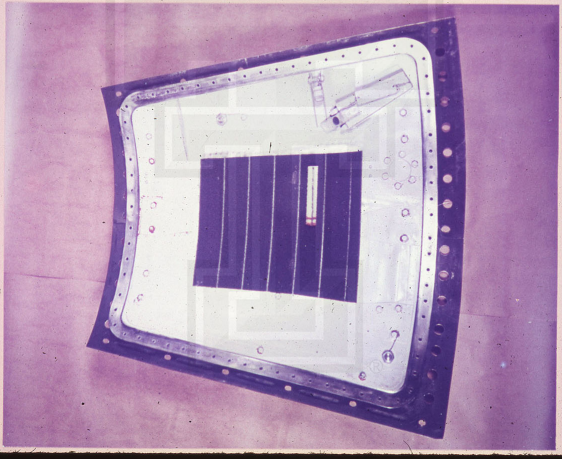
BIOMEDICAL FACTORS IN WEIGHTLESS OR ROTATING SPACE VEHICLES

	ROTATING VEHICLE	NON-ROTATING VEHICLE
CARDIOVASCULAR EFFECTS	NONE AT 1 g	"DECONDITIONING" ? NOT SIGNIFICANT UNTIL RETURN TO 1 g WHEN PREVENTABLE BY CUFFS, DRUGS OR ANT-g SUITS
DISORIENTATION MOTION SICKNESS	SEVERE FROM CANAL SICKNESS & CORIOLIS FORCES WITH SMALL RADIUS. PROBABLY MILD WITH LARGE RADIUS	POSSIBLE FROM OTOLITH. VISUAL CUES OVERCOME DRUGS COULD PREVENT

MA-9
MERCURY GROUND NETWORK

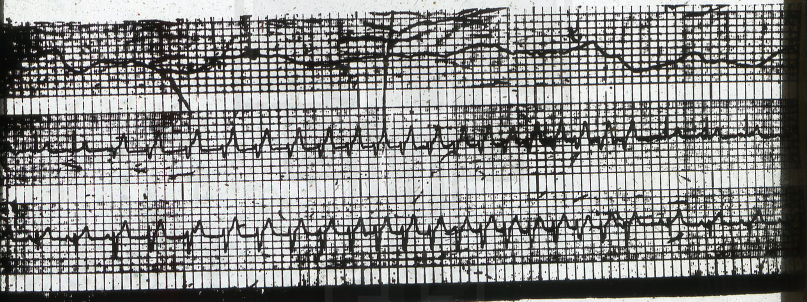
STATION	SYMBOL	VOICE/TM	S or C BAND RADAR	ACQUISITION AID	COMMAND CAPABILITY	TV RECEPTION
CAPE CANAVERAL (CONTROL CENTER)	CNV	V/TM	S/C	A	YES	TV
BERMUDA	BOA	V/TM	S/C	A	YES	—
CANARY ISLANDS	CYI	V/TM	S	A	—	TV
KANO, NIGERIA	KNO	V/TM	—	A	—	—
ZANZIBAR	ZZB	V/TM	—	A	—	—
MUCHEA, AUSTRALIA	MUC	V/TM	S	A	YES	—
CANTON ISLAND	CTN	V/TM	—	A	—	—
COASTAL SENTRY QUEBEC (SHIP)	CSQ	V/TM	—	A	YES	TV
HAWAII	HAW	V/TM	S/C	A	YES	—
PT. ARGUELLO, CALIFORNIA	CAL	V/TM	S/C	A	YES	—
GUAYMAS, MEXICO	GYM	V/TM	S	A	YES	—
WHITE SANDS, NEW MEXICO	WHS	—	C	A	—	—
CORPUS CHRISTI, TEXAS	TEX	V/TM	S	A	—	—
EGLIN AFB, FLORIDA	EGL	—	S/C	A	—	—
ROSE KNOT VICTOR (SHIP)	RKV	V/TM	—	A	YES	—
TWIN FALLS VICTORY (SHIP)	TFV	V/TM (RECORD)	C	A	—	—
RANGE TRACKER (SHIP)	RTK	V/TM (RECORD)	C	A	—	—

RADIATION DOSIMETER ON HATCH



BIOMEDICAL FACTORS IN WEIGHTLESS OR ROTATING SPACE VEHICLES (CONT)

	ROTATING VEHICLE	NON-ROTATING VEHICLE
SKELETAL CHANGES	NONE AT 1 g	OSTEOPOROSIS PREVENTABLE BY APPROPRIATE EXERCISES
MUSCULAR CHANGES	NONE WITH STANDARD EXERCISES	NONE WITH SPECIAL EXERCISES



JANUARY 27, 1962 6:30 A.M.,E.S.T.

MA-6 ATTEMPTED LAUNCH

PAPER SPEED 25 MM/SECOND

MERCURY BIOMEDICAL DATA SUMMARY

1 OBJECTIVE: TO ASSESS THE PHYSIOLOGICAL AND PSYCHOLOGICAL EFFECTS OF SPACE FLIGHT ON THE HUMAN ORGANISM

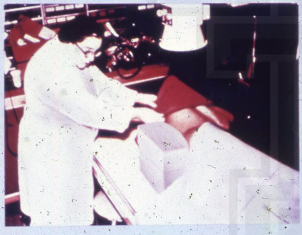
2 EXPERIMENTAL FORMAT: DICTATED LARGELY BY OPERATIONAL CONSTRAINTS:

A) DESIGN SIMPLICITY

B) GOAL: GROSS TRENDS INDEX IN TROUBLE AREAS

GEMINI MEDICAL EXPERIMENT M-6

BONE DEMINERALIZATION

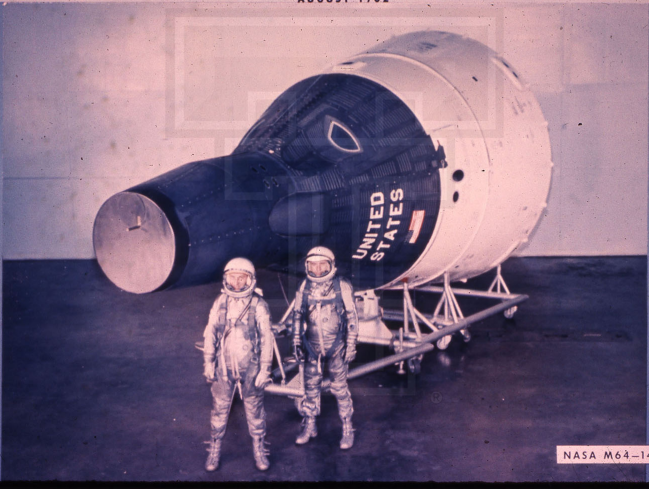


PURPOSE	ESTABLISH DEGREE OF BONE DETERIORATION
EQUIPMENT	STANDARD X-RAY
WEIGHT	N/A VOLUME N/A
PROCEDURE	PRE AND POST FLIGHT HEEL AND FINGER XRAYS BY SPECIAL TECHNIQUE
LOCATION	N/A

MM 5-9988

GEMINI SPACECRAFT ENGINEERING MOCK-UP

AUGUST 1962

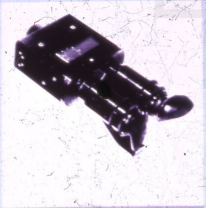


NASA M64-147

NASA
S-62-2344

GEMINI EXPERIMENT M-9

HUMAN OTOLITH FUNCTION



IN-FLIGHT
VISION TESTER

PURPOSE - IDENTIFY AND CALIBRATE TIME COURSE OF CHANGES IN OTOLITH FUNCTION

EQUIPMENT SPECIAL FLIGHT GOGGLES; PRE AND POST FLIGHT TILT FRAME AND OCULAR PHOTOGRAPHY

WEIGHT GOGGLES INCORPORATED INTO S-8 EQUIPMENT

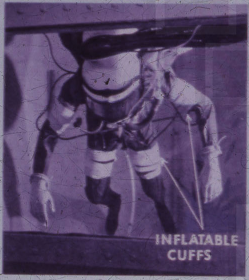
PROCEDURE DETERMINE EGOCENTRIC VISUAL LOCATION OF HORIZON INFLIGHT. DETERMINE OCULAR COUNTER-ROLLING PRE AND POST FLIGHT.

LOCATION PRESSURIZED CABIN

MM 5-9990

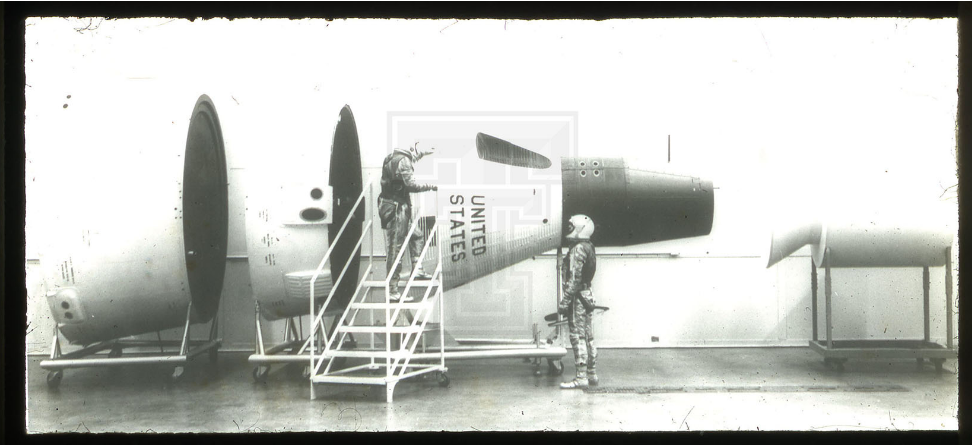
GEMINI EXPERIMENT M-1

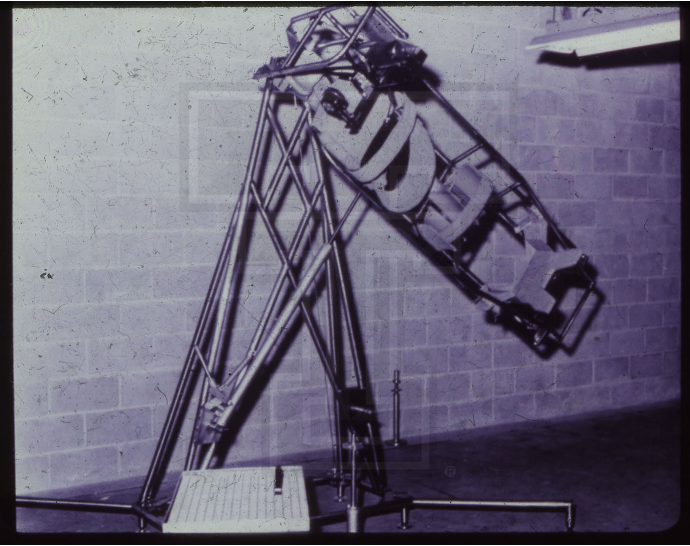
CARDIOVASCULAR CONDITIONING



PURPOSE	DETERMINE EFFECTIVENESS OF TECHNIQUE TO PREVENT CARDIOVASCULAR DECONDITIONING
EQUIPMENT	PNEUMATIC CUFF DEVICE
WEIGHT	5 LBS. VOLUME 0.06 CU. FT.
PROCEDURE	RHYTHMIC CUFF INFLATION-ONE ASTRONAUT
LOCATION	PRESSURIZED CABIN AND ASTRONAUT'S BODY

MM 5-9991


UNITED
STATES



GEMINI EXPERIMENT

M-1

CARDIOVASCULAR

CONDITIONING

NASA MW65-6837

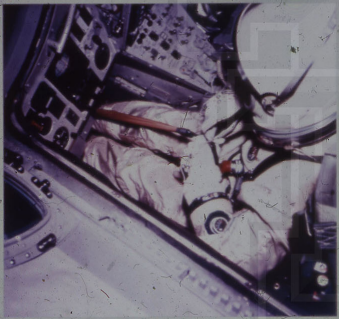
IN-FLIGHT MEDICAL EXPERIMENTS

M-1 (CUFF EXPERIMENT)
M-3 (CALIBRATED EXERCISE TEST)
M-4 (PHONOELECTROCARDIOGRAM)
M-5 (HORMONAL STUDIES - STEROIDS, CATECHOLS, ADH)
M-6 (BONE DENSITOMETRY)
M-7 (ELECTROLYTE BALANCE)
M-8 (EEG)
M-9 (VESTIBULAR STUDY)
M-11 (CYTOGENETIC AND IMMUNOLOGIC BLOOD STUDY)
M-12 (BICYCLE ERGOMETER - a. AS PREVENTIVE: b. AS PROVOCATIVE TEST)
M-17 (CARDIAC OUTPUT BY ELECTRICAL IMPEDANCE)
M-18 (VECTORCARDIOGRAPHY - FRANK LEADS)
M-19 (IN-FLIGHT METABOLIC RATE)
M-20 (PULMONARY FUNCTION)
M-21 (SEMICIRCULAR CANAL FUNCTION)
M-22 (RBC SURVIVAL)

OPERATIONAL PROCEDURES - M-2 (TILT TABLE AND BODY FLUID COMPARTMENTS)
M-10 (ASTRONAUT BODY MOVEMENT)
M-13 (VENOUS COMPLIANCE AND ARTERIOLAR REACTIVITY)

UNDER CONSIDERATION - M-14 (EAR OXIMETER)
M-15 (PERFORMANCE MEASUREMENT)
M-16 (NEPHELOMETER)
M-23 (PHYSICAL FITNESS FOLLOWING WEIGHTLESSNESS)

GEMINI IN-FLIGHT EXERCISER (M-3)



PURPOSE	ASSESSMENT OF TIME COURSE OF CARDIOVASCULAR RESPONSE TO A FIXED WORK/LOAD STIMULUS
EQUIPMENT	BUNGEE CORD (INFLIGHT) BIOINSTRUMENTATION: ECG, BP, PRESS, & RESP.
WEIGHT	8 OZS. VOLUME MINOR
PROCEDURE	IDENTICAL MEASURED EXERCISE PERIODS THROUGHOUT FLIGHT
LOCATION	PRESSURIZED CABIN

MM 5-9987

GEMINI RENDEZVOUS

RADAR COMPUTER MODE

GEMINI MEDICAL EXPERIMENT M-4

INFLIGHT PHONOCARDIOGRAM

PURPOSE

USED IN CONJUNCTION WITH SIMULTANEOUSLY RECORDED ECG TO INDICATE POSSIBLE MYOCARDIAL (HEART MUSCLE) DECONDITIONING

EQUIPMENT

CHEST MICROPHONE BIOSENSOR
OPERATIONAL ECG

WEIGHT

1 TO 2 OZS. VOLUME MINOR

PROCEDURE

PASSIVE RECORDING DURING FLIGHT

LOCATION

APPLIED TO ASTRONAUT'S CHEST

MM 5-9989

GEMINI MEDICAL EXPERIMENTS

- M-1 CARDIOVASCULAR CONDITIONING
- M-3 INFLIGHT EXERCISER
- M-4 INFLIGHT PHONOCARDIOGRAM
- M-5 BIOASSAYS BODY FLUIDS
- M-6 BONE DEMINERALIZATION
- M-7 CALCIUM BALANCE STUDY
- M-8 INFLIGHT SLEEP ANALYSIS
- M-9 HUMAN OTOLITH FUNCTION

