

UNCLASSIFIED

AD NUMBER
AD471052
NEW LIMITATION CHANGE
TO Approved for public release, distribution unlimited
FROM Distribution authorized to U.S. Gov't. agencies and their contractors; Administrative/Operational Use; 28 SEP 1965. Other requests shall be referred to US Army Medical Biomechanical Research Laboratory, Walter Reed Army Medical Center, Washington, DC 20012.
AUTHORITY
WRAC, d/a ltr, 28 Aug 1969

THIS PAGE IS UNCLASSIFIED

# **SECURITY**

---

# **MARKING**

**The classified or limited status of this report applies to each page, unless otherwise marked.**

**Separate page printouts MUST be marked accordingly.**

---

**THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18, U.S.C., SECTIONS 793 AND 794. THE TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.**

**NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.**

AD

ANNUAL PROGRESS REPORT  
1 July 1964-30 June 1965

421052

CATALOGED BY: DDC  
AS AD NO.

Reported by: Colonel Peter M. Margetis, DC, Director  
Fred Leonard, PhD, Scientific Director

28 September 1965

DDC  
RECEIVED  
OCT 8 1965  
DDC-IRA E

U. S. ARMY MEDICAL BIOMECHANICAL RESEARCH LABORATORY  
WALTER REED ARMY MEDICAL CENTER  
Washington, D. C. 20012

Qualified requesters may obtain copies  
of this report from DDC.

Destroy this report when it is no longer  
needed. DO NOT RETURN TO ORIGINATOR.

The findings in this report are not to be  
construed as an official Department of the  
Army position, unless so designated by  
other authorized documents.

**ANNUAL PROGRESS REPORT**  
**Fiscal Year 1965**

**Fiscal Year 1965 Projects:**

**3A014501A71E 03 (090-096)**

**3A014501B71P 03 037**

**3A013001A91C 01 (010-012)**

**Reported by: Colonel Peter M. Margetis, DC, Director**  
**Fred Leonard, PhD, Scientific Director**

**28 September 1965**

**U. S. ARMY MEDICAL BIOMECHANICAL RESEARCH LABORATORY**  
**WALTER REED ARMY MEDICAL CENTER**  
**Washington, D. C. 20012**

## SUMMARY

The research program of the U. S. Army Medical Biomechanical Research Laboratory is devoted to the development of internal and external body biomechanical devices and to special AMEDS projects as assigned.

The various research projects described in this report are directed toward the implementation of this program.

## FOREWORD

During FY 1965 the Laboratory continued to carry out research toward the development of internal and external body biomechanical materials and devices.

The year was marked by several major accomplishments. These were:

1. The development of more biologically receptive tissue adhesives and hemostasis inducing compounds.
2. The synthesis of L(+) polylactic acid, a biodegradable polymer, and the casting and extruding of films and fibers therefrom.
3. The design and fabrication of electrically powered arm components including a proportional control prehension device suitable for use in hybrid electrical and body powered prostheses as well as in all-electrical systems.
4. The development of a mechanical hand incorporating a soft feel and outstanding cosmesis.
5. The design, development, and procurement of 200 all-plastic optical inserts for the NBC protective mask.
6. The development of a foam-in-place splint and packaging system.

During the year a pathologist and an electronics engineer were added to the Laboratory's staff. With these additions the Laboratory now has the chemical, mechanical, and electronic medical evaluation capability suitable for coping with a variety of biomedical engineering problems.

In conducting the research described in this report the investigators adhered to the "Principles of Laboratory Animal Care" as established by the National Society for Medical Research.

TABLE OF CONTENTS

	<u>Page no.</u>
Externally Powered Devices	2
Externally Powered Prostheses	3
Electric Elbow Unlock	
Externally Powered Prosthesis	
Optical Inserts for Protective Masks	5
Foam in Place Splints	6
Foam splint	
Mandibular Foam Splint	
Cosmetic Prosthetics	8
Facial Prostheses	
Materials for Cosmetic Gloves	
External Prosthetic Devices	10
Foam Foot	
Graded Prehension Hook	
Lower Extremity Plastic Bracing	
Porous Below-Knee Socket with Soft Distal End	
Step-up Elbow Hinge with Lock	
Transmission System	
Size IV Active Resilient Hand	
Mechanical Hands	
Voluntary Opening Hook with Finger Flexion	
Stress Distributing Foot Support	
Hand Splint Materials	
Proximal Interphalangeal Assist Finger Splint	
Soft Foamed Hand Splint	
Pronation-Supination Sandblock	
Graded Resistance Exercise Unit	
Burn Bed	
Stretcher Modification	
Military Identification Tag Cover	
Miscellaneous AMedS Projects	
Biomechanical Devices	22
Internal Prostheses	

3A014501A71E 03

Combat Surgery

RESEARCH AND TECHNOLOGY RESUME				1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
4. DATE OF RESUME	5. KIND OF RESUME	6. SECURITY	7. REGRADING		DA QA 6052	CSCRD 103	
10 09 65	C. Terminated 07 65	U RPT U WAK	NA		NL	A. Work Unit	
10a. CURRENT NUMBER/CODE				10b. PRIOR NUMBER/CODE			
62156011 3A025601A821 01 090				61145011 3A014501A71E 03 090			
11. TITLE:							
(U) Externally Powered Devices (09)							
12. SCIENTIFIC OR TECH. AREA				13. START DATE	14. CRIT. COMPL. DATE	15. FUNDING AGENCY	
002400 Bioengineering				07 64	07 65	Other DA	
16. PROCURE. METHOD		17. CONTRACT/GRANT		18. RESOURCES EST.		19. FUNDS (In thousands)	
D. Other Gov.		a. NUMBER NA		PRIOR FY 65		10	
		c. TYPE		CURRENT FY 66		0	
19. GOV'T LAB/INSTALLATION/ACTIVITY		20. PERFORMING ORGANIZATION					
NAME Headquarters		NAME Harry Diamond Labs.					
ADDRESS USAMRDC		ADDRESS Nat'l. Bureau of Standards					
Washington, D. C. 20315		Washington, D. C.					
RESP. INDIV. Kovaric, J. J. Lt Col		INVESTIGATORS K. Woodward, ME					
TEL. 202 OX 66082		PRINCIPAL ASSOCIATE					
		TEL 202 244-7700		TYPE: DA			
21. TECHNOLOGY UTILIZATION				22. COORDINATION			
Orthotics, Prosthetics				CPRD; HEW; VA			
23. KEYWORDS							
Amplification; Amputees; External Power; Fluid Amplifier; Orthotics, Prosthetics							
24.							
(U) Technical Objective: To conduct a pilot study on the feasibility of the application of fluid amplifiers to the operation of prosthetic and orthotic devices for the severely handicapped.							
25 (U) Approach: A detailed literature survey and site visits to laboratories concerned with the application of external power to prosthetic devices were made and the problems discussed. Laboratory models were fabricated and studied.							
26 (U) Progress: During the course of research, the application of fluid amplifiers as a control source for the operation of prosthetic and orthotic devices was considered to be unfeasible. After discussion it was decided to devote the balance of the contract period to the development of electric and pneumatic elbow locks. Bread-board models were built and preliminarily evaluated. A final report summarizing the work was prepared.							
27. COMMUNICATIONS SECURITY		28.		29. OSD CODE		30. BUDGET CODE	
<input type="checkbox"/> a. CONSEC OR CONSEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED				DT		1	
31. MISSION OBJECTIVE				32. PARTICIPATION			
NA				NA			
33. REQUESTING AGENCY				34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands)				36.			
CFY+1							

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 & 613C WHICH ARE OBSOLETE.

