steel shell V_{50} = 950 ft/sec
Nylon liner V_{50} = 860 ft/sec
Flight helmet - No requirement
CVC helmet V_{50} - 1025 ft/sec
Parachutist's helmet V_{50} = 1350 ft/sec

SECTION VII

NEW DEVELOPMENTS ON PROTECTIVE HEADGEAR

A. Australia

Infantry Helmet: Development is being carried out on a one-piece helmet to replace the current infantry steel helmet and liner combination (U.S.A. M-1). This is based on 14, 15, or 16 layers of ballistic nylon, laminated similarly as the current liner (U.S.A. M-1). Fifty samples are on order. These will be tested ballistically using the fragment simulator, grenades and mortar bombs. Trial was expected to be completed in 1971. No results are available for inclusion in this report.

B. Germany

CVC Helmet: Development work on a superior combat vehicle crewman's helmet is being carried out with great urgency. So far, no concrete results have been achieved in that the future type of helmet has not yet been defined. Concepts as described below are under development at the present time:

1. Flexible-type head protection for tank crews, with leather outer skin and a plastic shell to reduce the impact of blows and shocks. The liner is made of textile material and will be manufactured in individual head sizes.

2. Rigid-type head protection for tank crews, though with flexible outer skin made of composite material sheet metal and polyurethane foam.

3. Orders have been placed for models with a liner adaptable to all head sizes, as customary with protective helmets used in industry, and for models with specific head sizes.

4. Rigid-type head protection with a calotte of polycarbonate, whose liner is adaptable to several head sizes.

5. Individual size models with a plastic liner and models with a textile liner will be manufactured during the summer. It is expected that all prototype models will be available by mid-1971, at the earliest. After this date, the decision will be made as to which of the concepts will be chosen to manufacture models for use in service trials and, later on, for adoption by the German Armed Forces.

C. United Kingdom

Helmet Combat (Infantry):

1. Application: The combat helmet is designed for use by all arms and services primarily in a ballistic protection role.

2. Physical Characteristics: The Quartermaster Materiel Requirement under which this helmet is being developed calls for the following military physical characteristics:

a. Provide at least the ballistic protection against fragmentation weapons afforded by the present helmet.

b. Provide optimum coverage to the occipital and brain stem areas while allowing for dorsiflection of the neck sufficient for aiming in the prone position.

c. Not interfere with close combat activities, vision and hearing.

d. Suitable for use by parachutists and therefore as light as possible in order not to aggravate head whip.

e. Suspension system must hold the helmet firmly in place during violent movement, be comfortable in all climatic conditions, have the necessary resilience, and provide a suitable clearance between the skull and helmet. The weight is to be as low as possible to afford the required protection, but must not exceed two pounds. The helmet will be brimless and of one piece construction.

2. Operating Characteristics: The combat helmet is designed for use primarily in a ballistic protection role. It will afford the optimum of bump and ballistic protection compatible with weight limitations while allowing efficient performance of duties. The helmet will be suitable for use by parachutists and will be designed so as not to aggravate head whip.

3. Brief History and Current Status: The combat helmet is being developed under United Kingdom Quartermaster Materiel Requirement No. 320. The original work in the area of a lightweight, protective helmet was accomplished under QMMR No. 195 which required a helmet providing optimum ballistic protection against fragments primarily, and small arms secondarily; optimum coverage for protection of cranium, forehead, temples and back of neck; non-interference with close combat activities, use of weapons, vision or hearing; suspension system which would hold the helmet firmly in place at all times; and of one or two piece construction weighing not more than two and one-half pounds. The initial development in this area was a preliminary pilot model designed principally

to obtain user reactions to a change in the shape of the shell. It consisted of a fiberglass inner shell fitted into a steel outer shell. Tests of this pilot model concluded that the design did not obstruct the view of the wearer nor was the helmet impeded by equipment. A working party was established in 1962 to consider future developments and to make recommendations on the required characteristics of the new helmet. Since very large stocks of the current U.K. helmet were on hand, this project was designated as very long range. No further action was taken until 1967 when the U.K. initiated a feasibility study in this area. This study included: (a) survey of efforts by other ABCA countries; (b) evaluation of ballistic materials; and (c) head wound surveys. In 1968, the Stores and Clothing Research and Development Establishment (SCRDE) began construction of a firing range for ballistic testing of materials. This range was designed for use in a ballistics testing program in support of the lightweight protective helmet program. Various synthetic materials were evaluated by firing a .22 caliber, 17-grain fragment simulator and determining their ballistic limit. Initial evaluations showed that the polycarbonate shell was the only plastic material tested which offered protection equal to the present steel helmet. Difficulties appeared with the polycarbonate shell, however, due to its loss of impact strength when exposed to petroleum products such as gasoline. The U.K. test program to determine ballistic characteristics of various materials is a continuing program. When the U.K. determined that a lightweight paratrooper's helmet was urgently required, the program indicated that the ballistic nylon used in the U.S. helmet liner gave the best protection in relation to its weight. The U.K. at that time felt certain that by using resin impregnated ballistic nylon as a base, they could develop a two pound helmet which would give a V_{50} of 1200. In September 1969, the U.K. determined that a nylon helmet with a polystyrene liner would be developed for use by airborne troops . This helmet would weigh about 1-3/4 pounds but would have slightly reduced ballistic protective capabilities than the current heavier helmet. Current plans call for a 9 ± 1 ply bonded nylon helmet which incorporates a shape which will facilitate the wear of telecommunication equipment. A tool for the manufacture of prototype sheets of this design is being made. In order to provide impact resistance it is envisioned that the shell will be fitted with a liner of rigid polystyrene foam (11mm thick). The optimum density of this foam will be decided by experimentation. The liner is designed so that sections at the ears can be broken out to provide space to accommodate communication equipment or ear defenders. Soft polystyrene foam pads and a knitted nylon sock will ensure stability on the head. The chin strap will be attached to the helmet shell. The development of a lightweight infantry helmet is still in the materials research phase. In addition to continuing to explore the possibilities of non-metallic materials and composites, the U.K. is looking at steel, particularly special alloy steels, steel laminates, and surface steels. The trials on the parachutist's helmet will afford the Infantry the opportunity