NASA MM4-5557
9/22/65

HUMAN PERFORMANCE AND BIOINSTRUMENTATION STATION

MM65-11,319
11-6-65

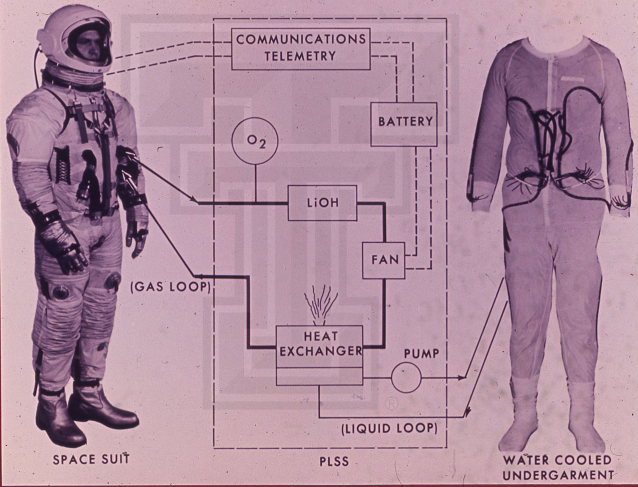
MSFEB APPROVED GEMINI MEDICAL EXPERIMENTS SCHEDULE

CODE	SHORT TITLE	WEIGHT	VOLUME CU. IN.	GEMINI 3 3 ORBITS	GEMINI 4 4 DAYS	GEMINI 5 8 DAYS	GEMINI 6 2 DAYS	GEMINI 7 14 DAYS	GEMINI 8 2 DAYS	GEMINI 9 2 DAYS	GEMINI 10 2 DAYS	GEMINI 11 2 DAYS	GEMINI 12 2 DAYS
M-1	CARDIOVASCULAR CONDITIONING	80 OZ.				X		X					
M-2	TILT TABLE	NA	NA	INCLUDE AS MED. OPS. PROCEDURE									
M-3	IN-FLIGHT EXERCISER	8 OZ.			X	X		X					
M-4	IN-FLIGHT PHONOCARDIOGRAM	1 TO 2 OZ.			X	X		X					
M-5	BIOASSAYS BODY FLUIDS	75 GMS PER VOIDING	75 CC PER VOIDING				X	X	X	X	X	X	X
M-6	BONE DEMINERALIZATION	NA	NA		X	X		X					
M-7	CALCIUM BALANCE STUDY	M-5 SPECIMEN	M-5 SPECIMEN					X					
M-8	IN-FLIGHT SLEEP ANALYSIS	10 OZ.	NA					X		X			
M-9	HUMAN OTOLITH FUNCTION	8 OZ.	D-13 EQUIP'T			X		X					
M-10	MOVEMENT	NA	NA			INCLUDED AS OPERATIONAL PROCEDURE							
M-13	VASCULAR RESPONSE	NA	NA			INCLUDED AS MED. OPS. PROCEDURE							

MM4-9220

NASA-S-64-2571

APOLLO PORTABLE LIFE SUPPORT SYSTEM



GEMINI MEDICAL EXPERIMENTS

M-1 CARDIOVASCULAR REFLEX CONDITIONING EXPERIMENT: CUFFS

M-2 CARDIOVASCULAR EFFECTS OF SPACE FLIGHT:
TILT TABLE: BLOOD VOLUME, INTERSTITIAL FLUID VOLUME, TOTAL BODY WATER

M-3 INFLIGHT CARDIOVASCULAR ASSESSMENT: CALIBRATED EXERCISE TOLERANCE

M-4 INFLIGHT CARDIOVASCULAR ASSESSMENT: PHONO-ELECTROCARDIOGRAM

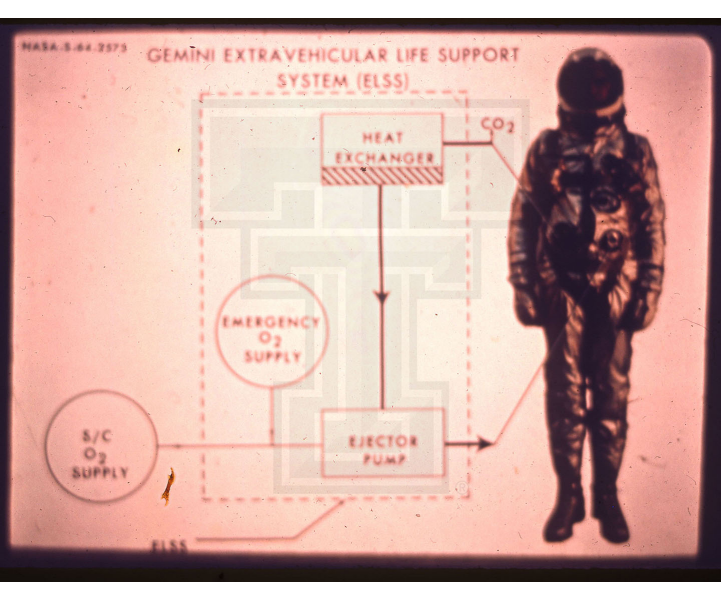
M-5 BIOCHEMICAL ANALYSIS OF BODY FLUIDS: STEROIDS: CATECHOLS: ADH

M-6 PRE AND POSTFLIGHT BONE DENSITOMETRY

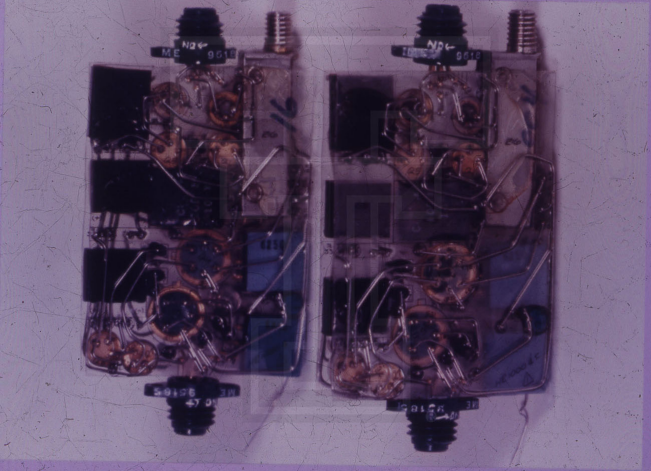
M-7 ELECTROLYTE BALANCE STUDY: CALCIUM: NITROGEN: HYDROXYPROLINE

M-8 INFLIGHT ELECTROENCEPHALOGRAM (EEG)

M-9 VESTIBULAR EXPERIMENT


NASA-S-64-2573
GEMINI EXTRAVEHICULAR LIFE SUPPORT SYSTEM (ELSS)
HEAT EXCHANGER
CO_2
EMERGENCY O_2 SUPPLY
S/C O_2 SUPPLY
EJECTOR PUMP
ELSS

EEG SIGNAL CONDITIONERS



MM65-11,330

MSFEB APPROVED APOLLO MEDICAL EXPERIMENTS SCHEDULE

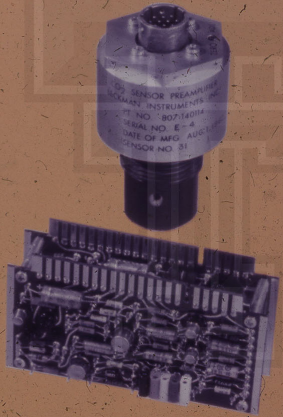
FLIGHT	204	205	207	503	504
	M-1A	M-4A	M-23	M-5A	M-5A
	M-4A	M-5A		M-11	M-11
	M-5A	M-7A			
	M-6A	M-9A			
	M-9A	M-11			
	M-11	M-12			
	M-12	M-19			
		M-20			

MM65-11, 309

- MASS MEASUREMENT DEVICE
- BARANY CHAIR
- EXAMINATION TABLE
- CREWMAN "CHAIR"

MM65-11.318
11-6-65

CARBON DIOXIDE SENSOR



MM65-11,327
11-6-65

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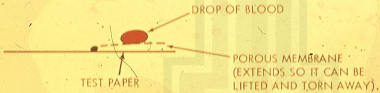
WOOD, EARL, M.D., PH.D. PROFESSOR OF PHYSIOLOGY	MAYO CLINIC

MM65-11, 336

ALTERNATIVE FILTER PAPER TECHNIQUE

FOR BLOOD CHEMISTRIES (SPAMAG)

TOP VIEW



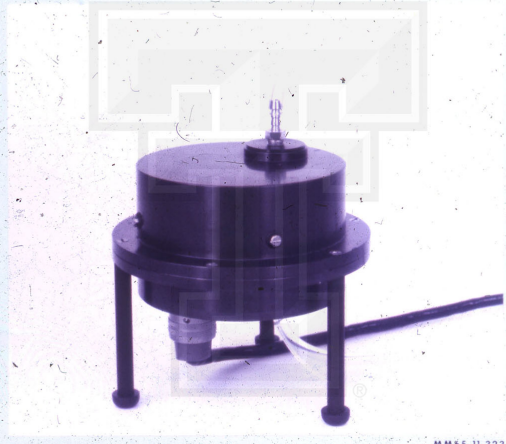
SIDE VIEW

MM65-11,312

MASS MEASUREMENT DEVICE

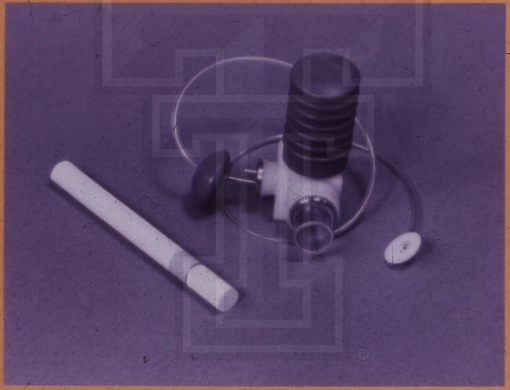
MM65-11,315
11-6-65

RESPIRATION ANALYZER



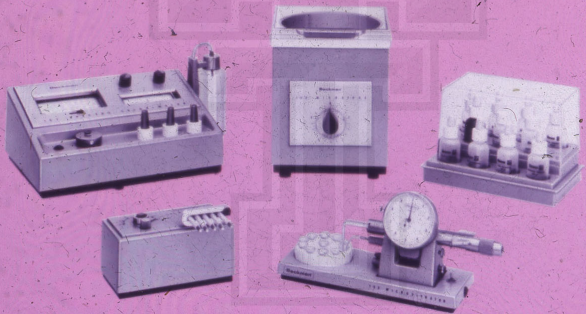
MM65-13,323
11-6-65

PAROTID SECRETION COLLECTOR



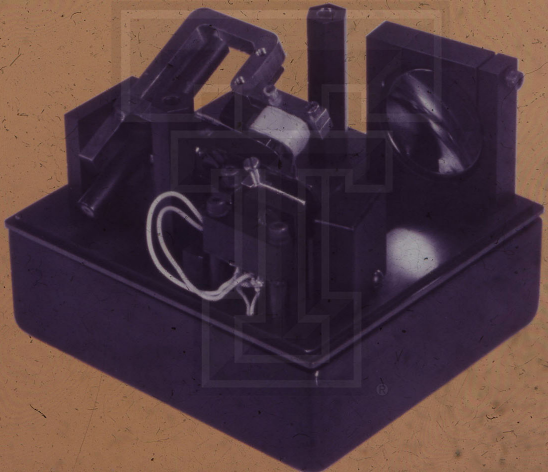
MM.65-11,322
11-6-65

MICRO ANALYTICAL SYSTEM



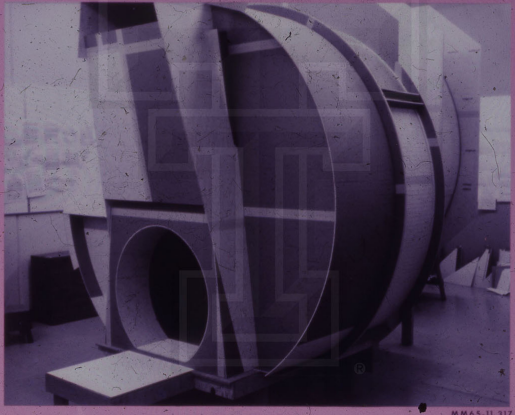
MM65-11,328
11-6-65

INFRA-RED CARBON DIOXIDE ANALYZER



MM65-11,320
11-6-65

APOLLO APPLICATIONS LEM LAB MOCK-UP

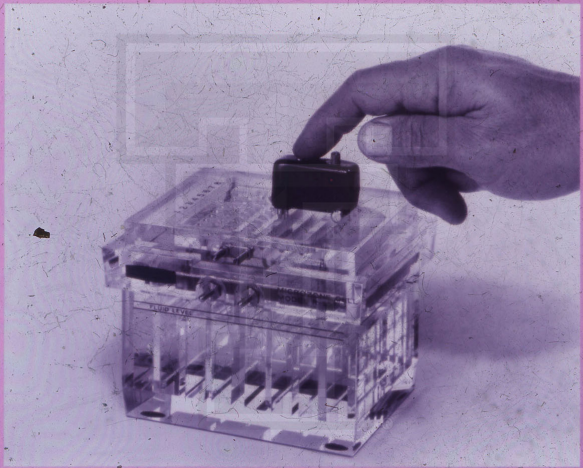


MM65-11,317
11-6-65

PAROTID SECRETION COLLECTION SYSTEM

MM65-11,321
11-6-65

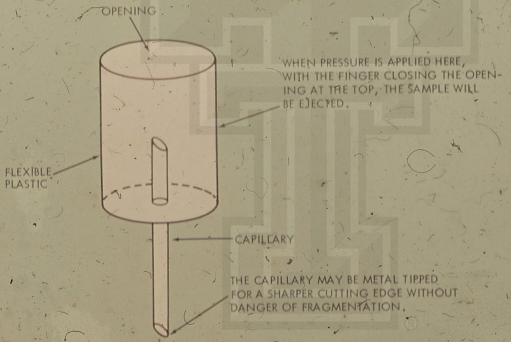
MICROZONE ELECTROPHORESIS



MM65-11,325
11-6-65

INFLIGHT BLOOD SAMPLING TECHNIQUE

(SPAMAG)



MM65-11,314

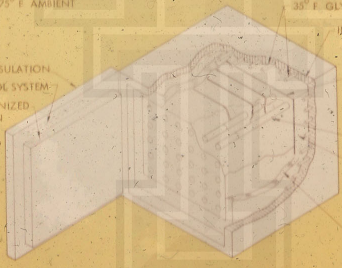
LIST OF MSFEB APPROVED GEMINI AND APOLLO EXPERIMENTS CURRENTLY PLANNED FOR INCLUSION ON APOLLO APPLICATIONS FLIGHTS

EXPERIMENT NO.	SHORT TITLE
M-4	IN-FLIGHT PHONOCARDIOGRAM
M-5	BIOASSAYS BODY FLUIDS
M-7	CALCIUM BALANCE STUDY
M-8	IN-FLIGHT SLEEP ANALYSIS
M-11	CYTOGENIC STUDY
M-12	EXERCISE ERGOMETER
M-17	THORACIC BLOOD FLOW
M-18	VECTORCARDIOGRAM
M-19	METABOLIC RATE MEASUREMENT
M-20	PULMONARY FUNCTION
M-22	RED BLOOD CELL SURVIVAL
M-23	LOWER BODY NEGATIVE PRESSURE

MM65-11, 310

URINE FREEZER UNIT

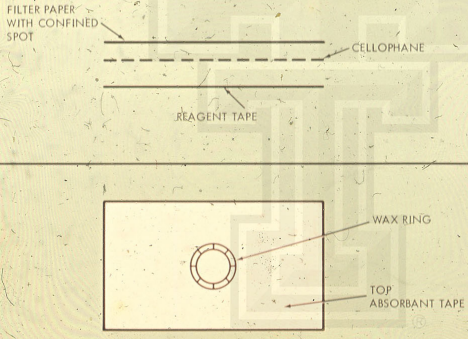
CRYOGENIC REFRIGERATOR CONTAINING SOLID MIXTURE OF ETHANOL AND WATER



MM65-11,311

FILTER PAPER TECHNIQUE

FOR BLOOD CHEMISTRIES (SPAMAG)

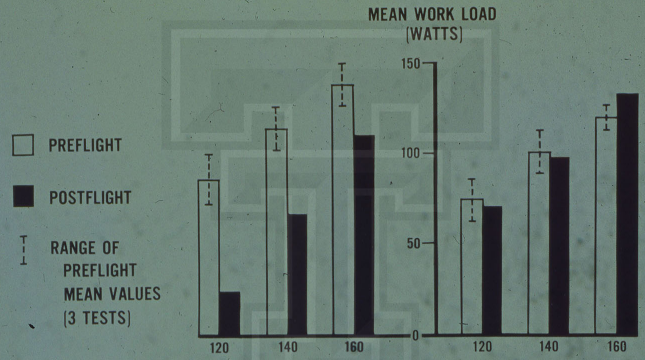


SIDE VIEW

TOP VIEW

MM65-11,313

SUMMARY OF WORK LOAD CHANGE – APOLLO VII.