<b>RESEARCH AND TECHNOLOGY RESUME</b>		1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
				DA OA6053	CSCRD-103
4. DATE OF RESUME	5. KIND OF RESUME	6. SECURITY	7. REGRADING	8. RELEASE LIMITATION	9. LEVEL OF RESUME
01 07 65	D. Change	<input checked="" type="checkbox"/> <b>CONF</b> <input checked="" type="checkbox"/> <b>SECRET</b>	N/A	NL	A. Work Unit
10a. CURRENT NUMBER/CODE			10b. PRIOR NUMBER/CODE		
62156011-3A025601A821-01-091			61145011 3A014501A71E 03 091		
11. TITLE:					
(U) Externally Powered Prostheses (09)					
12. SCIENTIFIC OR TECH. AREA			13. START DATE	14. CRIT. COMPL. DATE	15. FUNDING AGENCY
002400 Bioengineering			01 64	N/A	Other   DA
16. PROCURE. METHOD	17. CONTRACT/GRANT		18. RESOURCES EST.		19. FUNDS (In thousands)
C. In House	a. NUMBER N/A		PROFESSIONAL MAN-YEARS		28
	c. TYPE		CURRENT FY 66		
19. GOV'T LAB/INSTALLATION/ACTIVITY			20. PERFORMING ORGANIZATION		
NAME Headquarters			NAME USAMRII		
ADDRESS: USAMRII Washington, D. C. 20315			ADDRESS Walter Reed Army Medical Center Washington, D. C. 20012		
RESP. INDIV. Kovacic, J. J., Lt Col			INVESTIGATORS		
TEL: 202-OK 66082			PRINCIPAL Leonard, F. PhD		
			ASSOCIATE V. T. Riblett - Roy I. Katsuren		
			TEL 202-576-5153		
			TYPE: DA		
21. TECHNOLOGY UTILIZATION			22. COORDINATION		
Prosthetics			CPRD, VA, NPRL, HEW		
23. KEYWORDS Force Transducers; Electromyography; External Control; Prosthetics, External Power; Prostheses, Electrically Powered					
24. (U) Technical Objective: To develop electrically powered prostheses and methods for their control.					
25. (U) Approach: The approach will consist of designing and developing electrically powered prosthetic components which will be incorporated into mechanically controlled prostheses to make hybrid arms. The functional regain then will be determined. A study of the possibility of electromyographic signal control or pressure transducer control will be made.					
26. (U) Progress: The laboratory has developed an electric elbow unlocking device and a powered forearm lift. Instruments are being obtained for studying and analyzing the amplitude and frequency of the electromyographic signal and several unique switches have been designed.					
27. COMMUNICATIONS SECURITY		28.	29. OSD CODE		30. BUDGET CODE
<input type="checkbox"/> a. COMSEC OR COMSEC RELATED <input type="checkbox"/> b. NOT RELATED			DT		1
31. MISSION OBJECTIVE			32. PARTICIPATION		
CDOG 1412 a			NA		
33. REQUESTING AGENCY			34. SPECIAL EQUIPMENT		
35. EST. FUNDS (In thousands)			36.		
CFY+1					

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

**TITLE:** Electric Elbow Unlock

**INVESTIGATORS:** Victor T. Riblett  
Roy I. Katsuren, SP4

**DESCRIPTION:** An electrically operated solenoid type elbow lock, requiring minimal forces and excursion, is under development.

**PROGRESS:** Several models have been prepared. Engineering drawings and specifications have been compiled and three production prototypes ordered. These units will be evaluated on amputees. Two units have been fitted to female forequarter amputees.

**SUMMARY:** This unit provides the severely handicapped amputee having minimal force and excursion with the elbow locking function. The velocity-lock mechanism obviates the need for simultaneous control of two functions during the locking phase.

**PUBLICATIONS:** Dwg. T-666

**TITLE:** Externally Powered Prosthesis

**INVESTIGATORS:** Victor T. Riblett  
Roy I. Katsuren, SP4  
Lloyd L. Salisbury, Jr.

**DESCRIPTION:** The purpose of this project is to develop an externally powered artificial arm, with proportional-controlled terminal device.

**PROGRESS:** An electrically operated arm has been designed and built. Final drawings and specifications are being prepared for procuring several prototype models. A breakthrough in the development of a proportional-control, electrically powered terminal device system has been achieved and a breadboard model which demonstrates the feasibility of the system has been prepared. See Project 3A013001A91C 01, Biomedical Electronics.

**SUMMARY:** An electric arm and a proportional-controlled electrically powered, terminal device system have been developed. These items will be evaluated for use by severely handicapped amputees.

**PUBLICATIONS:** Dwg T-679

RESEARCH AND TECHNOLOGY RESUME		1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
4. DATE OF RESUME 01-07-65		5. KIND OF RESUME D. Change		6. SECURITY U RPT	7. REGRADING NA
8. RELEASE LIMITATION NL		9. LEVEL OF RESUME A. Work Unit		3. AGENCY ACCESSION DA 0A6054	
10a. CURRENT NUMBER/CODE 62156011 3A025601A821 01 092			10b. PRIOR NUMBER/CODE 61145011 3A014501A71E 03 092		
11. TITLE (U) Optical Inserts for Protective Masks (09)					
12. SCIENTIFIC OR TECH. AREA 013300 Protective Equipment			13. START DATE 06 59	14. CRIT. COMPL. DATE NA	15. FUNDING AGENCY OTHER DA
16. PROCURE. METHOD C. In-House	17. CONTRACT/GRANT a. DATE b. NUMBER c. TYPE NA d. AMOUNT		18. RESOURCES EST. PRIOR FY CURRENT FY	19. PROFESSIONAL MAN-YEARS 65 66	20. FUNDS (In thousands) 10 10
19. GOV'T LAB/INSTALLATION/ACTIVITY NAME ADDRESS RESP. INDIV. TEL:			20. PERFORMING ORGANIZATION NAME ADDRESS INVESTIGATORS PRINCIPAL ASSOCIATE TEL TYPE		
21. TECHNOLOGY UTILIZATION Optical Inserts for NBC Masks			22. COORDINATION Army Materiel Command		
23. KEYWORDS Optical Materials; Optical Insert, Military Protective; Masks, Protective; Polyallomer					
24. (U) Technical Objective: To design and develop inexpensive lightweight optical inserts for NBC Masks.					
25. (U) Approach: To design and fabricate plastic inserts to make lightweight functional inserts for NBC Masks.					
26. (U) Progress: Type I has been type classified and the project is completed. Type 2R1 has been replaced by the polyallomer insert (Type 3R1 short temporal struts). Type 3R1 - Short Temporal Struts is currently being evaluated at USAMRDC. Results of the evaluation will indicate further research or type classification for use in the M14 Tanker's NBC Mask and M25 Helicopter Pilot's NBC Mask.					
27. COMMUNICATIONS SECURITY <input type="checkbox"/> CONSEC OR CONSEC RELATED <input checked="" type="checkbox"/> NOT RELATED		28.	29. OSD CODE AR	30. BUDGET CODE 1	
31. MISSION OBJECTIVE CDOG 1412 a			32. PARTICIPATION		
33. REQUESTING AGENCY		34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands) CFY+1		36.			

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 & 613C WHICH ARE OBSOLETE.

<b>RESEARCH AND TECHNOLOGY RESUME</b>		1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
				DA OA6055	CSCRD 103
4. DATE OF RESUME	5. KIND OF RESUME	6. SECURITY	7. REGRADING	8. RELEASE LIMITATION	9. LEVEL OF RESUME
12 07 65	C. Terminated 06 65	U RPT U WRK	NA	NL	A. Work Unit
10a. CURRENT NUMBER/CODE			10b. PRIOR NUMBER/CODE		
62156011 3A025601A821 01 093			61145011 3A014501A71E 03 093		
11. TITLE.					
(U) Foam-in-Place Splints (09)					
12. SCIENTIFIC OR TECH. AREA			13. START DATE	14. CRIT. COMPL. DATE	15. FUNDING AGENCY
002400 Bioengineering			06 63	NA	Other   DA
16. PROCURE. METHOD	17. CONTRACT/GRANT		18. RESOURCES EST.		19. FUNDS (In thousands)
C. In-House	a. NUMBER NA c. TYPE d. AMOUNT		a. PROFESSIONAL MAN-YEARS		15
			b. PRIOR FY 65		
19. GOV'T LAB/INSTALLATION/ACTIVITY			20. PERFORMING ORGANIZATION		
NAME Headquarters ADDRESS USAMRDC Washington, D. C. 20315  RESP. INDIV Kovaric, J. J., Lt Col TEL 202 OX 66082			NAME USAMBRL ADDRESS Walter Reed Army Medical Center Washington, D. C. 20012  INVESTIGATORS F. Leonard, PhD PRINCIPAL J. T. Hill - Donald R. Ingenito ASSOCIATE TEL 202 576-5153 TYPE: DA		
21. TECHNOLOG. UTILIZATION			22. COORDINATION		
Emergency Splinting			Medical Materiel Div., USAMRDC, OTSG		
23. KEYWORDS					
Polyurethane foams; Mylar Bags; Velcro Tape					
24. (U) Technical Objective: To develop a foam-in-place splint for immobilization of fractures in the field.					
25. (U) Approach: To evaluate polyurethane foaming resins and to develop a packaging system for use in a foam-in-place splint.					
26. (U) Progress: A polyurethane foam-in-place splint package has been developed for immobilizing fractured limbs. The splint may be molded to the contours of the extremity and permits immobilization around joints. Engineering design is being frozen at this stage pending medical evaluation on patients.					
27. COMMUNICATIONS SECURITY		28.	29. OSD CODE		30. BUDGET CODE
<input type="checkbox"/> a. COMSEC OR CONSEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED			DT		1
31. MISSION OBJECTIVE			32. PARTICIPATION		
CDOG 1412 a			NA		
33. REQUESTING AGENCY		34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands)		36.			