of deciding on the acceptability of the new shape and whether or not the proposed new liner and fitting system are satisfactory. The level of ballistic protection required still remains to be answered. This decision will in turn determine whether or not any immediately available material can be used for the shell or whether further research is required. Policy on this requirement will be determined in the near future by a new committee under the Chairmanship of the Deputy Quartermaster General. At this time, it appears that a separate helmet will be developed for armored vehicle crewmen. This helmet will have bump protection as its first priority with ballistic protection being of secondary importance. This requirement will not be classified under a Quartermaster Materiel Requirement until trials are completed with a U.K. commercially developed helmet which has already been sold as an armored vehicle crewmen's helmet to Sweden. The U.K. development will be based on the results of the evaluation of this commercial helmet.

D. United States of America

A capability is required to provide the combat soldier with protection against hazards of prevailing climatic conditions, toxic chemical agents, biological agents and vectors, radiant thermal energy from nuclear and incendiary munitions and radioactive fallout or contamination, while concurrently protecting the individual against fragmentation munitions, small arms fire and antipersonnel mines.

With the present day mobile army, the changes in tactical warfare, and advances in fragmentation munitions, it has become evident that the M-1 Steel Helmet is too heavy, unstable, and restrictive. The U.S. Army, therefore, conducted feasibility studies to determine what material or combination of materials could be utilized to develop a lighter weight helmet with equivalent protection to that provided by the M-1.

The results of these studies showed that to achieve equivalent protection and lighter weight, the helmet would have to be made of a new material or the head coverage changed drastically. This resulted in a newer and radical conceptual design change which reduced the silhouette, increased head coverage and provided improved hearing and compatibility with field equipment. After several prototype fabrications and subsequent testing and evaluations, it became evident that more data were needed not only anthropometrically, but basic information was lacking in other areas.

As a consequence, the U.S. Army Materiel Command has developed a five year exploratory development program to conduct research and exploratory studies to obtain fundamental scientific and technical data required for the optimum development of protective headgear.

These laboratories, through these investigations, will attempt to obtain sound data which will reflect basic design criteria and which will relate such factors as anthropometric considerations, weight, sizing, materials, helmet configurations, manufacturing capabilities, sound and vision factors, area coverage and casualty reduction to the functional performance of headgear. The major Sub-Tasks in the program are as follows:

Sub-Task 1 - Development of Mathematical Head Model
Sub-Task 2 - Liaison with Foreign Science and Technology Center, Industry, Military Departments
Sub-Task 3 - Documentation of M-1 Helmet
Sub-Task 4 - Helmet Offset and Suspension Systems
Sub-Task 5 - Casualty Studies and Area Coverage
Sub-Task 6 - Materials System Evaluation
Sub-Task 7 - Helmet Construction and Processing Techniques
Sub-Task 8 - Helmet Configuration - Human Factors
8a - Physiological Studies
Sub-Task 9 - Measurements of Helmet Forms - Hearing and Vision
Sub-Task 10 - Mathematical Model of Face and Neck
Sub-Task 11 - Physical Testing of Experimental Helmet

While work is progressing on the development of a new infantry helmet, improved suspension systems for the M-1 Helmet are under test. An engineering design test (EDT) conducted in September 1971 recommended a Product Improvement Test of a modified airborne chin strap for the M-1 infantry helmet (see Figure 7-a). A subsequent In-Process Review (IPR) recommended a service test (ST) of two suspension systems, namely: (1) The modified standard A M-1 suspension that has foam leather pads added to the crown and nape straps and has a foam padded headband (see Figure 7-b), and (2) The modified Welson-Davis Suspension that consists of two halves of 4.5 ounce cattle leather which are fastened together at the forehead, at the nape and two straps over the head by means of velcro taps. An injection molded plastic mounting bracket is attached to the suspension system for mounting on the studs of the nylon liner (see Figure 7-c).

The tests are scheduled to begin 1st Quarter FY 73 and will be completed 2nd Quarter FY 73. An IPR will be held in December 1972 at which time the selected chin strap and suspension system will be approved for type classification.