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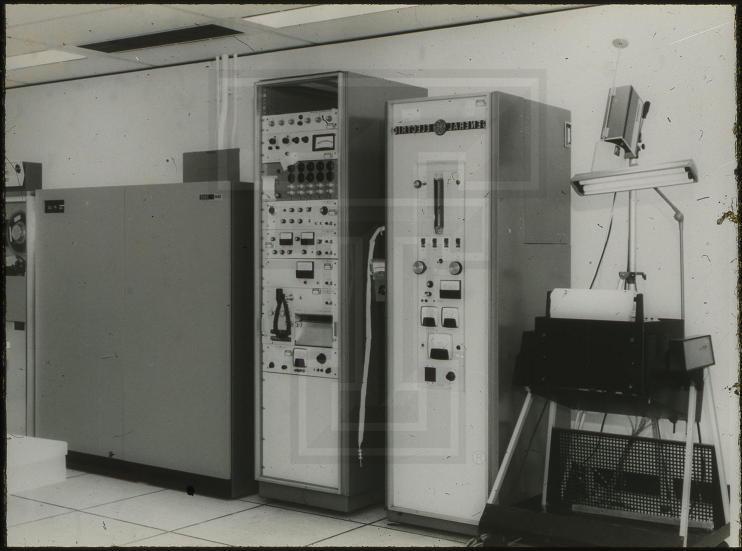
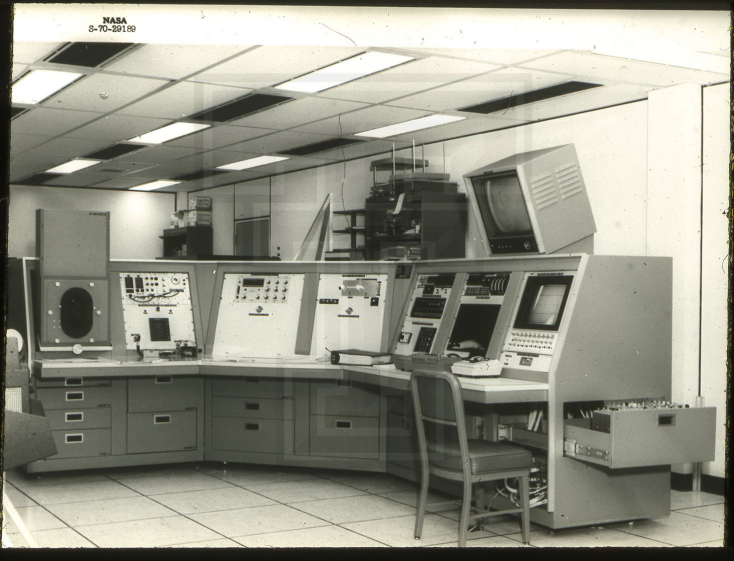
4-15-69

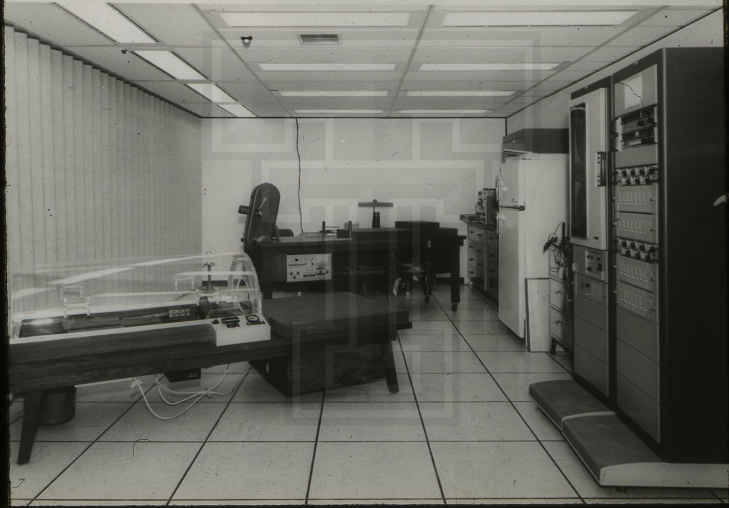


NASA
S-70-29189

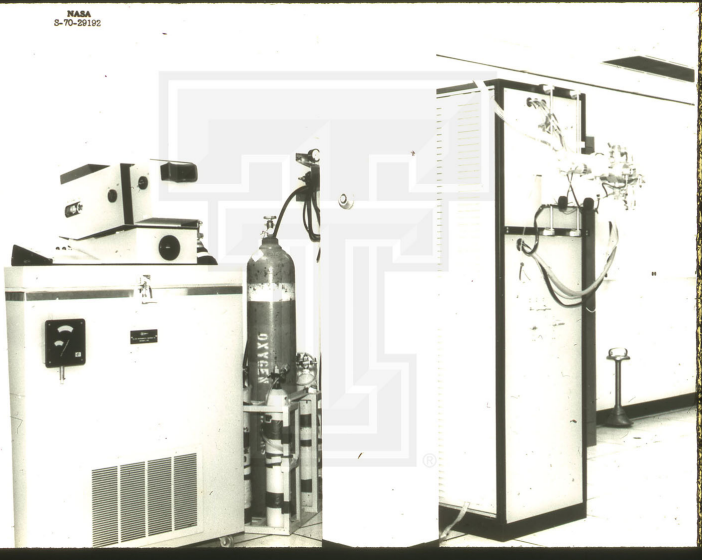


NASA
S-70-29165

NASA
S-70-29190



NASA
S-70-29192



MEDICAL EXPERIMENTS PROGRAM
FUNCTIONAL ORGANIZATION

I. MEDICAL/BEHAVIORAL EXPERIMENTS

A. DETERMINATION OF REQUIREMENTS AND MAINTAINING RELATIONSHIPS, SUPPORT, AND PARTICIPATION OF THE SCIENTIFIC COMMUNITY.

B. REVIEW OF EXPERIMENT PROPOSALS FOR SCIENTIFIC MERIT.

C. SUPPORT OF EXPERIMENTS IN DEFINITION.

D. SELECTION, CONVERSION, AND SUPPORT OF EXPERIMENTS FOR DEVELOPMENT PHASE.

E. SUPPORT AND GUIDANCE DURING OPERATIONAL DATA GATHERING, AND POST MISSION DATA REDUCTION AND REPORTING PHASES.

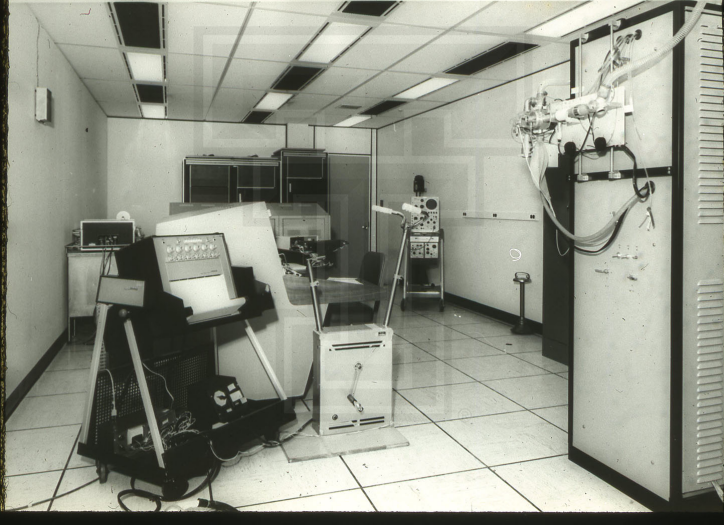
F. APPLICATION OF DATA TO THE MEDICAL/BEHAVIORAL EXPERIMENTS PROGRAM, MANNED SPACE FLIGHT, AND THE CIVILIAN COMMUNITY AS INDICATED.

II. R&D SUPPORT OF MEDICAL/BEHAVIORAL EXPERIMENTS PROGRAM

A. IMBMS (INTEGRATED MEDICAL AND BEHAVIORAL LABORATORY MEASUREMENT SYSTEM).

B. PARALLEL DEVELOPMENT EFFORTS TO ADVANCE STATES OF THE ART IN MEASUREMENT TECHNIQUES AND EQUIPMENT TO ENHANCE THE CAPABILITIES OF IMBMS AND PROPOSED EXPERIMENTS.

C. SIMULATIONS AND GROUND BASED DATA, I.E., THE SUPPORT OF GROUND BASED SIMULATION AND OTHER STUDIES IN ORDER TO OBTAIN A BODY OF PERTINENT DATA AS A NORMATIVE OR CONTROL BASE TO PERMIT THE EXTRACTION OF VALID CONCLUSIONS FROM FLIGHT DATA.



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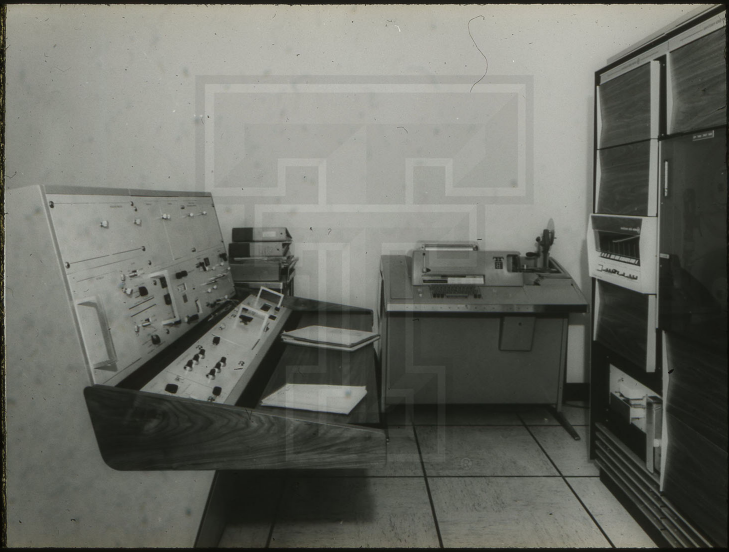
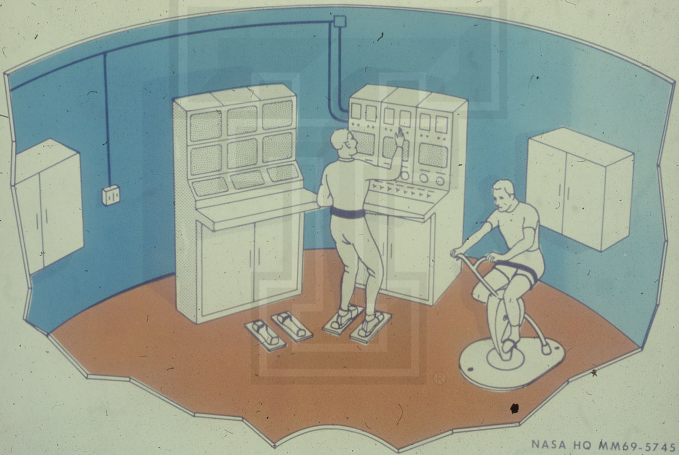


IMBLMS

INTEGRATED MEDICAL/BEHAVIORAL LABORATORY MEASUREMENT SYSTEM



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MEDICAL/BEHAVIORAL EXPERIMENTS PROGRAM
IMBLMS

AIMS

1. PROVIDE INFLIGHT MEASUREMENT CAPABILITY TO ACCOMMODATE ALL MEDICAL/BEHAVIORAL EXPERIMENTS

2. PROVIDE MAXIMUM FLEXIBILITY FOR:

   a. ADAPTABILITY TO LATE CHANGES IN MISSION EXPERIMENT PLANS

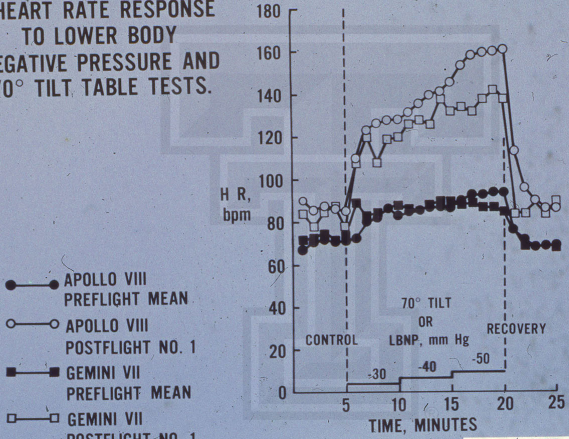
   b. EASE OF INFLIGHT MAINTENANCE

   c. EASE AND ECONOMY OF INCORPORATION OF UPDATED TECHNIQUES AND EQUIPMENT

IMBLMS FUNCTIONAL ELEMENTS

1. PHYSIOLOGICAL MEASUREMENT
2. BEHAVIORAL MEASUREMENT
3. BIOCHEMICAL
4. MICROBIOLOGICAL
5. DATA MANAGEMENT

HEART RATE RESPONSE TO LOWER BODY NEGATIVE PRESSURE AND 70° TILT TABLE TESTS.



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GEMINI 4 & 5
BLOOD VOLUME CHANGES

DETERMINATION	GEMINI 4(CP)	GEMINI 4(P)	GEMINI 5(CP)	GEMINI 5(P)
BLOOD VOLUME, cc	-378 (7%)	-910 (13%)	-592 (13%)	-547 (13%)
PLASMA VOLUME, cc	-118 (4%)	-492 (13%)	-209 (8%)	-106 (4%)
RBC MASS, cc	-260 (11%)	-418 (13%)	-383 (20%)	-441 (20%)
RBC SURVIVAL AT 8 DAYS (Cr 51)				
% EXPECTED	--------	--------	82 - 83%	82 - 83%
% OBSERVED	--------	--------	70%	69%

TABLE VI. RED CELL MASS

	PERCENTAGE CHANGE IN RED CELL MASS IN EACH CREWMAN		
APOLLO VII	−0.5	−9.4	−0.3
APOLLO VIII	+2.3	−2.3	−4.0

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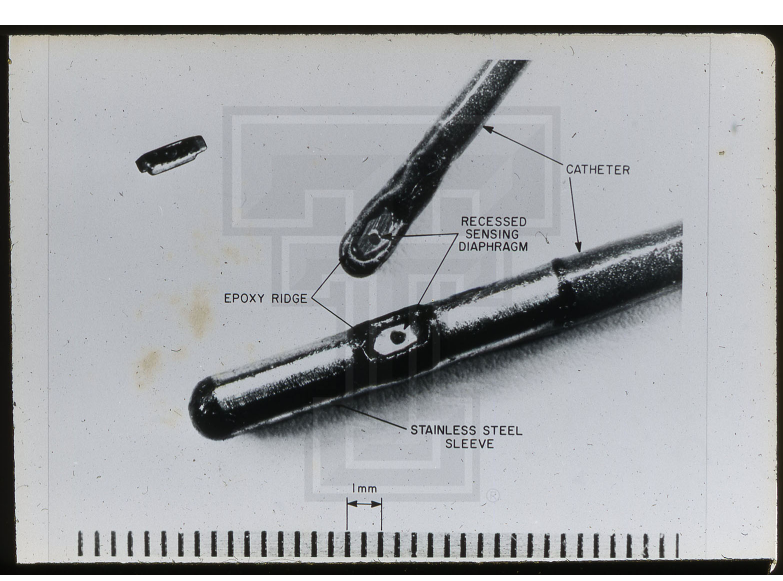
4-15-69