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 & 613C WHICH ARE OBSOLETE.

**TITLE:** Foam Splint

**INVESTIGATORS:** F. Leonard, PhD  
J. T. Hill  
D. R. Ingenito

**DESCRIPTION:** A lightweight, low bulk splint kit has been developed which could be used under combat conditions by the field soldier to make a strong immobilization splint.

**PROGRESS:** Foam-in-place arm and leg splints have been prepared and arrangements made for demonstration of the splints before qualified medical personnel for opinions on medical feasibility.

**SUMMARY:** The engineering feasibility of a foamable splint for field use has been demonstrated. Medical evaluation is necessary before further engineering design is undertaken.

**TITLE:** Mandibular Foam Splint

**INVESTIGATORS:** Colonel P. M. Margetis, DC  
J. T. Hill  
D. R. Ingenito

**DESCRIPTION:** A lightweight, small bulk, easily removable splint for the immobilization of fractured mandibles was designed and fabricated.

**PROGRESS:** This item is undergoing testing.

**SUMMARY:** A polyurethane foam-in-place mandibular splint has been developed.

RESEARCH AND TECHNOLOGY RESUME				1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL	
4. DATE OF RESUME		5. KIND OF RESUME		6. SECURITY		7. REGRADING	8. RELEASE LIMITATION	9. LEVEL OF RESUME
01 07 65		D. Change		U U RPT WRK		NA	NL	A. Work Unit
10a. CURRENT NUMBER/CODE				10b. PRIOR NUMBER/CODE				
62156011- 3A025601A821 01 094				61145011 3A014501A71E 03 094				
11. TITLE								
(U) Cosmetic Prosthetics (09)								
12. SCIENTIFIC OR TECH. AREA				13. START DATE		14. CRIT. COMPL. DATE	15. FUNDING AGENCY	
002400 Bioengineering				01 48		NA	Other DA	
16. PROCURE. METHOD		17. CONTRACT/GRANT		18. RESOURCES EST.		19. PROFESSIONAL MAN-YEARS	20. FUNDS (In thousands)	
C. In-House		a. NUMBER MA c. TYPE		PRIOR FY 65		2	19	
		d. AMOUNT		CURRENT FY 66		2	21	
19. GOV'T LAB/INSTALLATION/ACTIVITY				20. PERFORMING ORGANIZATION				
NAME Headquarters ADDRESS USAMRDC Washington, D. C. 20315				NAME USAMBRL ADDRESS Walter Reed Army Medical Center Washington, D. C. 20012				
RESP. INDIV. Kovaric, J. J., Lt Col TEL 202 OX 66082				INVESTIGATORS PRINCIPAL Carl A. Nielson ASSOCIATE John J. Urban TEL 202 576-5154 TYPE DA				
21. TECHNOLOGY UTILIZATION				22. COORDINATION				
Maxillofacial Prosthetics				VA, HEW				
23. KEYWORDS Prosthetics, Facial; Maxillofacial; Stain & Dye Resistant Elastomers, Adhesives, Facial; Translucent Elastomers								
24. (U) Technical Objective - To develop materials and techniques and to fabricate maxillofacial prostheses for patients who have lost a portion of the face as a result of trauma or disease.								
25. (U) Approach: The major difficulties to be overcome in the fabrication and wear of facial prostheses may be attributable to deficiencies in available materials. The synthesis of durable elastomers resistant to staining and weathering has been achieved. Techniques for molding these materials have been developed.								
26. (U) Progress: One of continuing investigation. Material has been synthesized and is being evaluated clinically with very encouraging results.								
27. COMMUNICATIONS SECURITY		28.		29. OSD CODE		30. BUDGET CODE		
<input type="checkbox"/> a. CONSEC OR CONSEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED				AR		1		
31. MISSION OBJECTIVE				32. PARTICIPATION				
CDOG 1412 a				NA				
33. REQUESTING AGENCY				34. SPECIAL EQUIPMENT				
35. EST. FUNDS (In thousands)				36.				
CFY+1								

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

**TITLE:** Facial Prostheses

**INVESTIGATORS:** J. J. Urban  
Joshua Nelson  
Joseph E. Ouellette

**DESCRIPTION:** A two component prosthesis has been developed using an acrylate terpolymer skin, synthesized at the laboratory and a flexible foam filler foundation.

**PROGRESS:** During this period facial prostheses of all types have been fitted to patients referred by the Division of Plastic Surgery, Walter Reed General Hospital. Satisfactory results continue to be obtained. A report detailing this work is nearing completion.

**SUMMARY:** The materials and prosthesis designs will continue to be evaluated on patients. As soon as the report has been completed it is planned to set up cooperative programs with other centers for a more complete evaluation of the techniques developed.

**PUBLICATIONS:** MR 1-65 Prostheses Fabricated for Plastic Surgery Service, Walter Reed General Hospital.

**TITLE:** Materials for Cosmetic Gloves

**INVESTIGATORS:** Carl A. Nielson  
James C. Eaton, Jr.

**DESCRIPTION:** Development of materials for stain-resistant cosmetic gloves is continuing.

**PROGRESS:** A resin-rich vinyl plastisol formulation was developed, field tested and found to be superior to presently manufactured cosmetic gloves. The new formulation was published and gloves prepared by commercial manufacturers were procured by New York University and tested for the Committee on Prosthetics Research and Development. The results of the tests were satisfactory.

**SUMMARY:** A new cosmetic glove formulation was developed. It was found to be more stain-resistant and stronger than presently used formulations.

**PUBLICATIONS:** MR 10-64 Production of RREP dilaminar gloves  
11-64 Viscosity of RREP plastisol at elevated temperatures  
13-64 Modification of plastisol RREP for decreased viscosity

<b>RESEARCH AND TECHNOLOGY RESUME</b>		1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
				DA OA6057	CSCRD 103
4. DATE OF RESUME	5. KIND OF RESUME	6. SECURITY	7. REGRADING	8. RELEASE LIMITATION	9. LEVEL OF RESUME
01 07 65	D. Change	U RPT U WRK	NA	NL	A. Work Unit
10. CURRENT NUMBER/CODE			10b. PRIOR NUMBER/CODE		
62156011 3A025601A821 01 095			61145011 3A014501A71E 03 095		
11. TITLE:					
(U) External Prosthetic Devices (09)					
12. SCIENTIFIC OR TECH. AREA			13. START DATE	14. CRIT. COMPL. DATE	15. FUNDING AGENCY
002400 Bioengineering			06 45	NA	Other DA
16. PROCURE. METHOD	17. CONTRACT/GRANT	a. DATE	18. RESOURCES EST.	a. PROFESSIONAL MAN-YEARS	b. FUNDS (In thousands)
C. In-House	b. NUMBER NA		PRIOR FY 65	7	76
	c. TYPE	d. AMOUNT	CURRENT FY 66	7	84
19. GOV'T LAB/INSTALLATION/ACTIVITY			20. PERFORMING ORGANIZATION		
NAME Headquarters			NAME USAMBRL		
ADDRESS USAMRDC			ADDRESS Walter Reed Army Medical Center		
Washington, D. C. 20315			Washington, D. C. 20012		
RESP. INDIV Kovaric, J. J., Lt Col			INVESTIGATORS PRINCIPAL ASSOCIATE F. Leonard, PhD		
TEL. 202 OX 66082			TEL 202 576-5153 TYPE DA		
21. TECHNOLOGY UTILIZATION			22. COORDINATION		
Prosthetics			CPRD; VA; HEW; NPRL		
23. KEYWORDS					
Terminal Devices; Elbow Units; Porous Plastics; Orthotics; Prosthetics					
24. (U) Technical Objective: 1) To design and fabricate prototype upper and lower extremity prosthetic and orthotic devices; 2) to develop materials and techniques applicable to the fitting and harnessing of prostheses; and 3) to develop accelerated test methods for laboratory evaluation of upper extremity components.					
25. (U) Approach: To first evolve design criteria through a study of amputee needs and then to design the device to meet the criteria. The device is then evaluated both in the laboratory and on the amputee.					
26. (U) Progress: The laboratory is engaged in the design of new and improved terminal devices, wrist units, elbow and shoulder units, both conventionally and externally powered. In addition, the laboratory is developing and applying porous laminating techniques to the fabrication of patellar tendon-bearing below-knee prostheses and above-knee porous suction sockets as well as all-plastic lower extremity braces. The laboratory is serving as an evaluation agency for accelerated testing of upper-extremity components in a cooperative national program. The laboratory develops performance specifications for upper-extremity components.					
27. COMMUNICATIONS SECURITY		28.	29. OSD CODE		30. BUDGET CODE
<input type="checkbox"/> CONSEC OR CONSEC RELATED <input checked="" type="checkbox"/> NOT RELATED			DT		1
31. MISSION OBJECTIVE			32. PARTICIPATION		
CDOG 1412 a					
33. REQUESTING AGENCY		34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands)		36.			
CFY+1					