CVC Helmet

A New Military Need (MN) has been established for a CVC Helmet. The MN emphasizes bump protection and relegates ballistic protection to a secondary requirement. Two approaches have been taken to produce a new CVC Helmet. (1) In-House work is underway to produce a close

fitting, padded, hard-faced plastic helmet. This helmet is in three sections which may be adjusted in relation to each other to obtain a proper fit (similar to a hockey helmet). Communication headsets fit over the helmet and are removable. Ballistic protection could be either incorporated into the material of the close fit helmet or by designing a ballistic shell to fit over the helmet. (2) Claims are made for a commercial proprietary item that it meets the requirements of the MN. A limited quantity are being procured for evaluation. The evaluation should be completed by 3rd Quarter FY 73.

Figure VII - 1a
U. S. A.
Modified M-1 Chin Strap

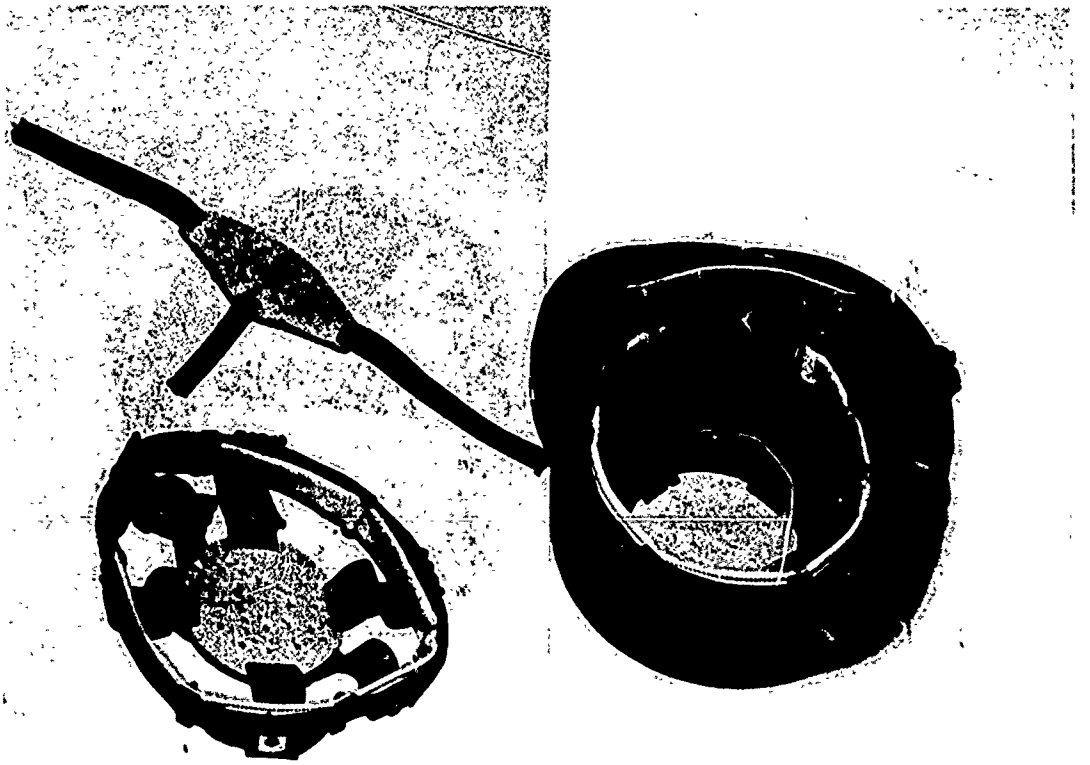

Figure VII - 1b
U. S. A.
Modified Standard "A" Suspension

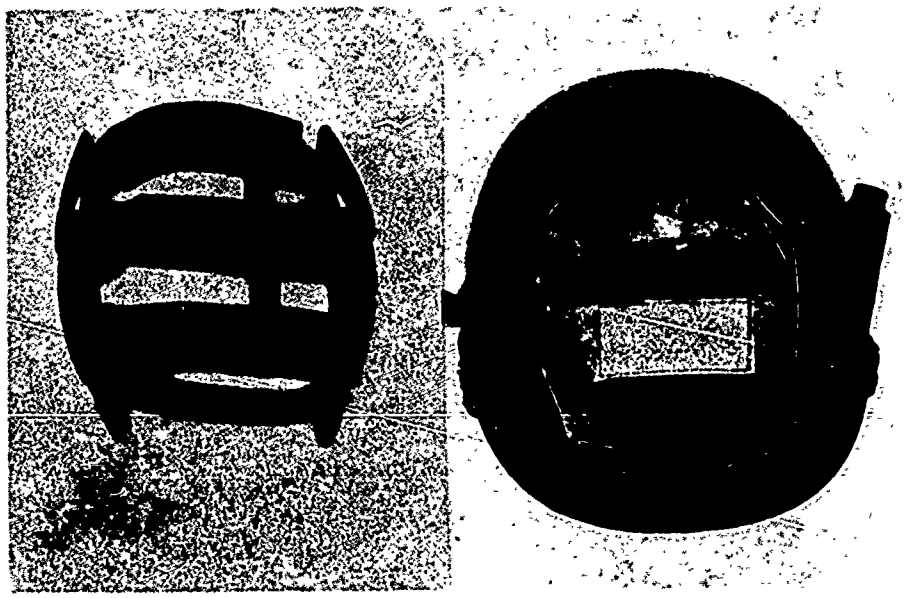

Figure VII - 1c
U. S. A.
Welson-Davis Suspension

SECTION VIII

PAST AND PRESENT

HELMETS OF OTHER COUNTRIES

CZECHOSLAVAKIA

INFANTRY HELMET

The helmet is made of steel and has three padded leather sections riveted to the steel shell as a suspension system (See Figure VIII - 1a, b, c). The three sections are drawn together at the apex by a draw string for height adjustability. The helmet has a 12.5mm chin strap riveted to the steel shell; the closure is a prong type buckle. The helmet weighs 1450 g.