CATHETER
RECESSED
SENSING
DIAPHRAGM
EPOXY RIDGE
STAINLESS STEEL
SLEEVE
1mm

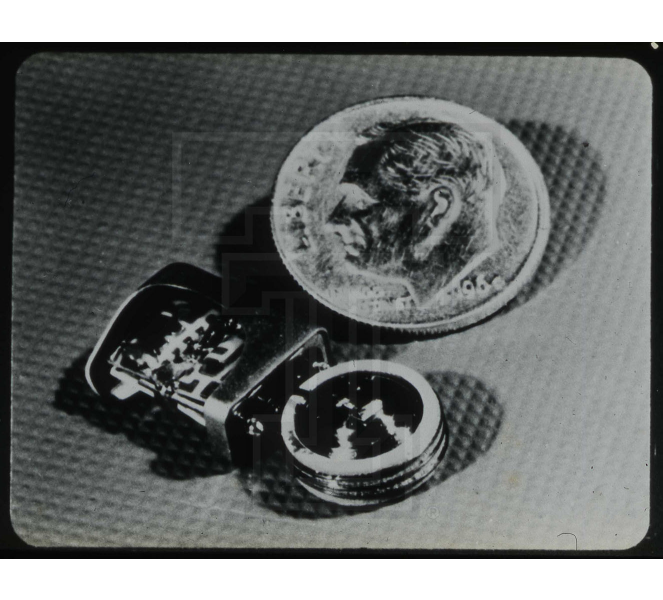
BREATHING SENSOR-TUD- 7

EIGHT AREAS OF MEDICAL EVALUATION

EXPERIMENTS	NEURO.	RESP.	CARDIO-VASC.	METAB. & NUTRITION	ENDOCR.	HEMATOL.	MICROBIOL.	BEHAV.
DEM.	M008 M009	M003	M001 M002 M004 M005 MED. OPS.	M005 M006 M007	M005	MED. OPS.		MED. OPS.
AP.		M003	M012 M017 M023 M024 M025	M012 M009		M011	MED. OPS.	
AAP	M013 (M014)	M011	M001 M011 (M017)	M010 M012 M016 M018	M012	M011		M010

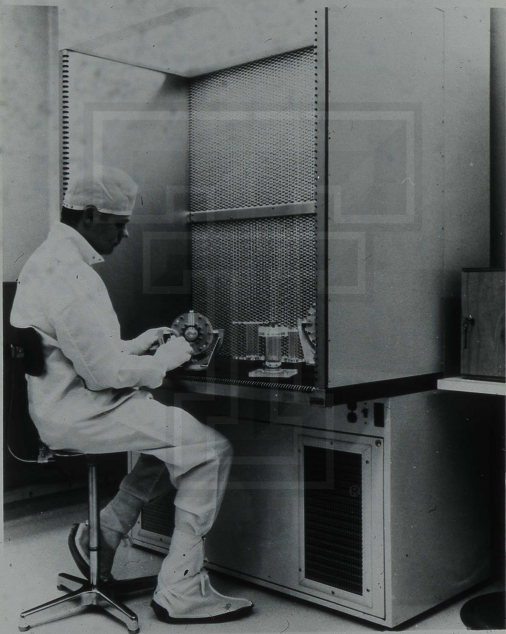
NASA-S-69-1638

IMPEDANCE CARDIOGRAPH FLIGHT INSTRUMENTATION AND HARNESS




LIGHT SOURCE
AND TRANSISTOR AMPLIFIER
CONTROL
SENSOR
CABLE TO BATTERY PACK
AND CONTROL RELAY

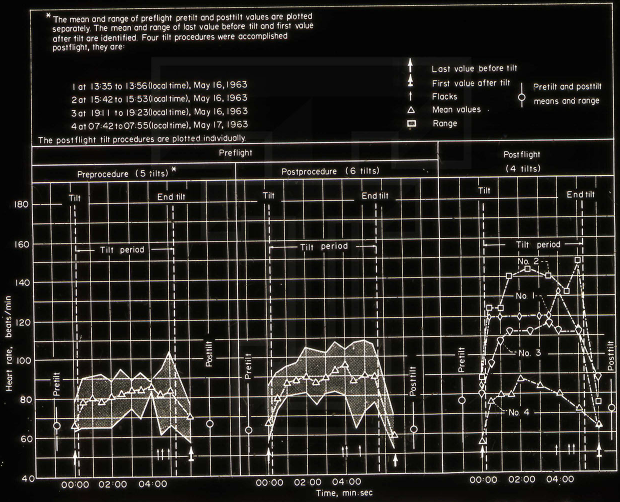
EKG TRANSMITTING SYSTEM-TUD-21



MEDICAL/BEHAVIORAL EXPERIMENTS PROGRAM
PARALLEL DEVELOPMENT

REQUIREMENTS (SELECTED)

- METABOLIC ANALYZER, RAPID RESPONSE, ADAPTABLE TO SUITED ACTIVITY
- MICROBIAL CULTURE AND IDENTIFICATION TECHNIQUES FOR INFLIGHT USE
- TECHNIQUES FOR INFLIGHT BIOCHEMICAL ANALYSIS
- SAMPLE PRESERVATION TECHNIQUES FOR INFLIGHT USE
- IMPROVED LIMB PLETHYSMOGRAPHY TECHNIQUES
- NON-INVASIVE CARDIAC OUTPUT DETERMINATION TECHNIQUES
- NON-INVASIVE VENOUS PRESSURE TECHNIQUES
- BEHAVIORAL MEASUREMENT TECHNIQUE REFINEMENT
- BLOOD CELL COUNTING TECHNIQUES FOR INFLIGHT USE
- TECHNIQUES FOR INFLIGHT MEASUREMENT OF PULMONARY DIFFUSION CAPACITY
- IMPROVED URINE VOLUME MEASUREMENT DEVICE



TILT STUDIES—HEART RATE RESPONSES—MA—9

SPAMAG END PRODUCTS

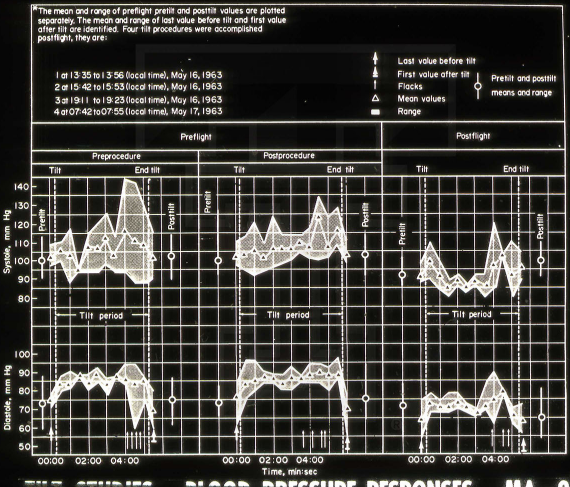
1. GROUP OF ORL MEDICAL EXPERINMENTS IN FORMAT
2. GROUP OF ADDITIONAL ORL MEDICAL MEASUREMENTS IN FORMAT
3. GROUP OF LIFE SUPPORT RECOMMENDATIONS IN FORMAT
4. GROUP OF PREREQUISITE GROUND BASED EXPERIMENTS
5. GROUP OF PREREQUISITE SPACEFLIGHT EXPERIMENTS
6. GROUP OF RECOMMENDATIONS FOR RESEARCH AND DEVELOPMENT
7. GENERAL PHILOSPHY AND RECOMMENDATIONS FOR ORL EXPERIMENTAL APPROACH
8. RECOMMENDATIONS FOR GENERAL ORL DECISIONS
9. TENTATIVE FLIGHT PLAN
10. REVIEWS OF WORK OF FOUR STUDY CONTRACTS AND ORL BEWG
11. SUMMARY OF POSSIBLE USES OF SPACE ENVIRONMENT FOR STUDY AND THERAPY OF PATHOLOGICAL STATES
12. RECOMMENDATIONS FOR FUTURE STUDY EFFORT

MM A-1235

LIST OF EXPERIMENTAL ENVIRONMENTAL FACTORS

1. WEIGHTLESSNESS
2. RADIATION
3. CONFINEMENT
4. SOCIAL RESTRICTION
5. MONOTONY
6. THREAT OF DANGER
7. ARTIFICIAL ATMOSPHERE
8. TOXIC SUBSTANCES
9. PARTICULATE MATTER (IN WEIGHTLESSNESS)
10. MICROORGANISMS
11. CHANGE IN CIRCADIAN RHYTHMS
12. MAGNETIC FIELDS
13. ULTRA VIOLET EXPOSURE
14. INFRA RED EXPOSURE
15. NOISE

MM 4 1231



TILT STUDIES — BLOOD PRESSURE RESPONSES — MA—9

- INFLIGHT DATA
  - TM
  - ON BOARD RECORDING
  - POST FLIGHT DETERMINATIONS
- BASELINE DATA
  - SELECTION
  - CENTRIFUGE RUNS
  - SIMULATIONS
  - TRAINERS
  - PRESSURE CHAMBER RUNS
  - STRESS STUDIES
  - ROUTINE PHYSICAL EXAMINATIONS
  - GENERAL OBSERVATIONS
  - PRE FLIGHT DETERMINATIONS

BODY FUNCTIONS

1. NEUROLOGICAL FUNCTION
   - CNS
     - STATES OF CONSCIOUSNESS
       - SLEEP
       - ALERTNESS
     - SPEECH FUNCTIONS
     - ADAPTABILITY
     - EMOTIONAL REACTIVITY
   - SPECIAL SENSES
     - VISION
     - AUDITORY
     - SMELL
     - TASTE
     - VESTIBULAR
   - PERIPHERAL N.S.
     - SOMATIC
     - AUTONOMIC
2. PSYCHOLOGICAL PERFORMANCE
   - SENSATION
   - PSYCHOMOTOR
   - PERCEPTION
   - HIGHER MENTAL PROCESSES
3. CIRCULATION
   - PUMP
   - BLOOD VOLUME CONTROL
   - VASOMOTOR CONTROL
4. RESPIRATION
   - LUNG
   - BLOOD
   - TISSUE
5. DIGESTION
6. METABOLISM
7. ENDOCRINE BALANCE
8. THERMO-REGULATORY AND INTEGUMENTARY
9. NEUROMUSCULAR
10. SKELETAL
11. FLUID & ELECTROLYTE BALANCE, RENAL AND URINARY TRACT FUNCTIONS
12. REPRODUCTION
13. HEMATOLOGICAL RESPONSE
14. IMMUNOLOGICAL RESPONSE

SPAMAG RECOMMENDATIONS

1. LIFE SUPPORT
   (CONTROLLED ENVIRONMENTAL FACTORS)

2. MEDICAL EXPERIMENTS
   (UNCONTROLLED ENVIRONMENTAL FACTORS)

3. ORL DECISIONS
   (SPECIFICATIONS AND OPERATIONS)

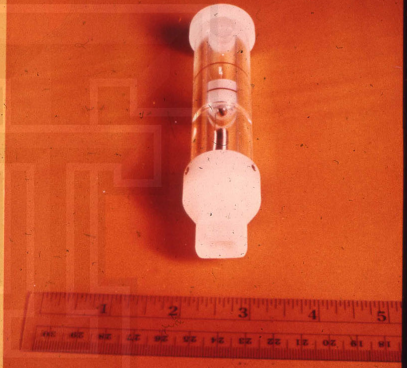
MM 4 1273

LIFE SUPPORT FACTORS

*1. ATMOSPHERE
2. SUITS
3. FOOD
4. WATER
5. WASTE
6. LIVING CONDITIONS & STANDARDS
7. GROUP INTEGRITY
8. HAZARD PROTECTION
9. SAFETY MONITORING

MM 4-1233

VAL-SALVA DEVICE



LIST OF ORL DECISIONS- SPAMAG

A. BEST & CHEAPEST OVERALL APPROACH

B. ORBIT

C. ON-BOARD CENTRIFUGE

D. ROTATION FOR ARTIFICIAL G?

E. SIZE REQUIREMENTS

F. WEIGHT REQTS.

G. POWER REQTS.

H. NUMBER OF PERSONNEL

I. TYPES OF PERSONNEL

J. ANIMALS?

K. CYCLING OF PERSONNEL & ANIMALS

L. ON BOARD LABORATORY REQUIREMENTS

M. STORAGE REQTS. (VOLUME & TYPE)

N. SUPPORTING LOGISTICS

O. BIOINSTRUMENTATION REQUIREMENTS

P. COMMUNICATIONS (METHODS & EQUIPMENT)

Q. GROUND SUPPORT

R. NECESSITY FOR TOTAL GROUND SIMULATION PRIOR TO FLIGHT

S. REQUIREMENTS FOR POST -LANDING MEDICAL EXAMINATIONS

T. DOUBLE-ENDED TRAMPOLINE IN-FLIGHT?

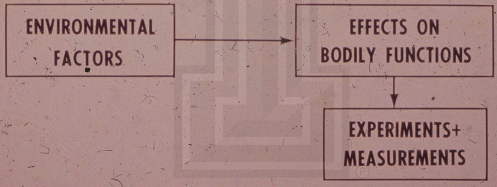
U. CREW EFFECTIVENESS PARAMETERS

MM 4-1229

ORL EXPERIMENTS FORMULATION SCHEMA SPAMAG

(UNCONTROLLED ENVIRONMENTAL FACTORS) (VARIABLES)

LIST OF EXPERIMENTS & EXPERIMENTAL REQUIREMENTS TO BE FORMULATED ACCORDING TO THE FOLLOWING SCHEMA:



MM 4-1236

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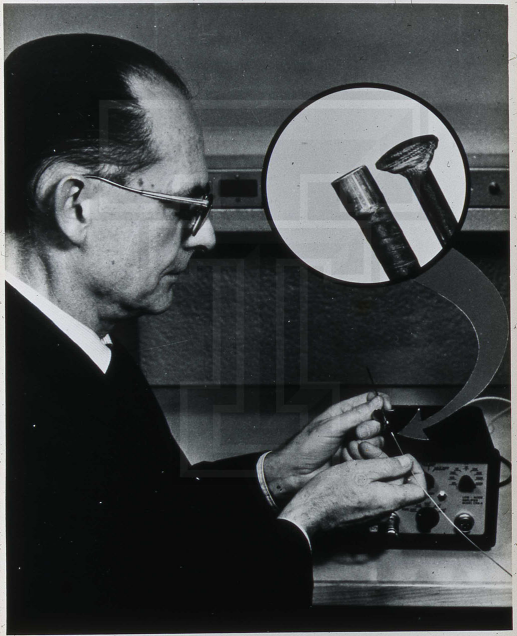
BLOOD STUDIES

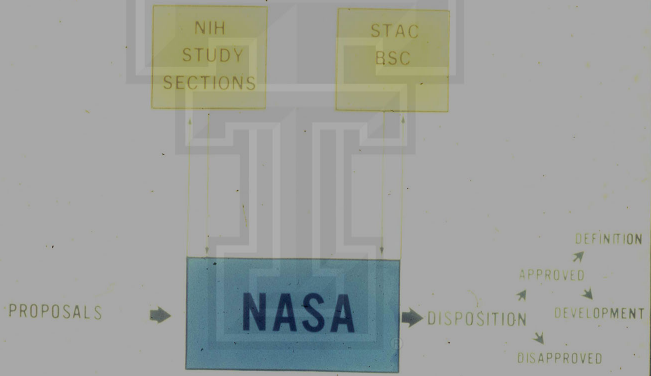
	[illegible]					
WHITE CELL COUNT/MM³	[illegible]					
NEUTROPHILES, PERCENT						
JUVENILE FORMS, PERCENT						
LYMPHOCYTES, PERCENT						
MONOCYTES, PERCENT						
EOSINOPHILES, PERCENT						
BASOPHILES, PERCENT						
RETICULOCYTE COUNT, PERCENT						
	MEAN [illegible]		MEAN [illegible]		MEAN	
RED CELL COUNT, MILLIONS/MM³	[illegible]		4.4		[illegible]	
HEMATOCRIT, PERCENT	[illegible]		42		[illegible]	
HEMOGLOBIN CONCENTRATION, GRAM PERCENT	16 TO [illegible]		[illegible] TO [illegible]		[illegible]	
RED BLOOD CELL INDICES						
MEAN CORPUSCULAR VOLUME µ³	95	[illegible]	95	87	[illegible]	
HEMOGLOBIN γγ	30	[illegible]	[illegible]	[illegible]	[illegible]	
HEMOGLOBIN CONCENTRATION PERCENT	[illegible]	36	[illegible]	[illegible]	[illegible]	