DD FORM 1498

1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

**TITLE:** Foam Foot

**INVESTIGATORS:** Fred Leonard, PhD  
J. T. Hill  
Donald R. Ingenito  
V. T. Riblett

**DESCRIPTION:** The development of a flexible urethane solid ankle, cushion heel foot (SACH) has been undertaken.

**PROGRESS:** A high density sponge composition has been developed that shows promise of meeting the Veterans Administration specifications for the SACH type molded foot. The mold used for these feet has been redesigned and has been cast. Several foot moldings have been made.

**SUMMARY:** The new mold design in conjunction with the foam sponge compositions should make it possible to fabricate foam feet that will meet the Veterans Administration specifications.

**PUBLICATIONS:** Dwg T-638

**TITLE:** Graded Prehension Hook

**INVESTIGATORS:** Fred Leonard, PhD  
Albert B. Colman

**DESCRIPTION:** A terminal device, with provision for easily obtaining variable prehension forces which can be adjusted to suit the amputee's daily needs, is under development.

**PROGRESS:** A model with a roller to adjust prehension force from 1 to 5 lbs. is in the design stage.

**SUMMARY:** This device will undergo further design studies to increase efficiency and to provide a better method of adjusting prehension force.

**PUBLICATIONS:** Preliminary design sketches

**TITLE:** Lower Extremity Plastic Bracing

**INVESTIGATORS:** James T. Hill

**DESCRIPTION:** Efforts are being made to develop materials and techniques for the preparation of all-plastic lower extremity braces, to replace aluminum and steel.

**PROGRESS:** A technique has been developed in which a paper tracing is transferred to wood which is used as a mandrel about which the plastic side bars may be laminated. Filament winding is being tested as a possible method for preparing all-plastic braces.

**SUMMARY:** Preliminary observations indicate that all-plastic braces may be feasible.

**PUBLICATIONS:** Patent Application

**TITLE:** Porous Below-Knee (BK) Sockets with Soft Distal End

**INVESTIGATORS:** Fred Leonard, PhD  
Robert E. Plumb  
Chester T. Shelton

**DESCRIPTION:** This laboratory developed a porous below-knee hard socket with a soft distal end. The socket is patellar-tendon-bearing and is composed of a polyester laminate with a soft silicone end.

**PROGRESS:** This socket has been fitted to several amputees at USAMBRL and is undergoing clinical evaluation on four amputees at New York University.

**SUMMARY:** The socket is lighter, more comfortable and cooler than the conventional patellar-tendon bearing socket.

**TITLE:** Step-up Elbow Hinge with Lock

**INVESTIGATORS:** V. T. Riblett  
J. W. Hodge, Jr.

**DESCRIPTION:** This hinge is designed to increase the amount of forearm flexion available to the amputee who has considerably less than the normal amount of flexion about the elbow and to provide locking. A step-up ratio of 1.5:1 is incorporated into the hinge. Locking is achieved by inserting a plunger in a notched sector at a specific degree of forearm flexion.

**PROGRESS:** Two sets of hinges and a laminating jig have been designed and fabricated. These have been submitted to New York University for amputee evaluation.

**SUMMARY:** This unit will enable an amputee with a very short stump with limited stump force and flexion to lock the forearm in position. In the locked position no load is sustained by the stump.

**PUBLICATIONS:** T. R. 6417 Fabrication procedures for split socket prosthesis using the AMBRL step-up hinge with lock

**TITLE:** Transmission System

**INVESTIGATORS:** John W. Hodge, Jr.  
V. T. Riblett

**DESCRIPTION:** A prototype all-plastic cable transmission system for controlling upper extremity prosthetic devices has been developed. The system consists of nylon ball and cable connectors, dacron cord cable, Teflon housing, and nylon retainers, and is currently undergoing laboratory evaluation. The dacron cord has a strength in tension of 117 lbs. and exhibits minimal wear when cycled 100,000 times. Force transmission efficiency was observed to be 90 percent. An adequate means of stabilizing the Teflon housing in the nylon retainers is being given special attention at this time. The system has been packaged and submitted to three testing agencies for clinical evaluation.

**SUMMARY:** The all-plastic cable transmission system has adequate strength, good efficiency, and was cycled with satisfactory results. It is expected that this system will replace in some instances the currently used steel cable transmission system, and in other instances work in conjunction with the steel transmission system. Repair is greatly facilitated by the use of the plastic system.

**PUBLICATIONS:** TR6507-Plastic cable transmission system for upper extremity prosthesis.

TITLE: Size IV Active Resilient Hand

INVESTIGATORS: Theodore J. Bushey  
John J. Urban  
Joseph E. Ouellette

DESCRIPTION: A functional resilient soft hand prosthesis has been designed. The resilient hand consists of a voluntary opening type operating mechanism enclosed in a metal, hand-shaped shell which operates the 1st and 2nd fingers. The metal shell, fingers and thumb are fitted into a foam cover which duplicates the contours of the human hand. This is then covered with a USAMBRL Cosmetic Glove, making a terminal device which approximates the appearance and feel of a human hand and which incorporates prehension function.

PROGRESS: The operating mechanism, mechanism shell, fingers and a two-position thumb have been designed, fabricated, and assembled into a hand-shaped foam covering. A number of these hands, both right and left, have been built and are under evaluation.

SUMMARY: The adaptation of a simple voluntary opening (VO) mechanism to the space restrictive requirements of a hand, which has soft feel and has the cosmetic features of a human hand, provides the amputee with a soft functional terminal device.

PUBLICATIONS: M. R. 9-65 Resilient hand evaluation  
Dwg. T-658

**TITLE:** Mechanical Hands

**INVESTIGATORS:** A. H. Brown  
V. T. Riblett

**DESCRIPTION:** Four of the five sizes of functional mechanical hands are under active development. Hand Size IV is in commercial production.

**PROGRESS:** Hand Sizes I and II have been completed and are manufactured commercially. Hand Size III is 98 percent complete. The parts for Hand Size V have been received from the foundry and will be assembled.

**SUMMARY:** The complete range of hand sizes made in accordance with the recommendations of the Committee on Prosthetic Research and Development, National Research Council, should be completed during the next report period.

**PUBLICATIONS:**

T. R. 6416	Evaluation of No. II Size hand
T. R. 6419	Hand Size No. I - Voluntary opening with single position stop
T. R. 6501	Hand Size No. II - Voluntary opening with single position stop
T. R. 6503	Improved technique for the fabrication of a double wall single laminated porous arm socket
MR 3-65	Adjustable torsion spring hook
MR 4-65	No. II Size Hand check-out
MT 10-65	Locking bar test
Dwg. T-659	
Dwg. T-670	
Dwg. T-673	

**TITLE:** Voluntary Opening Hook with Finger Flexion

**INVESTIGATORS:** Fred Leonard, PhD  
Albert B. Colman

**DESCRIPTION:** A terminal device which will provide 0 to 35 degree flexion of the hook fingers is being developed. Such a device will eliminate an additional arm component, the wrist flexion unit, from the prosthesis. In addition, the control systems for the terminal device will not be affected when the amputee requires the fingers of the hook to be in the flexed position.