Figure VIII - 1a
Czechoslavakia
Infantry Helmet (Front)

Figure VIII - 1
Czechoslovakia
Infantry Helmet (Side)

Figure VIII - 1c
Czechoslovakia
Infantry Helmet (Inside)

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GERMANY

Figure VIII - 2a, b, c, shows the Luftwaffe World War II Steel Helmet. The suspension system consists of a rigid steel ring 34mm wide attached to the steel helmet in three places by metal spread fasteners. To this ring a non-adjustable spring steel headband is attached by means of spring steel tabs that slide through brackets in the rigid ring. The headband is covered with leather which extends to form the head cover. The head cover is adjusted for height by a draw string at the apex. A 12.5mm chin strap is attached to "D" rings which are riveted to the rigid steel ring. The closure on the chin strap is a simple prong buckle type. The weight of the helmet in Figure VIII - 2a, b, c is 1280 g.

Figure VIII - 2a
Germany
World War II (Front)

Figure VIII - 2b
Germany
World War II (Side)

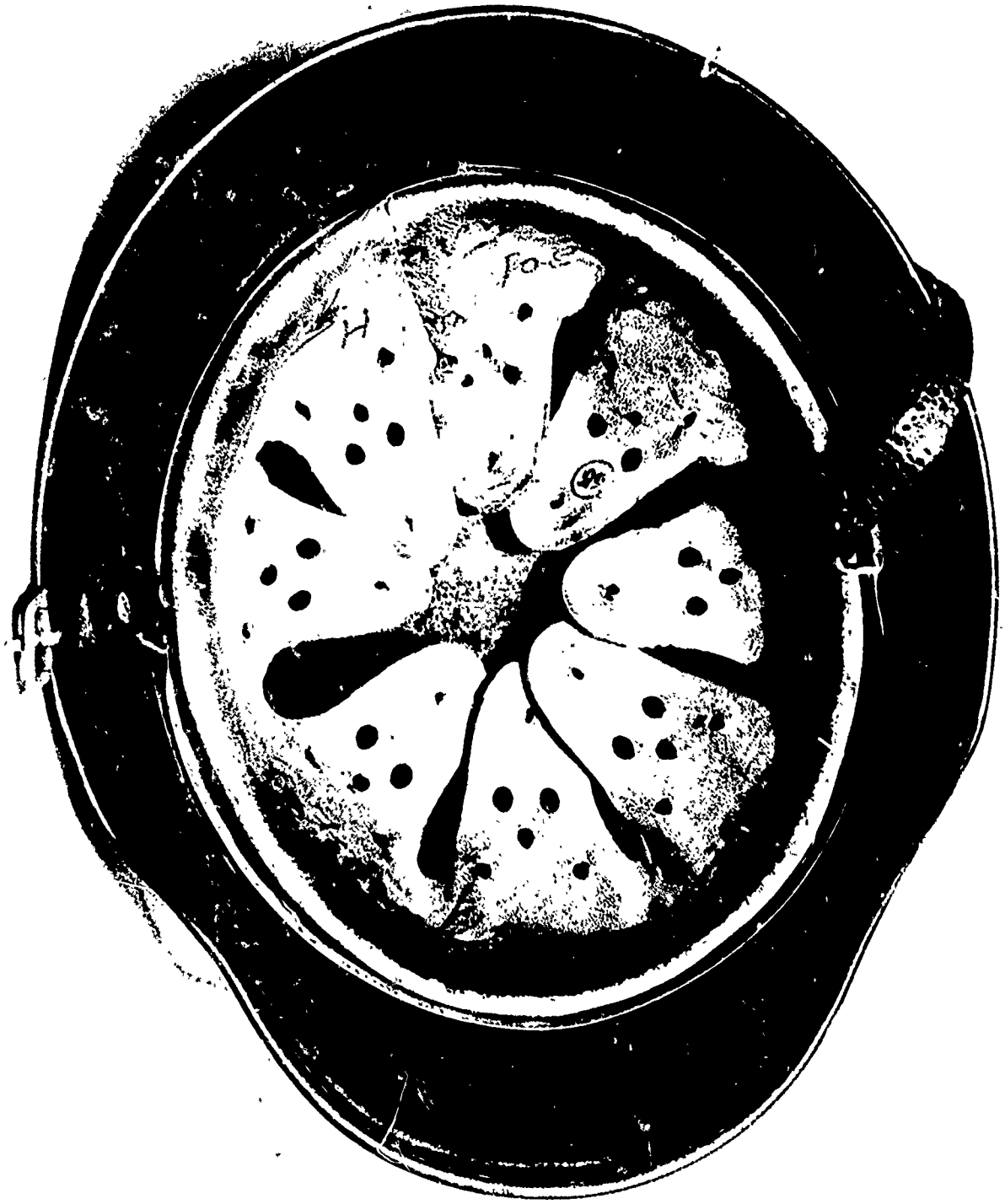

Figure VIII - 2c
Germany
World War II (Inside)

JAPAN

INFANTRY HELMETS

Figure VIII 3a, b, c show the Japanese helmet system that consists of a steel shell and plastic liner. The steel shell weighs 920 g and the plastic liner with suspension system weighs 355 gms for a total weight of 1275 g. The suspension system is a six point cradle type with an adjustable leather headband and draw string at the apex for height adjustability. A 12.5 mm wide leather chin strap is attached to the plastic liner. Adjustment of the chin strap is accomplished through use of a sliding pressure clip buckle. A chin strap consisting of cotton webbing that simply ties under the chin is attached to the steel shell.