ISOTOPE VOLUME STUDIES	OBSERVED	PREFLIGHT TO POSTFLIGHT VOLUME CHANGE CC	PERCENT
BLOOD VOLUME, CC	4442	-124	[illegible]
PLASMA VOLUME, CC	2760	-419	[illegible]
RED BLOOD CELL MASS VOLUME, CC	1682	[illegible]	[illegible]

RED BLOOD SURVIVAL, DAYS	18.5 DAYS
SPLEEN/LIVER	1.86 (+30 PERCENT)



MEDICAL / BEHAVIOR EXPERIMENTS PROGRAM
SCIENTIFIC MERIT EVALUTIONS SYSTEM



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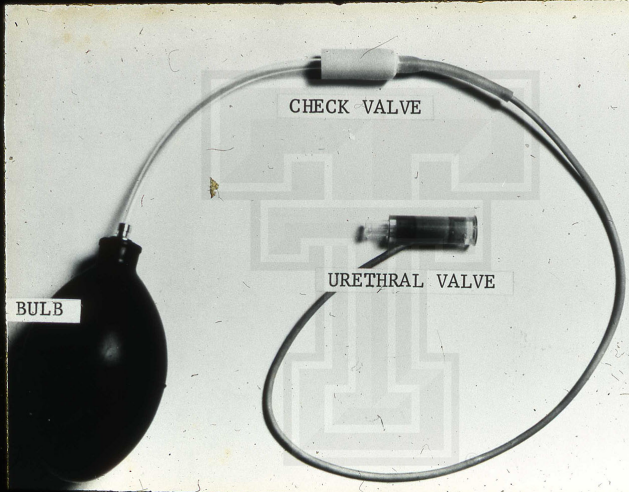
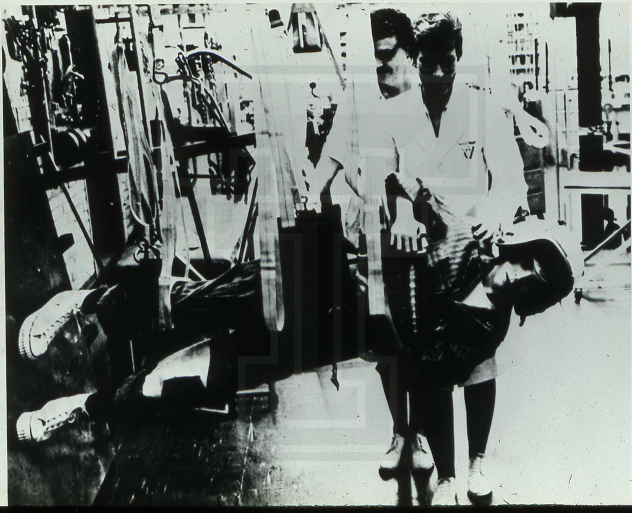
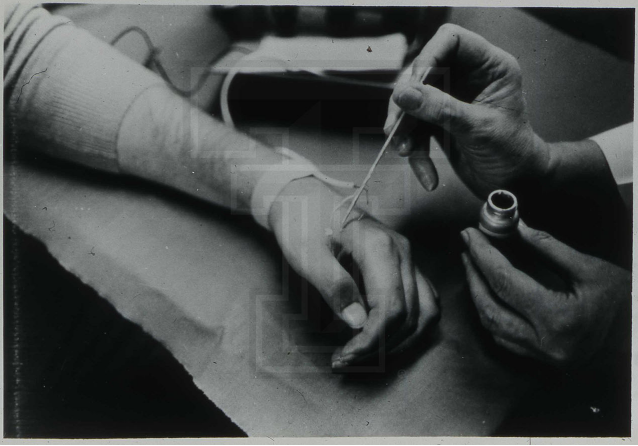
PROTOTYPE DIRECT
READOUT
ULTRASONIC BARE SCANNER


Patient MONITOR
CENTRAL STATION
PATIENT UNIT


CHECK VALVE
URETHRAL VALVE
BULB





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[illegible]

BLOOD STUDIES

COMMAND PILOT [illegible]

	DATE [illegible] MILES	NORMAL [illegible]
WHITE CELL COUNT MM DIFFERENTIAL	[illegible]	[illegible]
NEUTROPHILES PERCENT	84	[illegible]
JUVENILE FORMS PERCENT	[illegible]	[illegible]
LYMPHOCYTES PERCENT	[illegible]	[illegible]
MONOCYTES PERCENT	[illegible]	[illegible]
EOSINOPHILES PERCENT	[illegible]	[illegible]
BASOPHILES PERCENT	[illegible]	[illegible]
RETICULOCYTE COUNT PERCENT	[illegible]	[illegible]

	ON NOV 25 [illegible]	
	MEAN	RANGE	NORMAL RANGE
RED CELL COUNT MILLIONS MM	[illegible]	[illegible] TO [illegible]	[illegible]
HEMATOCRIT PERCENT	46	45 TO 49	[illegible]
HEMOGLOBIN CONCENTRATION GRAM PERCENT	[illegible]	[illegible]	[illegible]
RED BLOOD CELL INDICES			
MEAN CORPUSCULAR			
VOLUME μ	88	[illegible] TO [illegible]	85 TO [illegible]
HEMOGLOBIN γγ	29	29 TO 33	27 TO 31
HEMOGLOBIN CONCENTRATION PERCENT	34	33 TO 35	30 TO 34

ISOTOPE VOLUME STUDIES	PREDICTED	OBSERVED
BLOOD VOLUME CC	4550	4418
PLASMA VOLUME CC	2502	2341
RED BLOOD CELL MASS VOLUME CC	2048	2077

RED BLOOD SURVIVAL DAYS*	25 DAYS	NORMAL 22 TO 29 DAYS*
SPLEEN LIVER	1.44	

SUMMARY OF FLIGHT DATA

EVENT	PULSE RATE, BEATS/MIN	BLOOD PRESS., mm Hg	RESP. RATE, BREATHS/MIN	BODY TEMP., °F
LIFT-OFF PERIOD (MAXIMUM)	110	-	14	97.6
SPACECRAFT SEP.	114	-	12	97.6
WEIGHTLESSNESS	MEAN 86	MEAN 129/70	8 TO 14	98.6
RETROFIRE	96	-	12	99.2
REENTRY PERIOD (MAXIMUM)	134	-	19	99.3
BIOSENSOR DISCONNECT	104	-	16	99.5

MEASUREMENTS AND TECHNIQUES

ENDOCRINE *

CLINICAL ENDOCRINE EVALUATION (Hx FORM, AND Px)

MEASUREMENT OF PITUITARY ACTIVITY (CIRCULATING ACTH; URINARY ADH, AND SPECIFIC GRAVITY)

MEASUREMENT OF THYROID ACTIVITY (PBI; TBPA)

MEASUREMENT OF PARATHYROID ACTIVITY (CIRCULATING PARATHORMONE)

MEASUREMENT OF ADRENAL CORTICAL ACTIVITY (URINARY 17 OHCS, 17 KETOSTEROIDS, AND ALDOSTERONE)

MEASUREMENT OF GONADAL ACTIVITY (PRE- AND POST-FLIGHT GERM CELL EXAMINATION)

MEASUREMENT OF NEURO-HUMORAL ACTIVITY (URINARY CATECHOLAMINES AND SEROTONIN)

* The majority of A A medical measurements and techniques described, particularly under "Metabolism and Nutrition," are applicable to the evaluation of endocrine function. They are too numerous to be listed here.

† Assays to be done in earth based laboratories on specimens collected and stored in flight.

MM65-11,396
11-6-65

MEASUREMENTS AND TECHNIQUES

CARDIOVASCULAR

1. ASSESSMENT:

- CLINICAL CARDIOVASCULAR EVALUATION (Hx FORM, AND Px)
- BLOOD PRESSURE MEASUREMENT
- IMPEDENCE PNEUMOGRAM (SEE "RESPIRATORY")
- BODY TEMPERATURE (SEE "METABOLIC AND NUTRITIONAL")
- ELECTROCARDIOGRAM
- PHONO-ELECTROCARDIOGRAM (M-4)
- CARDIAC OUTPUT (NON-INVASIVE)
- THORACIC BLOOD FLOW (PLETHYSMOGRAPHY)
- CENTRAL AND PERIPHERAL VENOUS PRESSURE
- VENOUS COMPLIANCE
- REGIONAL BLOOD FLOW
- ARTERIOLAR REACTIVITY

  } LIMB PLETHYSMOGRAPHY
- BODY FLUID DISTRIBUTION
- URINARY CATECHOLAMINES, ADRENAL STEROIDS, ADH (SEE "ENDOCRINE")
- FLUID AND ELECTROLYTE BALANCE (SEE "METABOLIC AND NUTRITIONAL")

MA65-11,391
11-6-65

SUMMARY CARDIOPULMONARY DATA MA-8

EVENT	PULSE	BLOOD PRESSURE	RESPIRATION RATE
PRELAUNCH	72	117/89	20
LAUNCH	112	---	37
ORBITAL	76	126/69	19
REENTRY	104	---	43
POSTFLIGHT	56 (SUPINE)	120/84	--
	104 (ERECT)	94/70	--

FLIGHT TIME: 9 HRS 12 MIN
WEIGHT LOSS: $4\frac{1}{2} \pm \frac{1}{4}$ LBS
POSTFLIGHT TEMPERATURE:
100. 1°F (RECTAL)
HEMATOCRIT: 44 TO 47
SUBJECTIVE SYMPTOMS: NONE

MEASUREMENTS AND TECHNIQUES

HEMATOLOGICAL

GENERAL:

CLINICAL EVALUATION (Hx FORM AND Px)

CELLULAR CHANGES:

MEASUREMENT OF HEMIC CELL DYNAMICS (BLOOD CELL COUNTS AND MORPHOLOGY)

RBC SURVIVAL (ISOTOPE TAGGED RBC'S; RBC FRAGILITY; DIRECT BILIRUBIN - M-22)

CYTOGENETIC STUDIES (LYMPHOCYTE KARYOTYPING - M-11)

BODY DEFENSES:

LEUKOCYTE MOBILITY (PHAGOCYTOSIS)

IMMUNOLOGICAL EVALUATION (GLOBULIN ELECTROPHORESIS; ANTIBODY TITRATION; MEASUREMENT OF COMPLEMENT)

HEMATOSIS:

EVALUATION OF HEMOSTATIC MECHANISMS (BLEEDING AND COAGULATION TIMES; ASSAY OF ELEMENTS OF CLOTTING)

MM65-11,397
11-6-65

MEASUREMENTS AND TECHNIQUES

CARDIOVASCULAR (CONT'D)

2. PROVOCATIVE TESTING:

TILT TABLE RESPONSE (PRE- AND POST-FLIGHT)

FITNESS EVALUATION (PRE- AND POST-FLIGHT)

RESPONSE TO THERMAL CHANGE (ORTHOSTATIC TOLERANCE AND CUTANEOUS BLOOD FLOW)

RESPONSE TO CAROTID BODY STIMULATION (PROVOCATIVE AND REMEDIAL)

RESPONSE TO IN-FLIGHT EXERCISE (PROVOCATIVE AND REMEDIAL)

RESPONSE TO IN-FLIGHT EXERCISE (PROVOCATIVE AND REMEDIAL)

3. COUNTERMEASURES:

RESPONSE TO OCCLUSIVE CUFFS (M-1)

RESPONSE TO ANTI-G SUIT PRE-REENTRY

RESPONSE TO ELASTIC LEOTARD PRE-REENTRY

MM65-11,392
11-6-65

SUMMARY CARDIOPULMONARY DATA MA-9

EVENT	PULSE	BLOOD PRESSURE	RESPIRATION RATE
PRELAUNCH	72	113/79	19
ORBITAL	89	119/81	15
POSTFLIGHT (1-7 HRS) *	83 (SUPINE)	89/64	--
	123 (ERECT)	90/73	--
(18 HRS)	58 (SUPINE)	98/61	--
	80 (ERECT)	94/68	--

FLIGHT TIME: 34 1/3 HRS
WEIGHT LOSS: 7¾ LBS
POSTFLIGHT TEMPERATURE: 99.4°F (ORAL)
HEMATOCRIT: 43 TO 49
SUBJECTIVE SYMPTOMS: DIZZINESS

* SUBJECT UNDER RESIDUAL EFFECTS OF 5 MGM D-AMPHETAMINE SULFATE

MEASUREMENTS AND TECHNIQUES

MICROBIOLOGICAL

CLINICAL EXAMINATION (Hx FORM, AND Px)

ASSESSMENT OF CHANGES IN MICROBIOLOGICAL ECOLOGY AMONG FLIGHT CREW MEMBERS (CULTURES OF NOSE, THROAT, GI TRACT, SKIN; COUGH PLATES; CULTURES OF CABIN AND SUIT ECS)

MM65-11,398
11-6-65

MEASUREMENTS AND TECHNIQUES

RESPIRATORY

CLINICAL RESPIRATORY EVALUATION (Hx FORM, AND Px)

IMPEDENCE PNEUMOGRAM

LUNG CAPACITIES (AND BREATH HOLDING TIME)

WORK OF BREATHING

- LUNG COMPLIANCE
- GAS FLOW RATE
- AIRWAY RESISTANCE
- MAXIMUM INSPIRATORY AND EXPIRATORY PRESSURES

CLEARANCE OF INERT GAS (He OR N_2)

MEASUREMENT OF RESPIRATORY GAS EXCHANGE

- O_2 AND CO_2 IN EXPIRED AIR
- ARTERIAL (OR CAPILLARY) O_2 AND CO_2 CONTENT AND pH

FITNESS EVALUATION PRE- AND POST-FLIGHT (SEE "CARDIOVASCULAR")

MM65-11,393
11-6-65

IN-FLIGHT EXERCISE EXPERIMENT MA-9

(CALIBRATED WORKLOAD)

	PREFLIGHT (5 DETERMINATIONS)		FLIGHT (2 DETERMINATIONS)	
	MEAN HEART RATE	MEAN BLOOD PRESSURE	MEAN HEART RATE	MEAN BLOOD PRESSURE
PREWORK	74	104/81	89	117/77
WORK	115	---	131	---
POSTWORK	85	111/79	106	124/95

MA-9 MEDICAL DATA

- TEMPERATURE, ORAL
- ECG
- RESPIRATION
- BLOOD PRESSURE
- VOICE
- TELEVISION
- MOTION PICTURES OF ASTRONAUT
- SUIT CO_2
- SUIT AND CABIN O_2
- SUIT OUTLET AND CABIN TEMPERATURES

- BLOOD CHEMISTRIES
  - CALCIUM
  - CHLORIDE
  - PHOSPHORUS
  - SODIUM
  - POTASSIUM
  - TOTAL PROTEIN
- URINE
  - ROUTINE URINALYSIS
  - SODIUM
  - POTASSIUM
  - CALCIUM
  - CHLORIDE
  - PO_4
  - CREATININE

MEASUREMENTS AND TECHNIQUES

METABOLIC AND NUTRITIONAL

GENERAL:

CLINICAL METABOLIC AND NUTRITIONAL EVALUATION (Hx FORM, AND Px)

DETERMINATION OF LEAN BODY MASS (BODY MASS AND BODY VOLUME)

MEASUREMENT OF CORE AND SKIN TEMPERATURES

MUSCULAR STATUS:

MEASUREMENT OF MUSCLE SIZE AND STRENGTH

MEASUREMENT OF MUSCULAR EFFICIENCY (BLOOD LACTIC ACID; URINARY CREATININE AND CREATINE)