**PROGRESS:** Drawings and specifications were prepared to procure 3 right and 3 left models of the locking type flexion hook.

**SUMMARY:** Hooks with lock-in flexion are being procured for amputee evaluation.

**PUBLICATIONS:** Dwg. T-660

**TITLE:** Stress Distributing Foot Support

**INVESTIGATOR:** John J. Urban

**DESCRIPTION:** A quick setting dynamic arch support has been developed. The base elastomer is a filled silicone rubber which is placed in the patient's shoe. The filled elastomer sets within 15 minutes while the patient is walking.

**PROGRESS:** Materials and techniques have been developed and a report written. The technique has been submitted to the Veterans Administration for clinical evaluation.

**SUMMARY:** Preliminary patient evaluation is satisfactory. Plans are being made with the Veterans Administration for clinical evaluation.

**TITLE:** Hand Splint Materials

**INVESTIGATORS:** Fred Leonard, PhD  
Captain Mary H. Yeakel, AMSC

**DESCRIPTION:** Various plastic materials are being tested for feasibility for use in hand splints.

**PROGRESS:** Two materials, a rigid vinyl and polypropylene, have been obtained and are currently being tested on patients. The vinyl material can be cut to shape on a hand saw, with hand tools, or even with scissors, when the material is heated. It can be shaped by heating in boiling water and may be formed directly on the patient, thereby eliminating the necessity of molds and numerous fittings. It seems to have many fine qualities and field tests are favorable. Polypropylene rod, 3/16" diameter, is being tested as a substitute for metal hinges. Since this material can be cold-formed, the entire splint can be fabricated and the wrist hinge formed when the splint is on the patient. This makes alignment of the anatomical hinge of the wrist and the splint hinge more accurate and simpler to fabricate. Clinical evaluation has been successful.

**SUMMARY:** An all-plastic opponens splint has been prepared and is being evaluated on patients.

**PUBLICATIONS:** T. R. 6418 Clinical evaluation of vinyl thermoplastic splints.

**TITLE:** Proximal Interphalangeal Assist Finger Splint

**INVESTIGATORS:** Captain Mary H. Yeakel, AMSC  
Mr. Theodore J. Bushey

**DESCRIPTION:** A dynamic splint has been developed to assist the weakened or destroyed extensor tendon of the proximal interphalangeal joint. The splint is designed so that it will not impede use of the hand and is attached on the dorsum of the involved finger.

**PROGRESS:** The splint consists of two contoured aluminum discs which are adhered to the proximal and medial phalanges by adhesive tape. Each disc supports a post 3/4" in height. The distal post is slotted to accept a torsion spring which is held stationary by a set screw. The post on the proximal portion is slotted and permits the torsion spring to slide freely.

**SUMMARY:** Clinical evaluation at the University of North Carolina, Chapel Hill, North Carolina has been favorable. This project has been completed.

**TITLE:** Soft Foamed Hand Splint

**INVESTIGATORS:** Captain Mary H. Yeakel, AMSC  
John J. Urban

**DESCRIPTION:** A solid foam splint is being designed for static positioning of the severely burned hand. Size standards will be determined and the splint will be stocked for use at the Surgical Research Unit, Brooke Army Medical Center.

**PROGRESS:** Six splints have been field tested at SRU. Several designs and material combinations have been used. The outer protective, impervious skin of the splint was originally made from Dow-Corning room temperature vulcanizing silicone rubber and the inner core from a silicone foam and silicone rubber combination. Resilient polyurethane foams have been substituted for the silicones to provide a lighter, more easily fabricated splint. A metal hinge was incorporated at the wrist to provide a method of changing the wrist position to meet the needs of the patient. Field testing and design modification of this splint will continue.

**SUMMARY:** A solid foam, static, positioning splint is being developed for the severely burned hand. It is felt that most of the criteria for positioning can be incorporated into the device and that it will prove to be more desirable than the splints currently available for this task.

**TITLE:** Pronation-Supination Sandblock

**INVESTIGATORS:** Captain Mary H. Yeakel, AMSC  
V. T. Riblett

**DESCRIPTION:** A sandblock which requires the isolated motions of pronation and supination is being developed. These motions are difficult to encourage in woodworking activities with equipment presently available to the Occupational Therapist.

**PROGRESS:** Design specifications have been established, the device fabricated and submitted for testing and evaluation.

**SUMMARY:** A sandblock which required forearm pronation and supination was developed and clinically evaluated at Fort Knox, Ky. and found satisfactory. Project is terminated.

**PUBLICATIONS:** Dwg. T-656  
Dwg. T-664

**TITLE:** Graded Resistance Exercise Unit

**INVESTIGATORS:** Captain Mary H. Yeakel, AMSC  
V. T. Riblett  
A. H. Brown

**DESCRIPTION:** A small portable exercise unit, which can be used to provide graded resistance for therapeutic exercise, is being developed in cooperation with the Hunter Spring Company.

**PROGRESS:** Negotiations are being worked out with the Hunter Spring Company to modify the standard spring reel unit to meet specifications desired for exercise equipment. A pilot study, with limited units available, was quite encouraging with positive reactions from patients and therapists. A larger number of models are being procured for more extensive field trials.

**SUMMARY:** A small, lightweight exercise unit is being developed which should prove useful in clinic, ward, or home.

**PUBLICATIONS:** Dwg. T-663

**TITLE:** Burn Bed

**INVESTIGATORS:** Captain Mary H. Yeakel, AMSC  
Carl A. Nielson  
Victor T. Riblett

**DESCRIPTION:** An attempt is being made to construct a bed which will permit circulation of air about the circumferential burn wound. This will be accomplished by modification of a Stryker frame so that a coarse mesh, woven or knitted fabric, or plastic net can be attached to the frame. The frame must provide a simple method of changing tension in the net to permit equal distribution of pressures against the patient.

**PROGRESS:** Several knit and woven fabrics and polyallomer net samples have been obtained; however, none of these have been satisfactory. A dacron fabric has been obtained. This is to be silicone coated and evaluated.

**SUMMARY:** An attempt is being made to develop a bed which will permit circulation of air around the circumferential burn wound.

**TITLE:** Stretcher Modification

**INVESTIGATORS:** Fred Leonard, PhD  
Theodore J. Bushey  
Stanley W. Baker

**DESCRIPTION:** A medical field stretcher is being modified to decrease its length and cube. A design modification is being considered that will shorten the overall length to 77 inches when not in use. This is being accomplished by designing a set of carrying handles that will retract into the side rails thereby shortening the overall length by 13 inches.

**PROGRESS:** The prototype handles were made and installed on the stretcher. Professional consultants at the Office of the Surgeon General commented that the design appeared too complex and that dirt may get in the mechanism, causing a malfunction.

**SUMMARY:** Because of preliminary professional staff comments, further work was halted.

**PUBLICATIONS:** Dwg. T-662

**TITLE:** Military Identification Tag Cover

**INVESTIGATORS:** Fred Leonard, PhD  
A. H. Brown

**DESCRIPTION:** Military identification tag covers containing provision for re-fraction data were prepared and submitted to the Natick Laboratories, Natick, Massachusetts for evaluation. The covers were prepared from a plasticized polyvinyl chloride.

**PROGRESS:** Approximately 300 covers were made.

**SUMMARY:** This item was found to be highly satisfactory as a result of tests conducted by the Natick Laboratories and is ready for type classification.

**TITLE:** Miscellaneous

**INVESTIGATORS:** Laboratory Staff Members

**DESCRIPTION:** The laboratory engaged in a variety of short term development projects of interest to AMEDS activities. These included the development of an Amniocentesis Needle, Dental Forceps, evaluation of insulation material for the MUST unit, evaluation of Corfam, small animal container, surgical suction device, ear inserts, and medical apparatus.