The World War II Japanese helmet is shown in Figure VIII 3d. The helmet is steel and possesses a leather headband and leather head cover suspension system. Head height adjustability is accomplished through the draw string at the apex.

Figure VIII - 3a
Japan
Infantry Helmet (Front)

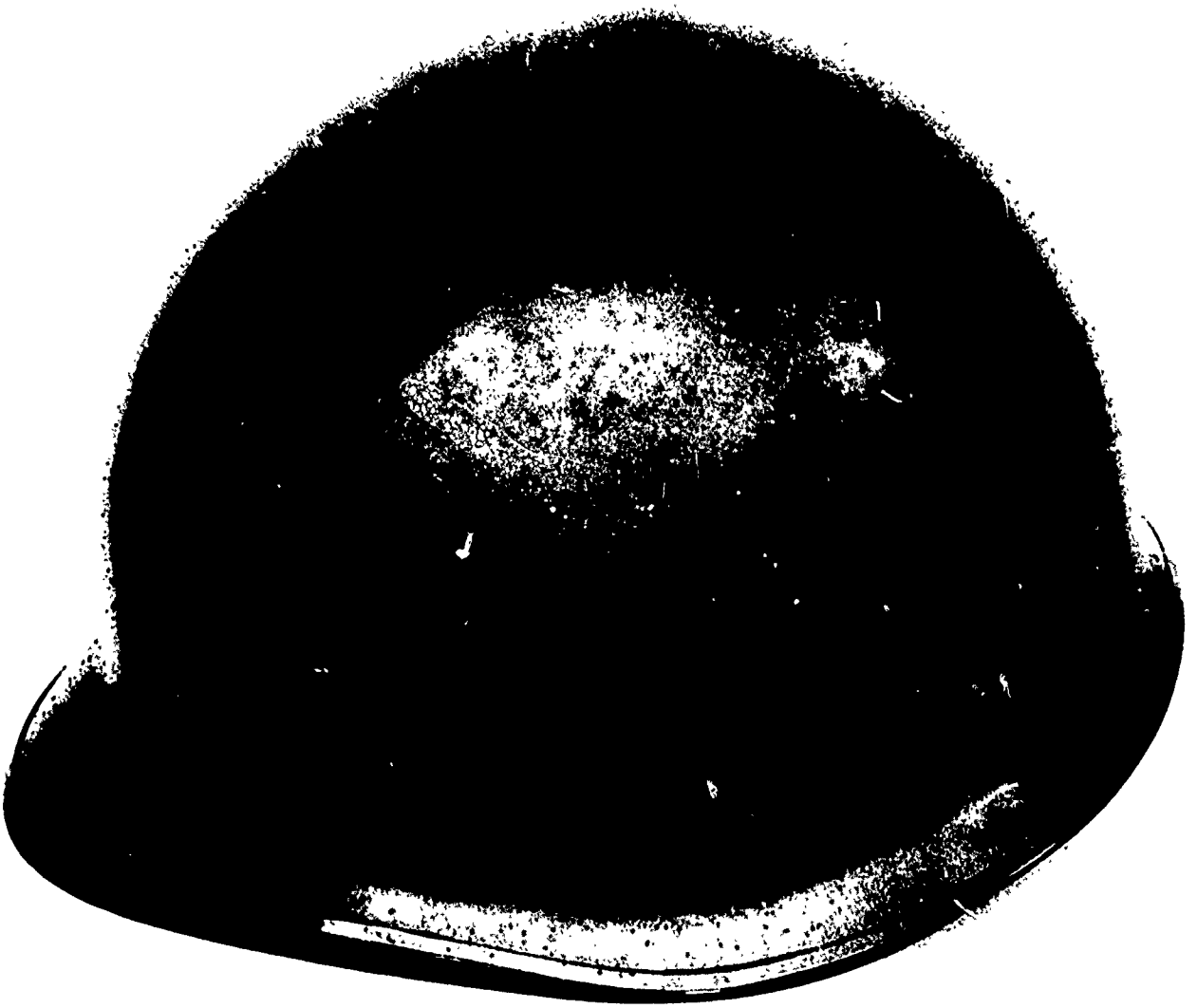

Figure VIII - 3b
Japan
Infantry Helmet (Side)