ELECTROMYOGRAPHY

FITNESS EVALUATION PRE- AND POST-FLIGHT (SEE "CARDIOVASCULAR")

MINERAL METABOLISM AND SKELETAL STATUS:

ELECTROLYTE BALANCE (INCLUDING URINALYSIS FOR STONE PRECURSORS)

IN-FLIGHT BONE DENSITY (INCLUDING SERUM ALKALINE PHOSPHATASE)

PRE- AND POST-FLIGHT BONE DENSITOMETRY (M-6)

MM65-11,394
11-6-65

MEASUREMENTS AND TECHNIQUES

BEHAVIORAL

1. SENSORY-PERCEPTUAL PROCESSES:

VISUAL FUNCTION (ACUITY, DEPTH PERCEPTION, PHORIAS, PATTERNS, READING)

AUDITORY FUNCTION (PITCH, INTENSITY, LOCALIZATION, PATTERNS, MOTION, SPEECH)

KINESTHETIC FUNCTION (POSITIONAL, DYNAMIC)

VESTIBULAR FUNCTION (LINEAR, ANGULAR) (SEE "NEUROLOGICAL")

ORIENTATION ABILITY (TEMPORAL, POSITIONAL, LOCATION)

2. PSYCHOMOTOR FUNCTIONING:

FINE MOTOR MOVEMENT (MANIPULATION, DEXTERITY, POSITIONING, STEADINESS)

GROSS MOTOR MOVEMENT (LOCOMOTION, DEXTERITY)

CONTINUOUS PROCESS (PURSUIT AND COMPENSATORY TRACKING – MOTOR AND COGNITIVE)

DISCRETE PROCESS (SIMPLE AND COMPLEX REACTION – MOTOR AND COGNITIVE)

3. COGNITIVE PROCESSES:

MEASUREMENT OF ATTENTION AND VIGILANCE (VISUAL AND AUDITORY)

PROBLEM SOLVING ABILITY (COMPUTATIONAL, SYMBOLIC, DIAGNOSTIC)

LEARNING ABILITY AND MEMORY RETENTION (LONG AND SHORT TERM)

4. INTEGRATED PERFORMANCE:

CONDUCT OF REENTRY SIMULATION

MM65-11,399
11-6-65

MA-9 MEDICAL DATA
(CONTINUED)

- RETINAL PHOTOGRAPHS PRE- AND POST FLIGHT
- RADIOLOGICAL MEASUREMENT
  - FILM BADGES AND THERMO-LUMINESCENT DETECTORS ON ASTRONAUT
  - IONIZATION CHAMBER INSIDE HATCH
  - EMULSION PACKS ABOUT CABIN
  - GEIGER-MUELLER CHAMBERS (2) IN RETROPACK
- SPECIAL TESTS
  - INFLIGHT EXERCISE - BUNGEE CORD
  - PRE- AND POSTFLIGHT TILT TABLE STUDIES WITH FLACK TEST

MEASUREMENTS AND TECHNIQUES

METABOLIC AND NUTRITIONAL (CONT'D)

GENERAL METABOLISM AND NUTRITION:

- METABOLISM AT VARIOUS LEVELS OF ACTIVITY (O_2 CONSUMPTION, CO_2 PRODUCTION, AND CALORIC INTAKE)
- GLUCOSE TOLERANCE
- FAT TOLERANCE
- MEASUREMENT OF ACID BASE METABOLISM (SEE ALSO "RESPIRATORY GAS EXCHANGE")
- PROTEIN METABOLISM (SERUM PROTEINS WITH ELECTROPHORESIS; NPN; BUN; BLOOD URIC ACID)
- FLUID BALANCE
- BODY FLUID DISTRIBUTION (SEE "CARDIOVASCULAR")
- STANDARD CLINICAL URINALYSIS

GASTROINTESTINAL ACTIVITY:

- MEASUREMENT OF GASTRIC MOTILITY AND pH (ENDORADIOSONDE)

*THERMAL REGULATION:

- COMFORT INDEX FOR VARYING THERMAL LOADS
- CARDIOVASCULAR RESPONSE TO THERMAL CHANGE (ORTHOSTATIC TOLERANCE AND CUTANEOUS BLOOD FLOW) (SEE "CARDIOVASCULAR")

* Effects of thermal change on metabolism, fluid and electrolyte balance, and other measurements also to be assessed.

MM65-11,395
11-6-65

MEASUREMENTS AND TECHNIQUES

NEUROLOGICAL

CLINICAL NEUROLOGICAL EVALUATION (Hx FORM, AND Px)

CEREBRAL ELECTRICAL ACTIVITY (EEG—M-8)

OCULAR COUNTER-ROLLING (IN-FLIGHT)

EGOCENTRIC VISUAL LOCATION OF HORIZON (M-9)

OCULOGRAVIC ILLUSION

OCULOGYRIC ILLUSION

THRESHOLD OF LINEAR ACCELERATIONS TO HEAD

VISUAL TASK PERFORMANCE WITH HEAD ROTATION

NYSTAGMOGRAM (EOG)

EYE MOVEMENT CINEMATOGRAPHY (FIBER OPTICS BUNDLE)

MM65-11,390
11-6-65

pH PROBE

MM65-11.332
11-6-65

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : ENDOCRINE-EXPERIMENT 0117

EXPERIMENTAL OBJECTIVES :

1. DETERMINE AND QUANTITATE THE OCCURRENCE OF ANY CHANGES IN ENDOCRINE AND NEUROENDOCRINE FUNCTION
2. DETERMINE MECHANISMS WHICH MEDIATE ANY OBSERVED CHANGES

CANDIDATE EQUIPMENT:

- M-5 (A)
- STANDARD CLINICAL AND LABORATORY TECHNIQUES
- STANDARD STORAGE TECHNIQUES

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : NEUROLOGICAL-EXPERIMENTS 0101 AND 0102

EXPERIMENTAL OBJECTIVES :
1. EVALUATE CHANGES IN SENSITIVITY OF OTOLITH MECHANISM
2. INVESTIGATE THE OCULOGRAVIC ILLUSION

CANDIDATE EQUIPMENT:

- M-9(A); M-21
- VESTIBULAR RESEARCH TECHNIQUES

MM65-10, 997

HUMAN PPERFORMANCE MEASUREMENTS

MEASUREMENT	METHOD
SENSORY-PERCEPTUAL	
ATTENTION-AUDITORY	WARNING SIGNALS
VISION-PATTERNS	MATCHING ON CRT DISPLAY
VISION-READING	COMPREHENSION-CRT
KINESTHESIS-POSITION	JOYSTICK AIMING-CRT
KINESTHESIS-TRACKING	JOYSTICK-VISUAL CRT TARGET
KINESTHESIS-DYNAMIC	LIMB POSITION-TIME & CAMERA RECORDING
VESTIBULAR-LINEAR	DETECTION OF THRESHOLD
VESTIBULAR-ANGULAR	DETECTION OF THRESHOLD
ORIENTATION-TEMPORAL	FILLED/UNFILLED TIME ESTIMATES
ORIENTATION-POSITION	SITUATIONAL-CAMERA RECORDING
ORIENTATION-LOCATION	SITUATIONAL-CAMERA RECORDING

MM65-10,994

OXYGEN SENSOR

MM65-11,324
11-6-65

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : HEMATOLOGICAL-EXPERIMENTS 0118, 0119, AND 0120

EXPERIMENTAL OBJECTIVES :

1. DETERMINE HEMATOLOGICAL CELLULAR CHANGES
2. ASSESS CHANGES IN IMMUNOLOGICAL SYSTEM AND LEUKOCYTE FUNCTION
3. DETERMINE BLOOD COAGULATION AND HEMOSTASIS CHANGES

CANDIDATE EQUIPMENT:

- M-11
- STANDARD CLINICAL AND LABORATORY TECHNIQUES

MM65-11, 301

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : CARDIOVASCULAR-EXPERIMENTS 0103, 0104, 0105, 0106, 0107, 0108

EXPERIMENTAL OBJECTIVES : 1. ASSESSMENT:

A. GENERAL CARDIOVASCULAR STATUS

B. STATUS OF MYOCARDIUM

C. STATUS OF VENOUS AND ARTERIAL INTEGRITY

D. STATUS OF BODY FLUID DISTRIBUTION

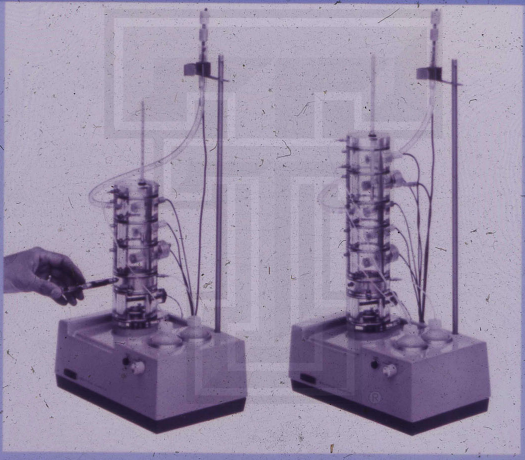
MM65-10, 998

HUMAN PERFORMANCE MEASUREMENTS (CONT'D)

MEASUREMENT	METHOD
SENSORY-PERCEPTUAL	
VISUAL ACUITY	OCULOMETER
DEPTH PERCEPTION	OCULOMETER
VISION-PHORIAS	OCULOMETER
AUDITION-INTENSITY	THRESHOLDS-TAPE RECORDINGS
AUDITION-PITCH	THRESHOLDS-TAPES
AUDITION-LOCALIZATION	DICHOTIC TAPE PRESENTATION
AUDITION-PATTERNS	TAPED PATTERNS
AUDITION-MOTION	DICHOTIC TAPES
AUDITION-SPEECH	PERCEPTION "CLIPPED" TAPES
VIGILANCE-AUDITORY	MONITORING FOR PRESENCE OR ABSENCE OF SIGNAL

MM65-10,994

BLOOD GAS ANALYZER



MM65-11,326
11-6-65

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : MICROBIOLOGICAL-EXPERIMENT 0121

EXPERIMENTAL OBJECTIVES : 1. DETERMINE CHANGES IN BACTERIAL ECOLOGY UNDER ACTUAL SPACE FLIGHT CONDITIONS

CANDIDATE EQUIPMENT:

- STANDARD BACTERIOLOGIC TECHNIQUES

MM65-11, 300

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM (CONT'D)

2. PROVOCATIVE TESTING:
   - A. TILT TABLE STUDIES (PRE & POST FLIGHT)
   - B. FITNESS EVALUATION (PRE & POST FLIGHT)
   - C. EXERCISE
   - D. LBNP
   - E. CAROTID SINUS STIMULATION

3. COUNTERMEASURES:
   - A. EXERCISE
   - B. LBNP
   - C. PNEUMATIC CUFFS-LOWER EXTREMITIES
   - D. MEDICATIONS
   - E. SUPPORTING MEASURES

CANDIDATE EQUIPMENT:

- M-1(A); M-3; M-4(A); M-5(A); M-12; M-17; M-18; M-22; M-23
- OPERATIONAL SAFETY MONITORING; TILT, BODY FLUID DISTRIBUTION STUDIES
- CARDIOVASCULAR CLINICAL AND LABORATORY EQUIPMENT
- STANDARD STORAGE TECHNIQUES
- PROPOSED TECHNIQUES (SPAMAG)

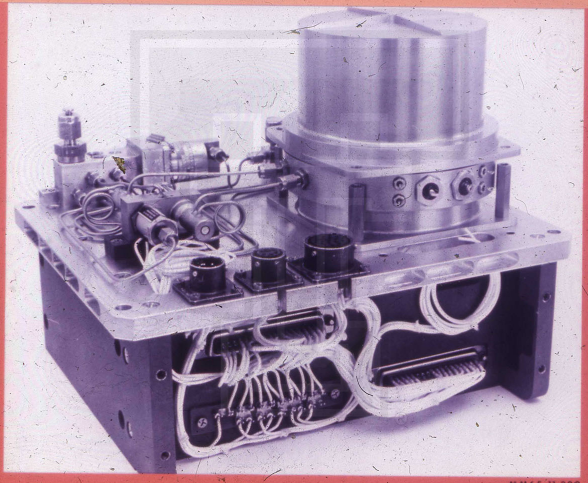
MM65-10,998

HUMAN PERFORMANCE MEASUREMENTS

MEASUREMENT	METHOD
PSYCHOMOTOR	
FINE MOTOR-MANIPULATION	DIAL ADJUSTMENT
FINE MOTOR-DEXTERITY	FINGER DEXTERITY IN SWITCHING
FINE MOTOR-POSITIONING	BALLISTIC AIMING
FINE MOTOR-STEADINESS	DIGIT AND HAND STEADINESS
GROSS MOTOR-LOCOMOTION	SOARING-CAMERA RECORDING
GROSS MOTOR-DEXTERITY	PRESSURE SUIT-DON AND DOFF-TIME AND CAMERA RECORDING
CONTINUOUS PROCESS-PURSUIT TRACKING	CRT DISPLAY/CONTROL
CONTINUOUS PROCESS-COMPENSATORY TRACKING	CRT DISPLAY/CONTROL
DISCRETE PROCESS-SIMPLE REACTION	VISUAL REACTION

MM65-10, 995

GAS CHROMATOGRAPH



MM65-11,329
11-6-65

ELECTROCARDIOGRAM AND IMPEDANCE PNEUMOGRAPH SIGNAL CONDITIONERS

MM65-11,333
11-6-65

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA: RESPIRATORY-EXPERIMENTS 0109 AND 0110

EXPERIMENTAL OBJECTIVES:
1. MEASURE PULMONARY CAPACITIES AND LUNG VOLUMES
2. DETERMINE STATUS OF PULMONARY GAS EXCHANGE

CANDIDATE EQUIPMENT:

- M-12; M-19; M-20
- PULMONARY CLINICAL AND RESEARCH EQUIPMENT
- STANDARD PHYSICAL CHEMISTRY TECHNIQUES
- STANDARD STORAGE TECHNIQUES
- PROPOSED TECHNIQUES (SPAMAG, INDUSTRY)

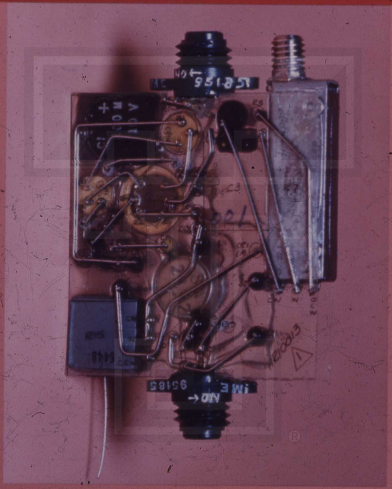
MM65-11, 304

HUMAN PERFORMANCE MEASUREMENTS (CONT'D)

MEASUREMENT	METHOD
COGNITIVE	
DISCRETE PROCESS-COMPLEX REACTION	VISUAL CRT SIGNALS
DISCRETE PROCESS-COMPLEX SEQUENCE	SYNTHETIC OPERATIONAL TASK
VIGILANCE-VISUAL	DRIFT MONITORING
ATTENTION-VISUAL	WARNING LIGHTS
PROBLEM-SOLVING-COMPUTATION	CRT PRESENTATION
PROBLEM-SOLVING-SYMBOLIC	INDUCTIVE CATEGORIZATION
PROBLEM-SOLVING-DIAGNOSTIC	SYNTHETIC TROUBLESHOOTING
LEARNING AND MEMORY-SHORT TERM	ALPHANUMERIC PRESENTATION
MEMORY-LONG TERM	OPERATIONAL PROCEDURES

MM65-10, 995

PHONOCARDIOGRAM SIGNAL CONDITIONER



MM65-11-331
11-6-65

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA: METABOLIC AND NUTRITIONAL-EXPERIMENTS 0111, 0112, 0113, 0114, AND 0115