**PUBLICATIONS:**

- T. R. 6502 Stress-strain characteristics and water vapor permeability of leather vs. Corfam
- T. R. 6509 Evaluation of failures in the aluminum-polyurethane foam composite used in MUST unit
- MR 8-64 The use of cyanoacrylate adhesive for luting gold dental castings
- MR 14-64 Improved ear inserts
- MR 6-65 Teflon utero-cervical vaginal pessary cannula (Dwg T-667)
- MR 7-65 Filter for use with the Cobalt 60 Irradiator, Radiation Therapy, WRGH (Dwg T-675)
- MR 8-65 Device for insertion of contact lenses (Dwg T-675)

Dwg T-661-1 Monkey vacuum chamber  
Dwg T-665 Mouthstick  
Dwg T-668 Surgical suction device-nozzle

<b>RESEARCH AND TECHNOLOGY RESUME</b>				1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBO
						DA OA6059	CSCRD 103
4. DATE OF RESUME	5. KIND OF RESUME	6. SECURITY		7. REGRADING	8. RELEASE LIMITATION	9. LEVEL OF RESUME	
01 07 65	A. New	U U RPT WRK		NA	NL	A. Work Unit	
10a. CURRENT NUMBER/CODE				10b. PRIOR NUMBER/CODE			
62156011 3A025601A821 01 096				61145011 3A014501A71E 03 096			
11. TITLE.							
(U) Biomechanical Devices (09)							
12. SCIENTIFIC OR TECH. AREA				13. START DATE	14. CRIT. COMPL DATE	15. FUNDING AGENCY	
002400 Bioengineering				07 57	NA	Other DA	
16. PROCURE. METHOD	17. CONTRACT/GRANT			18. RESOURCES EST.		19. PROFESSIONAL MAN-YEARS	
C. In-House	a. DATE			a. PRIOR FY		b. FUNDS (In thousands)	
	b. NUMBER NA			65		30	
	c. TYPE			CURRENT FY 66		32	
d. AMOUNT							
19. GOV'T LAB/INSTALLATION/ACTIVITY				20. PERFORMING ORGANIZATION			
NAME Headquarters				NAME USAMBRL			
ADDRESS USAMRDC				ADDRESS Walter Reed Army Medical Center			
Washington, D. C. 20315				Washington, D. C. 20012			
RESP. INDIV Kovaric, J. J., Lt Col				INVESTIGATORS PRINCIPAL ASSOCIATE Carl A. Nielson			
TEL. 202 OX 66082				TEL 202 576-5154			
				TYPE DA			
21. TECHNOLOGY UTILIZATION				22. COORDINATION			
Internal Prostheses				WRAIR			
23. KEYWORDS							
Internal Body Prostheses; Artificial Arteries; Artificial Bile Ducts							
24.							
(U) Technical Objective: To design and fabricate devices for biomechanical applications to replace tissue and organs which have been damaged as a result of trauma or disease.							
25.							
(U) Approach: Design criteria are obtained from interested surgeons and the medical literature where possible. The devices are molded from tissue receptive materials and submitted to the surgeon for evaluation in experimental animals. Design changes are made as required.							
26.							
(U) Progress: At present artificial arteries, bile ducts, tracheas, femoral hip caps and bandages for wounds and burns are being prepared and evaluated. Heart valves are under study.							
27. COMMUNICATIONS SECURITY		28.		29. OSD CODE		30. BUDGET CODE	
<input type="checkbox"/> a. COMSEC OR CC:SEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED				AR		1	
31. MISSION OBJECTIVE				32. PARTICIPATION			
CDOG 1412 a				NA			
33. REQUESTING AGENCY				34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands)				36.			
CFY+1							

DD FORM 1498

1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

**TITLE:** Internal Prostheses

**INVESTIGATORS:** Carl A. Nielson  
Joshua Nelson  
K. C. Pani, MD

**DESCRIPTION:** Current efforts are directed toward the development of internal body prostheses, such as tracheae, esophagi, vascular grafts, and bile ducts.

**PROGRESS:** During this period, assorted lengths of 4 mm, 6 mm, 8 mm, and 10 mm synthetic vascular grafts were submitted to Brooke Army Medical Center. Samples of synthetic vascular grafts and bile ducts were submitted to Dr. R. T. Sherman of the University of Tennessee. Both the synthetic vascular grafts as well as the synthetic bile ducts continue under evaluation at the Walter Reed Army Institute of Research and the University of Tennessee.

3A014501B71P 03

Biochemistry

<b>RESEARCH AND TECHNOLOGY RESUME</b>		1.	2 GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
				DA 0A6058	CSCRD-103
4. DATE OF RESUME	5. KIND OF RESUME	6. SECURITY	7. REGRADING	8. RELEASE LIMITATION	9. LEVEL OF RESUME
01-07-65	A. New	U U RPT WRK	NA	NL	A. Work Unit
10a. CURRENT NUMBER/CODE			10b. PRIOR NUMBER/CODE		
61145011 3A014501B71P 01 037			None		
11. TITLE:					
(U) Materials for Biomechanical Applications (09)					
12. SCIENTIFIC OR TECH. AREA			13. START DATE	14. CRIT. COMPL. DATE	15. FUNDING AGENCY
002400 Bioengineering			07 57	NA	Other   DA
16. PROCURE. METHOD	17. CONTRACT/GRANT		18. RESOURCES EST.		19. PROFESSIONAL MAN-YEARS
C. In-House	a. NUMBER NA c. TYPE d. AMOUNT		PRIOR FY 65		b. FUNDS (In thousands)
			CURRENT FY 66		7 140 7 153
19. GOV'T LAB/INSTALLATION/ACTIVITY			20. PERFORMING ORGANIZATION		
NAME Headquarters ADDRESS USAMRDC Washington, D. C. 20315			NAME USAMBRL ADDRESS Walter Reed Army Medical Center Washington, D. C.		
RESP. INDIV. Hawkes, G. R., PhD TEL: 202 OX 66791			INVESTIGATORS PRINCIPAL F. Leonard, PhD ASSOCIATE Carl A. Nielson -R.Kulkarni, PhD TEL 202 576-5153 TYPE DA		
21. TECHNOLOGY UTILIZATION			22. COORDINATION		
Artificial Internal Organs and Tissues			WRAIR, HEW		
23. KEYWORDS					
Internal Prostheses; Surgical Materials; Biological receptivity					
24. (U) Technical Objective: To develop materials which can be utilized in replacing tissues or organs which have been damaged as a result of trauma or disease.					
25. (U) Approach: To study the tissue receptivity-structure relationships as well as to fabricate internal body prostheses from known tissue-receptive materials.					
26. (U) Progress: Presently the laboratory is engaged in research toward the development of materials for use in internal body prostheses.					
27. COMMUNICATIONS SECURITY		28.	29. OSD CODE		30. BUDGET CODE
<input type="checkbox"/> a. COMSEC OR COMSEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED			AR		1
31. MISSION OBJECTIVE			32. PARTICIPATION		
NA			NA		
33. REQUESTING AGENCY		34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands)		36.			
CFY+1					

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

**TITLE:** Fabrics for Prosthetic Devices

**INVESTIGATORS:** Laboratory Staff Members

**DESCRIPTION:** This laboratory has continued the project with the Philadelphia College of Textiles Sciences. The College knits research textiles for the laboratory's use in fabricating internal and external body prostheses upon request.

**PROGRESS:** Textiles for internal body and external body biomechanical devices are being fabricated.

**SUMMARY:** Specialty textiles will be prepared as required.

**TITLE:** Implant Materials

**INVESTIGATORS:** Carl A. Nielson  
James C. Eaton, Jr.

**DESCRIPTION:** The purpose of this project is to develop a latex dispersed elastomer which would be utilized in the fabrication of reproducible cellular foam material for internal prosthetics.

**PROGRESS:** Both commercial and AMBRL batches of standard acrylate-amide latices have been evaluated for foam fabrication. Reproducibility of foam fabrication from batch to batch has not been satisfactory. The original 90/7.5/2.5 MA/MMA/MAD terpolymer latex has been modified to include poly vinyl alcohol in the polymerization medium. Results of experiments with several batches of this modified latex on reproducibility of foams are encouraging.

**SUMMARY:** Additional batches of the modified recipe will be evaluated for foam reproducibility and other additives such as poly (acrylic acid) will be evaluated as latex modifiers. In addition, other acrylate recipes will be polymerized in an attempt to produce an elastomeric material for possible utilization in internal body prostheses.

**PUBLICATIONS:** MR - 12-64 Terpolymer latex X-10E  
MR 15-64 Fabrication of grafts  
MR 5- 65 Foaming of terpolymer latices produced by  
American Cyanamid Co.  
MR 11 - 65 Acrylate amide foams prepared for evaluation  
as tissue prosthesis in orofacial surgery

**TITLE:** Biodegradable Polymers

**INVESTIGATORS:** Fred Leonard, PhD  
Ramchandra Kulkarni, PhD  
Kaniambakam Pani, MD

**DESCRIPTION:** Biodegradable polymers for use in internal body prostheses are being synthesized. It is planned to synthesize polypeptides and polymers of such compounds as lactic acid and hydroxy butyric acid.