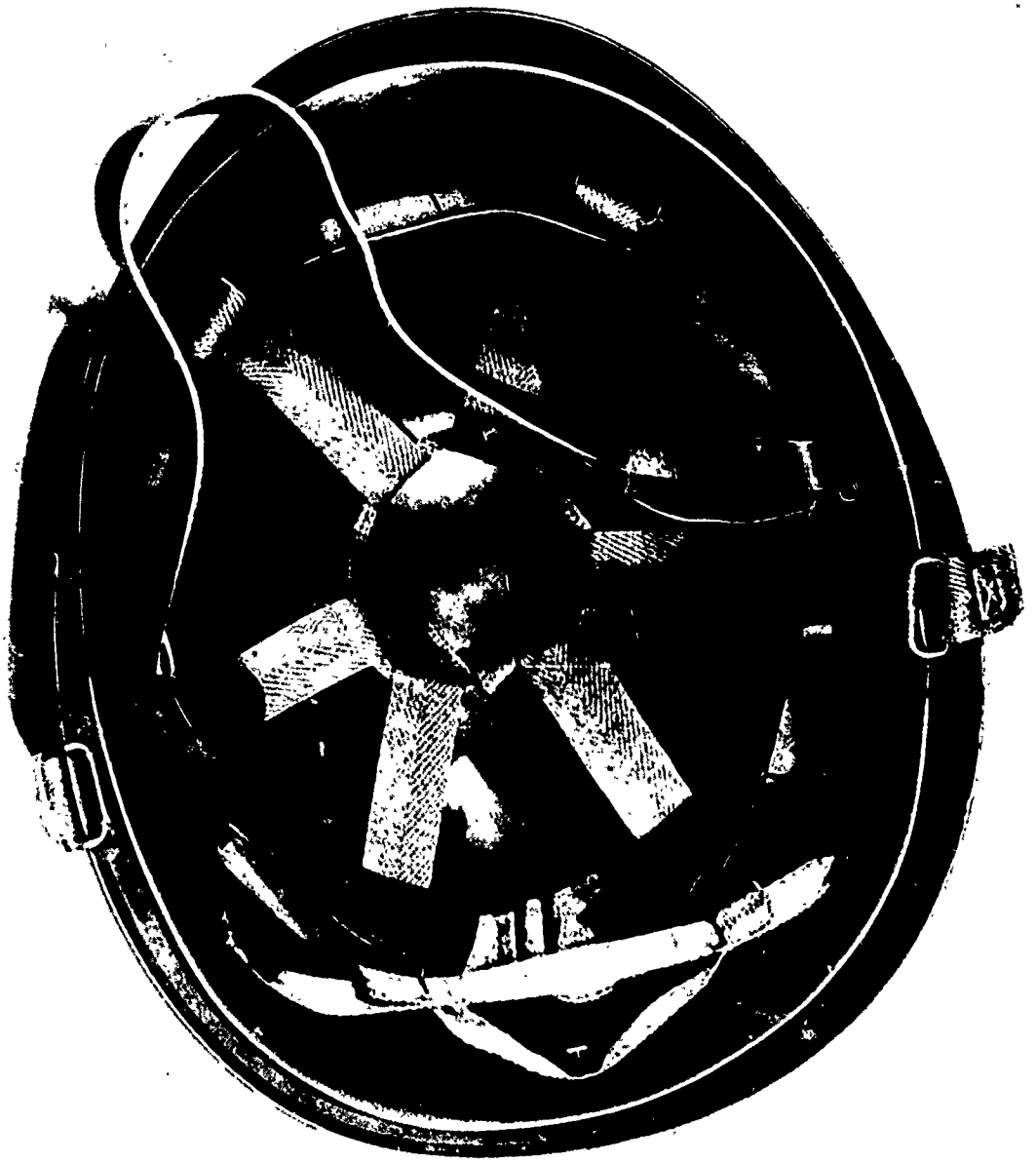

Figure VIII - 3c
Japan
Infantry Helmet (Inside)