EXPERIMENTAL OBJECTIVES:

1. EVALUATE EFFECTS ON MUSCLE MASS AND STRENGTH
2. EVALUATE EFFECTS ON MINERAL METABOLISM
3. ASSESS NUTRITION STATUS
4. EVALUATE EFFECTS ON GASTROINTESTINAL MOTILITY
5. EVALUATE EFFECTS ON THERMAL REGULATION

CANDIDATE EQUIPMENT:

- M-5 (A); M-6 (A); M-7 (A); M-12; M-19
- STANDARD CLINICAL AND LABORATORY TECHNIQUES
- STANDARD STORAGE TECHNIQUES
- PROPOSED TECHNIQUES (SPAMAG, INDUSTRY)

MM65-11, 302

PROPOSED MEDICAL AND BEHAVIORAL MEASUREMENTS FOR APOLLO APPLICATIONS PROGRAM

FUNCTIONAL AREA : BEHAVIORAL-EXPERIMENTS 0201, 0202 AND 0203

EXPERIMENTAL OBJECTIVES :

1. EVALUATE SENSORY-PERCEPTUAL PROCESSES
2. EVALUATE PSYCHOMOTOR FUNCTIONING
3. EVALUATE HIGHER MENTAL PROCESSES

CANDIDATE EQUIPMENT:

- M-8
- STANDARD CLINICAL AND LABORATORY TECHNIQUES
- PROPOSED BEHAVIORAL CONSOLE (INDUSTRY)

MM65-10,999

GEMINI MEDICAL EXPERIMENTS SCHEDULE

(JANUARY 1965)

CODE	SHORT TITLE	WEIGHT	VOLUME CU. IN.	GT-3 3 ORBITS	GT-4 4 DAYS	GT-5 7 DAYS	GTA-6 2 DAYS	GT-7	GTA-8	GTA-9	GTA-10	GTA-11	GTA-12
M-1	CUFFS	3 lbs.	210			X	+	X	+				
M-2	TILT TABLE	NA	NA	+	+	+	+	+	+	+	+	+	
				INCLUDE AS MED. OPS. PROCEDURE									
M-3	EXERCISE TOLERANCE	8 OZ.	10		X	X	+	X				+	
M-4	PHONO -ELECTROCARDIOGRAM	1 TO 2 OZ.	1.5		X	X	X	X	+	+	+	+	
M-5	BODY FLUIDS	75 GMS PER VOIDING	75 CC PER VOIDING				X	X	X	X	X	X	X
M-6	BONE DENSITOMETRY	NA	NA		X	X	+	X	+	+	+		
M-7	ELECTROLYTE BALANCE	M-5 SPECIMEN	M-5 SPECIMEN					X		+			
M-8	SLEEP ANALYSIS	10 OZ.	NA			+		X		X			
M-9	VESTIBULAR	8 OZ.	D-13 EQUIP'T			X*		X					
M-10	MOVEMENT	NA	NA	INCLUDED AS OPERATIONAL PROCEDURE									
M-13	VASCULAR RESPONSE	NA	NA	INCLUDED AS MED. OPS. PROCEDURE									

X MSFEB APPROVED AND REMAINING

+ MSFEB APPROVED; LATER DELETED BY MEP REQ.

X* ADDED TO SCHEDULE BY MSFEB AT LATER DATE

NASA MT64 9220
Rev. 5-17-65

GEMINI OPERATIONAL MEDICAL FINDINGS THROUGH GEMINI 5

(MAXIMUM DURATION 8 DAYS)

- DEHYDRATION
- DECREASED BLOOD VOLUME
- DIMINISHED TILT TABLE TOLERANCE (UP TO 36 HOURS POST-FLIGHT)
- ALTERED SLEEP PATTERNS IN-FLIGHT (WITH LATER RETURN TO NORMAL - GEMINI 5)
- NO DEGRADATION OF OPERATIONAL PERFORMANCE
- PHYSIOLOGICAL STATUS RETURNED TO NORMAL WITHIN ONE WEEK

NASA MG4 5-10,102
9/22/65

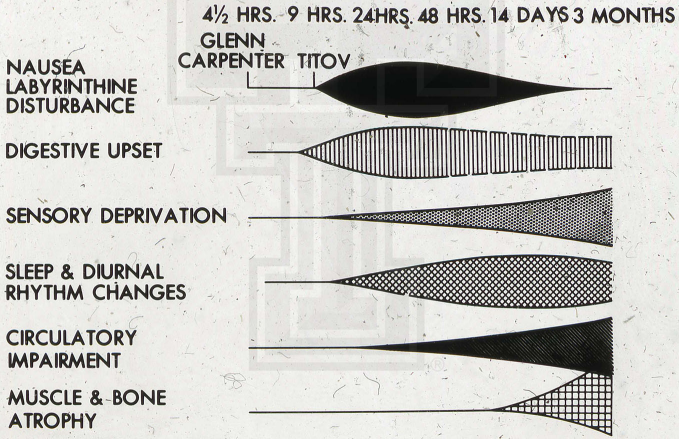
POTENTIAL MEDICAL PROBLEM AREAS AS VIEWED PRE-GEMINI

FUNCTIONS QUESTIONED	ORIGIN OF EVIDENCE	GEMINI APPROACHES
PRIMARY QUESTIONS		
CARDIOVASCULAR	1,2, & 3	M.O.+EXP.M1, M3, M4 & M5
WATER BALANCE (DEHYDRATION)	1,2, & 3	M.O.+EXP. M5
SKELETAL	2	EXP.M5, M6, & M7
MUSCULAR	1 & 2	M.O.+EXP.M7
OTHER IMPORTANT QUESTIONS		
BEHAVIORAL	2	M.O.
VESTIBULAR	2 & 3	EXP M9
METABOLIC & DIGESTIVE	2	(APOLLO)
RESPIRATORY	2	M.O.
CELLULAR	3	(APOLLO)
SLEEP AND DIURNAL RHYTHMS	2	M-8 (M-5)
VISUAL	1	EXP. S-8

1 = MERCURY FLIGHTS
2 = GROUND BASED DATA
3 = RUSSIAN FLIGHT DATA
M.O. = MEDICAL OPERATIONS INFO.

NASA MG 5-10,154
9-22-65

EXPECTED TIME COURSE IF SYMPTOMS DEVELOP IN WEIGHTLESSNESS



BONE DEMINERALIZATION EXPERIMENT (M-6)
PRELIMINARY FINDINGS
GEMINI 4 AND 5

RAW DATA: GEMINI 4 (4 DAYS) - OS CALCIS AND FIFTH FINGER X-RAYS OF BOTH ASTRONAUTS SHOW DIMINISHED POST-FLIGHT X-RAY DENSITY.

GEMINI 5 (8 DAYS) - QUANTITATIVE CHANGES SAME AS GEMINI 4 IN ONE ASTRONAUT: GREATER IN OTHER.

PROBLEMS: DATA VERY PRELIMINARY. REPETITION REQUIRED, PREFERABLY WITH SIMULTANEOUS CALCIUM BALANCE STUDY FOR ESTABLISHMENT OF STATISTICAL VALIDITY.

TENTATIVE CONCLUSIONS: SKELETAL DECONDITIONING OCCURS IN SPACE FLIGHT APPROXIMATELY AS ANTICIPATED. NO PRACTICAL PROBLEM IN 8 DAYS.

FUTURE PLANS: WILL BE REPEATED ON GEMINI 7 IN CONJUNCTION WITH CALCIUM BALANCE STUDY.

NASA MG5-10,386
9-22-65

MEDICAL OPERATIONS FLIGHT DATA

PRE AND POST-FLIGHT

SOURCE	FINDINGS
• PHYSICAL EXAMINATION	DEHYDRATION
• BRIEFING & DEBRIEFING	PERFORMANCE NORMAL HUNGER IN FLIGHT. FOOD INCREASED ENERGY [GEMINI 4]
• ROUTINE BLOOD & URINE ANALYSIS	DEHYDRATION ONLY
• TILT TABLE	DIMINISHED TOLERANCE
• BODY FLUID DISTRIBUTION	
• TOTAL BODY WATER	
• BLOOD VOLUME	DECREASED
PLASMA VOLUME	DECREASED
• RBC MASS	DECREASED
• VENOUS COMPLIANCE	DIMINISHED
ARTERIOLAR REACTIVITY	NOT MEASURED

NASA MG5-10,098
9/22/65

SPACEFLIGHT MEDICAL INFORMATION REQUIRED

- EFFECTS ON HUMAN FUNCTIONS AND TIME COURSE
- MECHANISMS INVOLVED
- PREDICTIVE MEANS
- CORRECTIVE MEANS

MM 5-9986

MSFEB APPROVED GEMINI MEDICAL EXPERIMENTS SCHEDULE

CODE	SHORT TITLE	WEIGHT	VOLUME CU. IN.	GEMINI 3 3 ORBITS	GEMINI 4 4 DAYS	GEMINI 5 8 DAYS	GEMINI 6 2 DAYS	GEMINI 7 14 DAYS	GEMINI 8 2 DAYS	GEMINI 9 2 DAYS	GEMINI 10 2 DAYS	GEMINI 11 2 DAYS	GEMINI 12 4 DAYS
M-1	CARDIOVASCULAR CONDITIONING	80 OZ				X		X					
M-2	TILT TABLE	NA	NA	INCLUDE AS MED. OPS. PROCEDURE									
M-3	IN-FLIGHT EXERCISER	8 OZ			X	X		X					
M-4	IN-FLIGHT PHONOCARDIOGRAM	1 TO 2 OZ			X	X		X					
M-5	BIOASSAYS BODY FLUIDS	75 GMS PER VOIDING	75 CC PER VOIDING				X	X	X	X	X	X	X
M-6	BONE DEMINERALIZATION	NA	NA		X	X		X					
M-7	CALCIUM BALANCE STUDY	M-5 SPECIMEN	M-5 SPECIMEN					X					
M-8	IN-FLIGHT SLEEP ANALYSIS	18 OZ	NA					X		X			
M-9	HUMAN OTOLITH FUNCTION	8 OZ	8-13 EQUIP'T			X		X					
M-10	MOVEMENT	NA	NA	INCLUDED AS OPERATIONAL PROCEDURE									
M-13	VASCULAR RESPONSE	NA	NA	INCLUDED AS MED. OPS. PROCEDURE									

IN-FLIGHT EXERCISE EXPERIMENT (M-3)
PRELIMINARY FINDINGS
GEMINI 4 AND 5

COMPARATIVE CARDIOVASCULAR RESPONSES TO EXERCISE:

	FLIGHT/PRE-FLIGHT	FLIGHT/FLIGHT (TIME COURSE)
GEMINI 4 (4 DAYS): (BOTH ASTRONAUTS)	NO SIGNIFICANT CHANGE	NO SIGNIFICANT CHANGE
GEMINI 5 (8 DAYS): (BOTH ASTRONAUTS)	NO SIGNIFICANT CHANGE	NO SIGNIFICANT CHANGE

PROBLEMS: EXERCISER USED AD LIB BECAUSE OF ASTRONAUT DESIRE FOR EXERCISE.

TENTATIVE CONCLUSIONS: NO CHANGE IN CARDIOVASCULAR RESPONSE TO EXERCISE DISCERNIBLE IN MISSIONS UP TO 8 DAYS.

FUTURE PLANS: TO BE REPEATED ON GEMINI 7.

NASA MG5-10,388
9-22-65

GEMINI OPERATIONAL MEDICAL FINDINGS THROUGH GEMINI 5

(MAXIMUM DURATION 8 DAYS)

- DEHYDRATION
- DECREASED BLOOD VOLUME
- DIMINISHED TILT TABLE TOLERANCE (UP TO 36 HOURS POST-FLIGHT)
- ALTERED SLEEP PATTERNS IN-FLIGHT (WITH LATER RETURN TO NORMAL - GEMINI 5)
- NO DEGRADATION OF OPERATIONAL PERFORMANCE
- PHYSIOLOGICAL STATUS RETURNED TO NORMAL WITHIN ONE WEEK

NASA MG4 5-10,102
9/22/65

MEDICAL OPERATIONS FLIGHT DATA

IN-FLIGHT

SOURCE	FINDINGS
• ECG	ARRHYTHMIAS
• RESPIRATION	NO SIGNIFICANT CHANGE
• BLOOD PRESSURE	SLIGHT DECREASE
• TEMPERATURE	SLIGHT ELEVATION
• VOICE CONTACT	NO ABNORMALITIES IN ALERTNESS OR COGNITION·EASE OF FATIGUE ON GEMINI 4 ATTRIBUTED TO UNSATISFACTORY W-R-S CYCLES. CORRECTED ON GEMINI 5.

NASA MG5-10,097
9-22-65

CARDIOVASCULAR CONDITIONING EXPERIMENT (M-I)
PRELIMINARY FINDINGS
GEMINI 5

- EQUIPMENT FAILURE AT 92 HOURS, 26 MINUTES (GET)
- COMPARATIVE RESPONSES OF EXPERIMENTAL WITH CONTROL PILOT:
  - INFLIGHT

BLOOD PRESSURE	NO SIGNIFICANT DIFFERENCE
ECG	NO SIGNIFICANT DIFFERENCE
EXERCISE RESPONSES	NO SIGNIFICANT DIFFERENCE
PHONO-ECG	DATA REDUCTION IN PROCESS

  - POST FLIGHT

TILT RESPONSE	LESS CHANGE
BLOOD VOLUME	LESS CHANGE
PLASMA VOLUME	LESS CHANGE
RBC MASS	SAME
VENOUS COMPLIANCE	LESS CHANGE

- CONCLUSIONS: REQUIREMENTS FOR MODERATE TECHNICAL CHANGES ASCERTAINED
- FUTURE PLANS: TO BE REPEATED ON GEMINI 7

NASA MG5-10,385
9-22-65

GEMINI MEDICAL EXPERIMENTS

- M-1 CARDIOVASCULAR CONDITIONING
- M-3 INFLIGHT EXERCISER
- M-4 INFLIGHT PHONOCARDIOGRAM
- M-5 BIOASSAYS BODY FLUIDS
- M-6 BONE DEMINERALIZATION
- M-7 CALCIUM BALANCE STUDY
- M-8 INFLIGHT SLEEP ANALYSIS
- M-9 HUMAN OTOLITH FUNCTION

NASA MM 4-5557
9/22/65

SIGNIFICANCE OF MEDICAL DATA THROUGH GEMINI-5

- SIGNIFICANT TO 14 DAY AND LUNAR LANDING MISSIONS.
- SIGNIFICANT TO 14 DAY AND LUNAR LANDING MISSIONS.
- SIGNIFICANT TO PROLONGED EARTH ORBITAL MISSIONS.
- SIGNIFICANT TO ORL PLANNING.
- SIGNIFICANT TO LONG TERM MISSION PLANNING AND VEHICULAR DESIGN.
- SIGNIFICANT TO FUTURE LONG DURATION MISSIONS.
- SIGNIFICANT TO APPLICATION TO RESEARCH IN CLINICAL AND ENVIRONMENTAL MEDICINE.

NASA MG 5-10155A
9-22-65

HUMAN OTOLITH FUNCTION EXPERIMENT (M-9)
PRELIMINARY FINDINGS GEMINI 5

COMPARATIVE FINDINGS:

OCULAR COUNTER-ROLLING:

C. PILOT	DATA REDUCTION
PILOT	IN PROCESS

EVLH:

C. PILOT	CONSISTENT ERROR INFLIGHT
PILOT	CONSISTENTLY NOMINAL

ADDITIONAL OBSERVATIONS:

NO VESTIBULAR SYMPTOMS OR SIGNS DURING OR FOLLOWING FLIGHT.

PROBLEMS:

HEAD POSITION NOT FIXED BY BRACE DURING INFLIGHT EVLH TESTS.

TENTATIVE CONCLUSIONS:

PROBABLY NO CHANGE IN OTOLITH FUNCTION IN 8 DAYS OF SPACEFLIGHT.