**PROGRESS:** Poly L (+) lactic acid has been synthesized and its physical properties studied. Initial implantation experiments have indicated that the polymer is well tolerated in the biological system and it may accelerate healing of wounds. Radioactive poly L (+) lactic acid has been synthesized and implanted in rats. Its gross metabolic fate is being determined by monitoring techniques.

**SUMMARY:** If poly lactic acid is biodegradable, efforts will be made to prepare sutures and vascular prostheses from the material. Films will also be prepared and evaluated as dressings for wounds and burns.

**PUBLICATIONS:** T. R. 6506 Biodegradable Polymers: Polylactic Acid.

**TITLE:** Burn Dressing

**INVESTIGATORS:** Fred Leonard, PhD  
George Brandes  
Kaniambakam C. Pani, MD

**DESCRIPTION:** The preparation of evaluation of the higher alpha cyanoacrylates homologs as spray on dressings for burns has been undertaken.

**PROGRESS:** Excellent progress has been made on the synthesis of the hexyl, heptyl, and octyl cyanoacrylates in purities of 98.5% or higher. Spray guns have been developed for spraying these monomers.

TITLE: Tissue Adhesives

INVESTIGATORS: Fred Leonard, PhD  
Ramchandra Kulkarni, PhD  
Kariambakam C. Pani, MD  
George Brandes

DESCRIPTION: The homologous series of the alpha cyanoacrylates is under study as tissue adhesive from the viewpoint of effectiveness in wound closure, histotoxicity, biodegradability, and structure reactivity relations.

PROGRESS: The homologous series of alpha cyanoacrylates from methyl to decyl were prepared in purities of 98.5% and higher. The mechanism of degradation has been studied in vitro and in vivo. A series of spray guns have been devised for delivering the monomers to wounds. Surgeons at the Walter Reed Army Institute of Research are studying the tissue closure characteristics of these materials in a variety of tissue, including bone, pancreas, liver, spleen, kidney, oral vascular, nerve, and oral cavity. During this period several research institutions were supplied with samples of monomers manufactured in this laboratory. These were: WRAIR, WRGH, AFIP, AIDR, Picatinny Arsenal, University of Pennsylvania, and Johns Hopkins University. The samples were: Methyl - 152 cc; Ethyl - 90 cc; Butyl - 190 cc; Methyl C<sup>14</sup> tagged - 30 cc; Heptyl - 35 cc; Propyl - 25 cc; Octyl-25 cc.

SUMMARY: Excellent progress is being made in this field of research. Promising hemostasis inducing compounds can be expected from this series of compounds.

PUBLICATIONS: A spray gun for tissue adhesive Surgery, 57:749, May 1965

T. R. 6415 The preparation of radioactive methyl alpha cyanoacrylate

T. R. 6505 Estimation of alkyl alpha cyanoacrylates by volumetric and hydrogenation procedures

T. R. 6508 Degradation of alpha cyanoacrylates by water

MR 16-64 Adsorption of butyl alpha cyanoacrylate onto Bio-Gel HT

MR 2-65 Preparation of polymers from alpha cyanoacrylates.

Dwg. T-674-1

Dwg. T-674-2

3A013001A91C 01

In-House Laboratory Independent Research

<b>RESEARCH AND TECHNOLOGY RESUME</b>		1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
				DA OA6050	CSCRD 103
4. DATE OF RESUME	5. KIND OF RESUME	6. SECURITY	7. REGRADING	8. RELEASE LIMITATION	9. LEVEL OF RESUME
12 07 65	D. Change	II II	NA	NL	A. Work Unit
10a. CURRENT NUMBER/CODE			10b. PRIOR NUMBER/CODE		
61130011 3A013001A91C 01 010			61145011 3A014501B71P 01 035		
11. TITLE: (U) Mechanism of the Degradation of Poly Alpha Cyanoacrylates (09)					
12. SCIENTIFIC OR TECH. AREA			13. START DATE	14. CRIT. COMPL. DATE	15. FUNDING AGENCY
002300 Biochemistry			07 63	NA	Other   DA
16. PROCURE. METHOD	17. CONTRACT/GRANT	a. DATE	18. RESOURCES EST.	a. PROFESSIONAL MAN-YEARS	b. FUNDS (In thousands)
C. In-House	b. NUMBER NA		PRIOR FY 65	3	25
	c. TYPE	d. AMOUNT	CURRENT FY 66	3	28
19. GOV'T LAB/INSTALLATION/ACTIVITY			20. PERFORMING ORGANIZATION		
NAME Headquarters			NAME USAMBRL		
ADDRESS USAMRDC			ADDRESS Walter Reed Army Medical Center		
Washington, D. C. 20315			Washington, D. C.		
RESP. INDIV. Hawkes, G. R., PhD			INVESTIGATORS Fred Leonard, PhD		
TEL. 202 OX 66791			PRINCIPAL R. Kulkarni, PhD - J. Nelson		
			ASSOCIATE		
			TEL 202 576-5153		
			TYPE DA		
21. TECHNOLOGY UTILIZATION			22. COORDINATION		
Tissue Adhesives			WRAIR		
23. KEYWORDS					
Degradation; Mechanism of Degradation; In vitro Degradation; In Vivo Degradation; Biodegradable					
24. (U) Technical Objective: To study the mechanism of the in vivo and in vitro degradation of alpha cyanoacrylate polymers.					
25.(U) Approach: The kinetics of the degradation of the homologous series of alpha cyanoacrylate polymers are under study.					
26.(U) Progress: The rates of degradation of C <sup>14</sup> alpha carbon tagged poly methyl alpha cyanoacrylate and poly butyl cyanoacrylate have been measured in vivo. The rates of degradation in distilled water of the various members of the homologous series from methyl to octyl are under study. It has been demonstrated that the alpha cyanoacrylate polymers degrade by hydrolytic chain scission. Formaldehyde is one of the derivatives.					
27. COMMUNICATIONS SECURITY		28.	29. OSD CODE	30. BUDGET CODE	
<input type="checkbox"/> a. CONSEC OR CONSEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED			BR	1	
31. MISSION OBJECTIVE			32. PARTICIPATION		
NA			NA		
33. REQUESTING AGENCY		34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands)		36.			
CFY+1					

DD FORM 1498

1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

RESEARCH AND TECHNOLOGY RESUME				1.	2. GOVT ACCESSION	3. AGENCY ACCESSION	REPORT CONTROL SYMBOL
4. DATE OF RESUME 12 07 65		5. KIND OF RESUME D. Change		6. SECURITY U U	7. REGRADING NA	8. RELEASE LIMITATION NL	9. LEVEL OF RESUME A. Work Unit
10a. CURRENT NUMBER/CODE 61130011 3A01300191C 01 011				10b. PRIOR NUMBER/CODE 61145011 3A014501B71P 01 036			
11. TITLE: (U) Mechanism of Degradation of Poly (L+) Lactic Acid (09)							
12. SCIENTIFIC OR TECH. AREA 002300 Biochemistry				13. START DATE 07 63		14. CRIT. COMPL DATE NA	15. FUNDING AGENCY Other DA
16. PROCURE. METHOD C.In-House		17. CONTRACT/GRANT a. NUMBER NA c. TYPE		18. RESOURCES EST. a. PRIOR FY 65 b. CURRENT FY 66		PROFESSIONAL MAN-YEARS 2 2	19. FUNDS (In thousands) 10 12
19. GOV'T LAB/INSTALLATION/ACTIVITY NAME Headquarters ADDRESS USAMRDC Washington, D. C. 20315  RESP. INDIV. Hawkes, G.R., PhD TEL: 202 OX 66791				20. PERFORMING ORGANIZATION NAME USAMBRL ADDRESS Walter Reed Army Medical Center Washington, D. C. 20012  INVESTIGATORS F. Leonard, PhD PRINCIPAL K.C. Pani, MD -R.K. Kulkarni, PhD ASSOCIATE TEL 202 576-5153 TYPE DA			
21. TECHNOLOGY UTILIZATION Kinetics of Degradation				22. COORDINATION WRGH WRAIR			
23. KEYWORDS Degradation of Polylactic Acid, In vivo Degradation; In vitro Degradation; Biodegradable; Mechanism of Degradation							
24. (U) Technical Objective: To study the mechanism of degradation of poly L (+) Lactic Acid.							
25. (U) Approach: Poly L(+) Lactic Acid C <sup>14</sup> tagged is to be implanted in rats to study the in vivo degradation and gross metabolic fate. Experiments will be started on the hydrolytic degradation of poly (L+) Lactic Acid.							
26. (U) Progress: Radioactive poly (L+) Lactic Acid) has been implanted in rats. It has been preliminarily observed that 15% of the initial radioactivity has disappeared after 2 months.							
27. COMMUNICATIONS SECURITY <input type="checkbox"/> a. CONSEC OR CONSEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED		28.		29. OSD CODE BR		30. BUDGET CODE 1	
31. MISSION OBJECTIVE NA				32. PARTICIPATION NA			
33. REQUESTING AGENCY				34. SPECIAL EQUIPMENT			
35. EST. FUNDS (In thousands) CFY+1				36.			