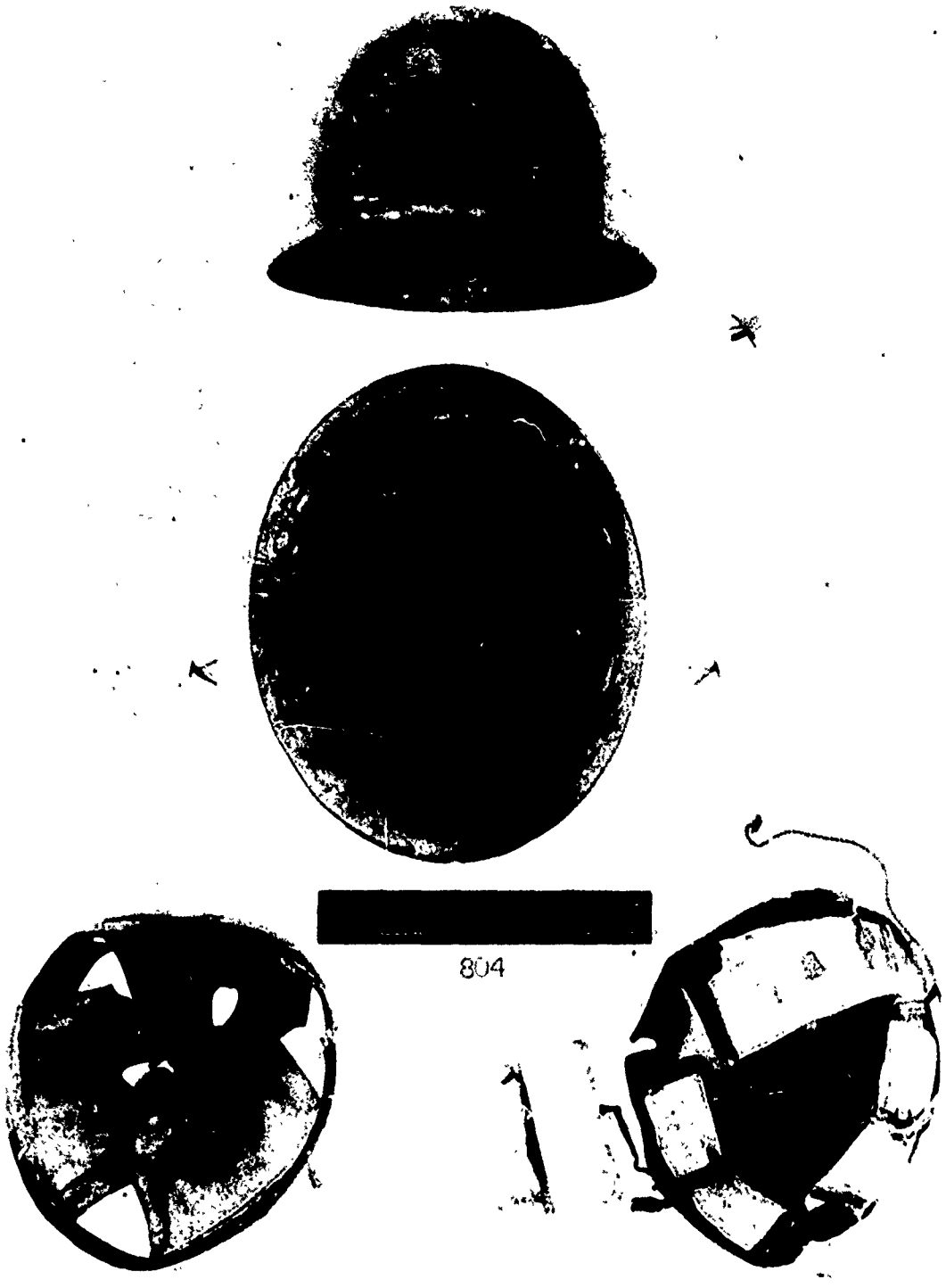

Figure VIII - 3d
Japan
Infantry Helmet, WW II

NETHERLANDS

The Netherlands pre-World War II Helmet is shown in Figure VIII 4a, b, c. The helmet is of steel and weighs 1100 g. The suspension system consists of a leather headband riveted to the helmet in seven places. A three sectional padded leather head cover is sewn to the headband. A draw string at the apex provides head height adjustability. At the back of the helmet the leather extends to cover the nape. An adjustable strap is provided on this nape cover. A 15.5mm wide chin strap is attached to the helmet by riveting of "D" rings. The closure of the chin strap is provided by a sliding, saw-toothed buckle.

Figure VIII - 4a
Netherlands
Pre-WW II (Front)

Figure VIII - 4b
Netherlands
Pre-WW II (Side)
101

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Figure VIII - 4c
Netherlands
Pre-WW II (Inside)

RUSSIA

The World War II infantry helmet with steel shell and no liner (see Figure VIII-5a, b, c) has a leather band riveted to the steel shell. The leather head cover is sewn to the leather headband and is adjustable for height by a draw string at the apex. A 12.5mm wide chin strap is riveted to the steel shell. The chin strap closure is a simple prong type buckle. A 9 mm diameter hole exists in the crown of the helmet which is covered on the top side with a 100 mm X 38 mm X 12.5 mm cupola. The helmet weighs 1065 g.

Figure VIII-5d, e, f shows a Russian steel shell with a spring steel type headband. The headband is covered with leather which extends to form the head cover. A draw string is provided at the apex for head adjustability. Four spring metal tabs attached to the headband serve for spacing the headband from the shell and also as points of fastening to the steel shell. The helmet weighs 1020 g. The chin strap is attached to the spring steel headband and has a simple prong type buckle as a closure.

POLAND

The Polish helmet is of Russian design and weighs 1475 g.

Figure VIII - 5a
Russia
WW II (Front)

Figure VIII - 5b
Russia
WW II (Side)

Figure VIII - 5c
Russia
WW II (Inside)

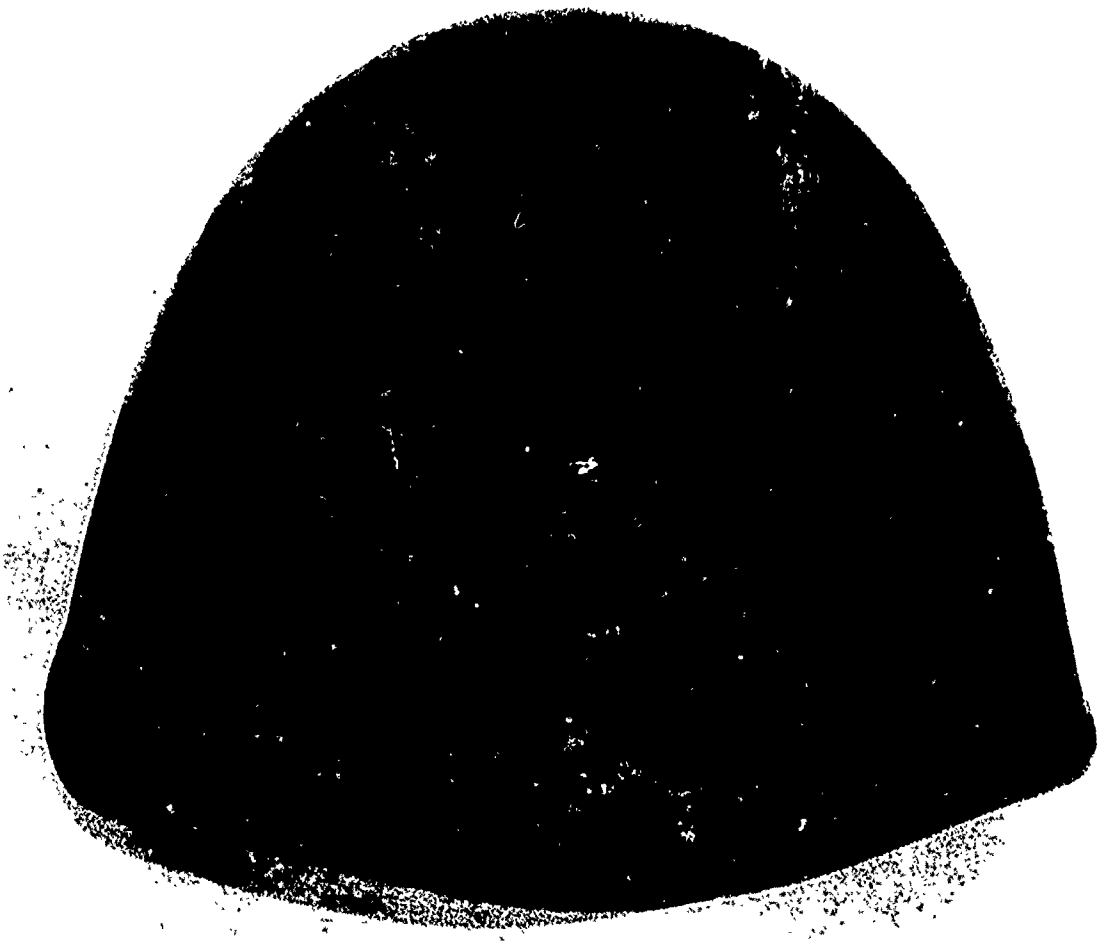

Figure VIII - 5d
Russia
Post WW II (Front)

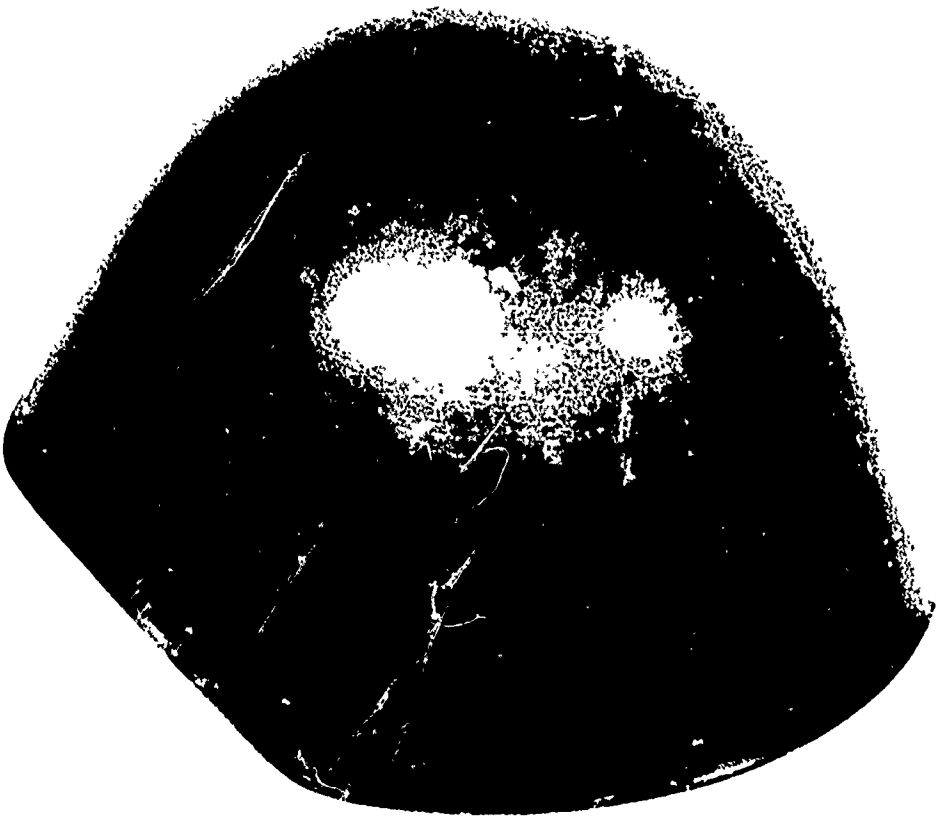

Figure VIII - 5e
Russia
Post WW II (Side)

Figure VIII - 5f
Russia
Post WW II (Inside)

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