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

<b>RESEARCH AND TECHNOLOGY RESUME</b>		1.	2. GOVT ACCESSION	3. AGENCY ACCESSION DAQA6060	REPORT CONTROL SYMBOL CSCRD 103
4. DATE OF RESUME 14 07 65	5. KIND OF RESUME A. New	6. SECURITY U RPT U WRK	7. REGRADING NA	8. RELEASE LIMITATION NL	9. LEVEL OF RESUME A. Work Unit
10a. CURRENT NUMBER/CODE 61130011 3A013001A91C 01 012			10b. PRIOR NUMBER/CODE None		
11. TITLE (U) Biomedical Electronics (09)					
12. SCIENTIFIC OR TECH. AREA 002400 Bioengineering			13. START DATE 01 65	14. CRIT COMPL. DATE NA	15. FUNDING AGENCY DA
16. PROCURE. METHOD C. In-House	17. CONTRACT/GRANT a. DATE b. NUMBER NA c. TYPE d. AMOUNT	18. RESOURCES EST. a. PROFESSIONAL MAN-YEARS b. FUNDS (In thousands)		19. GOV'T LAB/INSTALLATION/ACTIVITY NAME Headquarters ADDRESS USAMRDC Washington, D. C. 20315 RESP. INDIV Kovaric, J.J., Lt Col TEL. 202 OX 66082	
		18. PRIOR FY 65 CURRENT FY 66		19. INVESTIGATORS NAME USAMBRL ADDRESS Walter Reed Army Medical Center Washington, D. C. Lloyd L. Salisbury, Jr. PRINCIPAL ASSOCIATE TEL 202 576-5266 TYPE: DA	
21. TECHNOLOGY UTILIZATION Orthotics-Prosthetics			22. COORDINATION CPRD, VA		
23. KEYWORDS External Power, Prosthetics; Orthotics; Amputees, Pprehension; Terminal Device					
24. (U) Technical Objective: To develop a hand prosthesis incorporating automatic proportional control of grasp.					
25. (U) Approach: Incorporating in an electrically powered hand prosthesis a transducer for detecting slippage between the hand and the object grasped. The transducer output is used to actuate the power source to increase the pinch force until slippage ceases.					
26. (U) Progress: To date a hook prosthesis has been instrumented with a transducer for feasibility studies. Coefficient of friction measurements for standard cosmetic glove material vs. various common surfaces are being made. This will define the design parameters. The thumb from a standard hand is being modified to accept a transducer.					
PUBLICATIONS: Patent Application					
27. COMMUNICATIONS SECURITY <input type="checkbox"/> a. COMSEC OR COMSEC RELATED <input checked="" type="checkbox"/> b. NOT RELATED		28.	29. OSD CODE AR	30. BUDGET CODE 1	
31. MISSION OBJECTIVE NA			32. PARTICIPATION NA		
33. REQUESTING AGENCY		34. SPECIAL EQUIPMENT			
35. EST FUNDS (In thousands) CFY+1		36.			

DD FORM 1498  
1 AUG 64

(Items 1 to 26 identical to NASA Form 1122) REPLACES DD FORMS 613 &amp; 613C WHICH ARE OBSOLETE.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D		
<i>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</i>		
1 ORIGINATING ACTIVITY <i>(Corporate author)</i> U. S. Army Medical Biomechanical Research Laboratory WRAMC, Washington, D. C. 20012		2a REPORT SECURITY CLASSIFICATION UNCLASSIFIED
		2b GROUP
3 REPORT TITLE ANNUAL PROGRESS REPORT, FY 1965		
4 DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Progress Report, 1 July 1964 - 30 June 1965		
5 AUTHOR(S) <i>(Last name, first name, initial)</i>		
6. REPORT DATE 28 September 1965	7a. TOTAL NO. OF PAGES 40	7b. NO. OF REFS 51
8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)	
b. PROJECT NO.		
c.	9b. OTHER REPORT NO(S) <i>(Any other numbers that may be assigned this report)</i>	
d.		
10. AVAILABILITY/LIMITATION NOTICES Qualified requestors may obtain copies of this report from DDC.		
11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY U. S. Army Medical Research and Development Command Washington, D. C. 20315	
13 ABSTRACT The research program of the U. S. Army Medical Biomechanical Research Laboratory is devoted to the development of internal and external body biomechanical devices and to special AMedS projects as assigned. Research and Technology Resumes on the following projects are submitted: 1. Externally Powered Devices 2. Externally Powered Prostheses 3. Optical Inserts for Protective Masks 4. Foam in Place Splints 5. Cosmetic Prostheses 6. External Prosthetic Devices 7. Biomechanical Devices 8. Materials for Biomechanical Applications 9. Mechanism of the Degradation of Poly Alpha Cyanoacrylates 10. Mechanism of Degradation of Poly (L+) Lactic Acid 11. Biomedical Electronics.		

DD FORM 1473  
1 JAN 64

UNCLASSIFIED

Security Classification

**UNCLASSIFIED**  
Security Classification

14.	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	Amputee Orthotics Prosthetics Electromyography External Control Masks, Protective Polyallomer Polyurethane foams Elastomer Terminal Devices Elbow Units Porous Plastics Prostheses, Internal	Biological Receptivity Surgical Materials Degradation					
<b>INSTRUCTIONS</b>							
<p>1. <b>ORIGINATING ACTIVITY:</b> Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (<i>corporate author</i>) issuing the report.</p> <p>2a. <b>REPORT SECURITY CLASSIFICATION:</b> Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.</p> <p>2b. <b>GROUP:</b> Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.</p> <p>3. <b>REPORT TITLE:</b> Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.</p> <p>4. <b>DESCRIPTIVE NOTES:</b> If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.</p> <p>5. <b>AUTHOR(S):</b> Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.</p> <p>6. <b>REPORT DATE:</b> Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.</p> <p>7a. <b>TOTAL NUMBER OF PAGES:</b> The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.</p> <p>7b. <b>NUMBER OF REFERENCES:</b> Enter the total number of references cited in the report.</p> <p>8a. <b>CONTRACT OR GRANT NUMBER:</b> If appropriate, enter the applicable number of the contract or grant under which the report was written.</p> <p>8b, 8c, &amp; 8d. <b>PROJECT NUMBER:</b> Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.</p> <p>9a. <b>ORIGINATOR'S REPORT NUMBER(S):</b> Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.</p> <p>9b. <b>OTHER REPORT NUMBER(S):</b> If the report has been assigned any other report numbers (<i>either by the originator or by the sponsor</i>), also enter this number(s).</p>				<p>10. <b>AVAILABILITY/LIMITATION NOTICES:</b> Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:</p> <p>(1) "Qualified requesters may obtain copies of this report from DDC."</p> <p>(2) "Foreign announcement and dissemination of this report by DDC is not authorized."</p> <p>(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."</p> <p>(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."</p> <p>(5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."</p> <p>If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.</p> <p>11. <b>SUPPLEMENTARY NOTES:</b> Use for additional explanatory notes.</p> <p>12. <b>SPONSORING MILITARY ACTIVITY:</b> Enter the name of the departmental project office or laboratory sponsoring (<i>paying for</i>) the research and development. Include address.</p> <p>13. <b>ABSTRACT:</b> Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.</p> <p>It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).</p> <p>There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.</p> <p>14. <b>KEY WORDS:</b> Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.</p>			