FUTURE PLANS:

WILL BE REPEATED ON GEMINI 7.

NASA MG5-10,336
9-22-65

PHONOCARDIOGRAM EXPERIMENT (M–4)
PRELIMINARY FINDINGS GEMINI 4 AND 5

COMPARATIVE RESPONSES:

	FLIGHT PRE-FLIGHT	FLIGHT FLIGHT (TIME COURSE)
GEMINI 4 (4 DAYS): (BOTH ASTRONAUTS)	NO SIGNIFICANT CHANGE (PRELIMINARY)	NO SIGNIFICANT CHANGE (PRELIMINARY)
GEMINI 5 (8 DAYS):	DATA REDUCTION CURRENTLY IN PROGRESS	

PROBLEMS:

NONE

TENTATIVE CONCLUSIONS:

NO EVIDENCE OF MYOCARDIAL DECONDITIONING BY THIS METHOD IN 4 DAYS OF SPACE FLIGHT.

FUTURE PLANS:

TO BE REPEATED ON GEMINI 7.

NASA MG5-10 335
9-22-65

CONTRIBUTION OF GEMINI MEDICAL INFORMATION (THRU GEMINI 5) TO PRE-GEMINI MEDICAL PROBLEM AREAS

CARDIOVASCULAR	DECONDITIONING TREND DEMONSTRATED; NO DISABILITY - 8 DAYS
WATER BALANCE	DEHYDRATION TREND DEMONSTRATED NO DISABILITY - 8 DAYS
SKELETAL	EARLY ATROPHY SUGGESTED; NO DISABILITY - 8 DAYS
MUSCULAR	EARLY ATROPHY NOTED; NO DISABILITY - 8 DAYS
BEHAVIORAL	NO DEGRADATION
VESTIBULAR	PROBABLY NO CHANGE
METABOLIC AND DIGESTIVE	NO DYSFUNCTION NOTED
RESPIRATORY	NO DYSFUNCTION NOTED
CELLULAR	(APOLLO)
SLEEP AND DIURNAL RHYTHMS	SLEEP PATTERNS ALTERED - THEN NORMALIZED IMPORTANCE OF W-R-S CYCLE STRESSED
VISUAL	ACUITY UNCHANGED – VISIBILITY EXCELLENT FROM EARTH ORBIT

NASA MG5-10-101

SIGNIFICANCE OF MEDICAL DATA THROUGH GEMINI-5

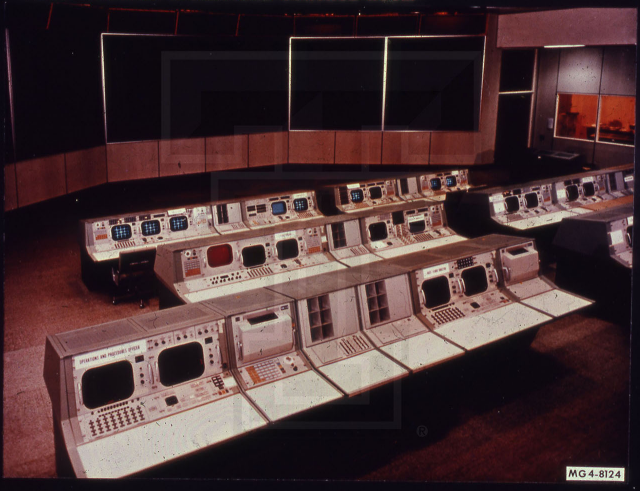
- VALIDATION OF MAN FOR SPACE FLIGHT OF 8 DAYS
- VALIDATION OF LIFE SUPPORT TECHNOLOGY FOR 8 DAYS OF SPACE FLIGHT
- RADIATION HAZARD SMALL IN NEAR EARTH ORBIT
- CARDIOVASCULAR AND BONE DECONDITIONING TENDENCIES AND VESTIBULAR EFFECTS BETTER DEFINED
- EVA CAPABILITY DEMONSTRATED - CREW SUPPORT VALIDATED
- MEDICAL GROUND SUPPORT TECHNIQUES AND EQUIPMENT VALIDATED TO 8 DAYS
- GEMINI BIOSENSORS VALIDATED TO 8 DAYS OF CONTINUOUS FUNCTION

NASA MG 5-10,155A
9-22-65

PROJECT MERCURY BIOINSTRUMENTATION

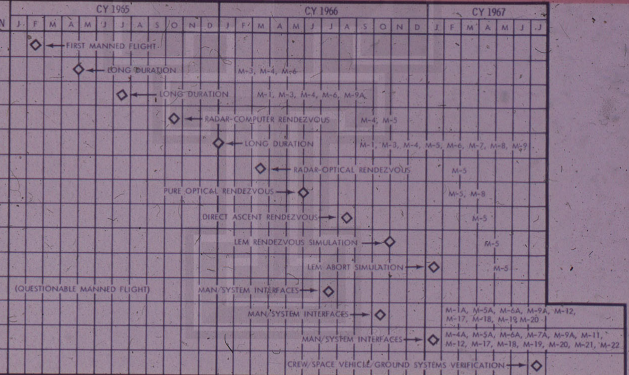
- TEMPERATURE
- ECG
- RESPIRATION
- BLOOD PRESSURE

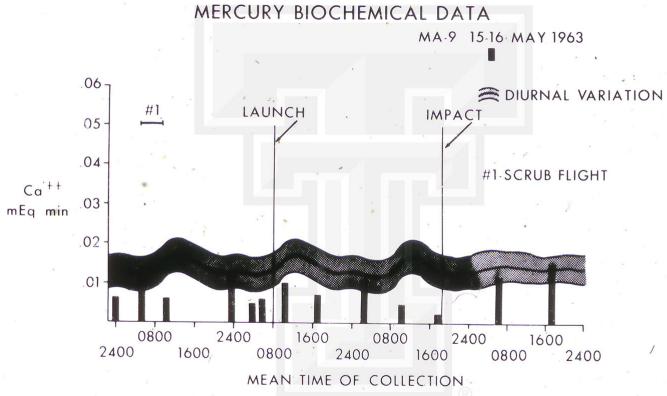
IMCC - MISSION OPERATIONS CONTROL ROOM

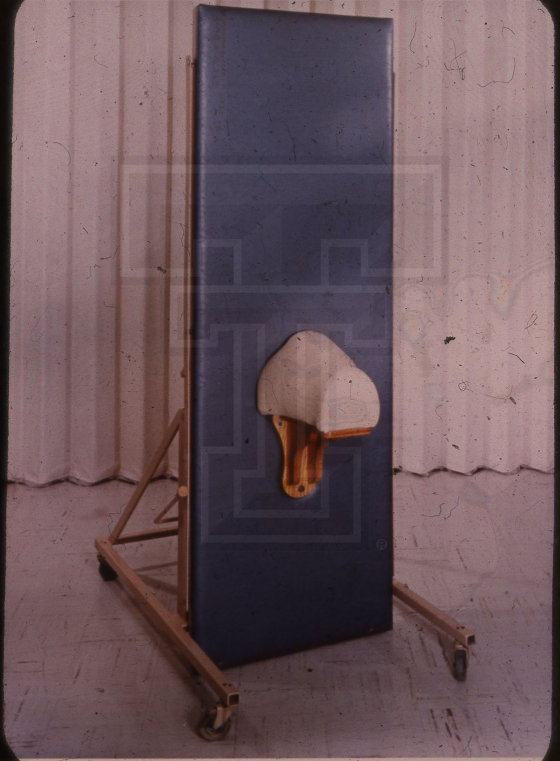


MG 4-8124

MANNED SPACE FLIGHT
CURRENT MISSION SCHEDULE, ASSIGNMENTS AND PLANNED MEDICAL EXPERIMENTS

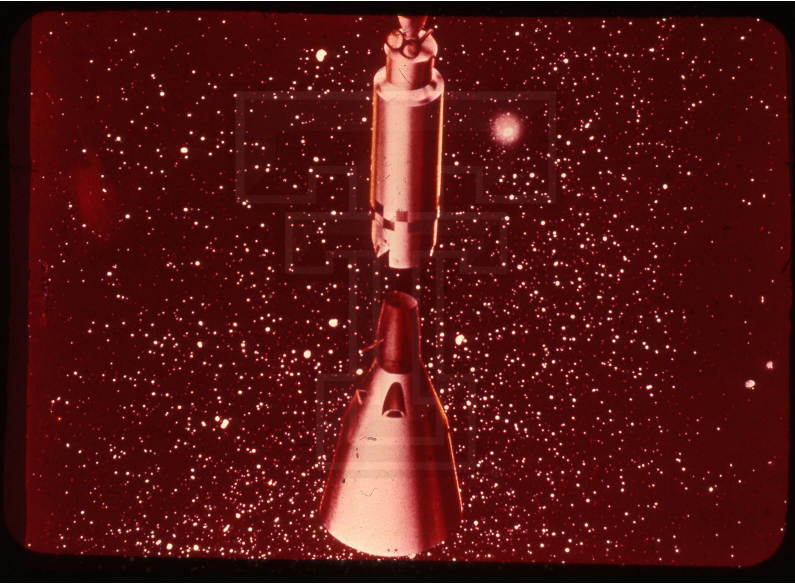



MERCURY BIOCHEMICAL DATA
MA-9 15-16 MAY 1963
DIURNAL VARIATION
#1
LAUNCH
IMPACT
#1-SCRUB FLIGHT
Ca++
mEq min
.06
.05
.04
.03
.02
.01
2400
0800
1600
2400
0800
1600
2400
0800
1600
2400
0800
1600
2400
MEAN TIME OF COLLECTION



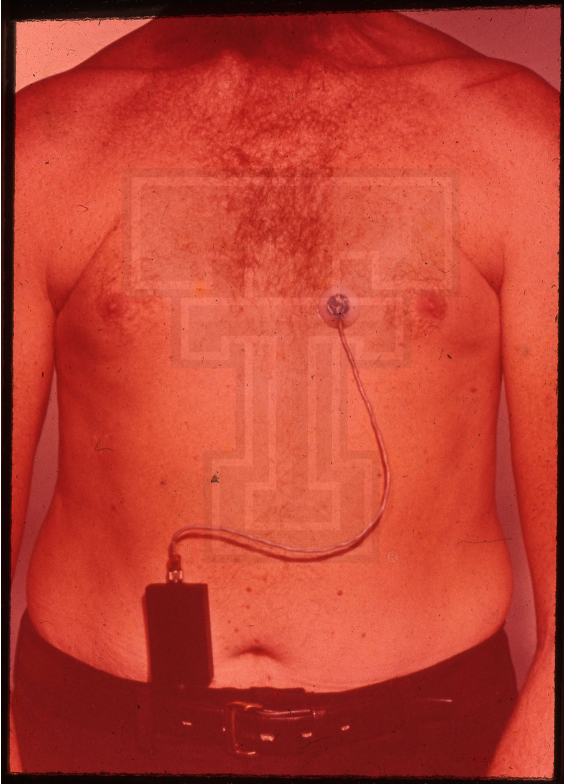
PROPOSED SCHEDULE OF APOLLO MEDICAL IN-FLIGHT EXPERIMENTS

204 (UP TO 14 DAYS)				205 (UP TO 14 DAYS)				207 (UP TO 3 DAYS)			
CODE	SHORT TITLE	WEIGHT	VOLUME	CODE	SHORT TITLE	WEIGHT	VOLUME	CODE	SHORT TITLE	WEIGHT	VOLUME
M-1A	CUFFS	3 lbs	210 cu. in.								
M-5A	HORMONE ASSAY	10 lbs	8 cu. in. + urine storage								
M-6A	BONE DENSITOMETRY	NA	NA								
M-9A	VESTIBULAR	1 lb	20 cu. in.								
M-12	BICYCLE ERGOMETER	3 lb	0.3 cu. ft.								
M-17	THORACIC BLOOD FLOW	2 lb	0.2 cu. ft.								
M-18	FRANK LEAD ECG & VCG	1 lb	3 cu. in.								
M-19	METABOLISM	5 lbs	250 cu. in.								
M-20	PULMONARY FUNCTION	3 lbs	0.5 cu. ft.								



MEP APPROVED GEMINI MEDICAL EXPERIMENTS SCHEDULE

	GT-3 3 ORBITS	GT-4 4 DAYS	GT-5 7 DAYS	GTA-6 2 DAYS	GT-7 14 DAYS	GTA-8 2 DAYS	GTA-9 2 DAYS	GTA-10 2 DAYS	GTA-11 2 DAYS	GTA-12 2 DAYS
M-1			X		X					
M-2	INCLUDE AS MED. OPS. PROCEDURE									
M-3		X	X		X					
M-4		X	X	X	X					
M-5				X	X	X	X	X	X	X
M-6		X	X		X					
M-7					X					
M-8					X		X			
M-9			X PART (A)		X					
M-10	INCLUDED AS OPERATIONAL PROCEDURE									
M-13	INCLUDED AS MED. OPS. PROCEDURE									

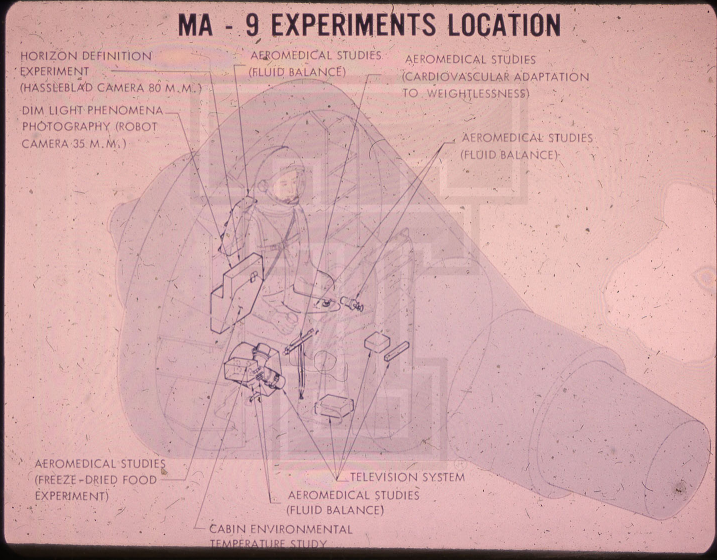


- INFLIGHT DATA
  - TM
  - ON BOARD RECORDING
  - POST FLIGHT DETERMINATIONS
- BASELINE DATA
  - SELECTION
  - CENTRIFUGE RUNS
  - SIMULATIONS
  - TRAINERS
  - PRESSURE CHAMBER RUNS
  - STRESS STUDIES
  - ROUTINE PHYSICAL EXAMINATIONS
  - GENERAL OBSERVATIONS
  - PRE FLIGHT DETERMINATIONS

MEP APPROVED GEMINI MEDICAL EXPERIMENTS SCHEDULE

CODE	SHORT TITLE	WEIGHT	VOLUME CU. IN.	GT-3 3 ORBITS	GT-4 4 DAYS	GT-5 7 DAYS	GTA-6 2 DAYS	GT-7 14 DAYS	GTA-8 2 DAYS	GTA-9 2 DAYS	GTA-10 2 DAYS	GTA-11 2 DAYS	GTA-12 2 DAYS
M-1	CUFFS	3 lbs.	210			X		X					
M-2	TILT TABLE	NA	NA	INCLUDE AS MED. OPS. PROCEDURE									
M-3	EXERCISE TOLERANCE	8 OZ.	10		X	X		X					
M-4	PHONO -ELECTROCARDIOGRAM	1 TO 2 OZ.	1.5		X	X	X	X					
M-5	BODY FLUIDS	75 GMS PER VOIDING	75 CC PER VOIDING				X	X	X	X	X	X	X
M-6	BONE DENSITOMETRY	NA	NA		X	X		X					
M-7	ELECTROLYTE BALANCE	M-5 SPECIMEN	M-5 SPECIMEN					X					
M-8	SLEEP ANALYSIS	10 OZ.	NA					X		X			
M-9	VESTIBULAR	.8 OZ.	D-13 EQUIP'T			X		X					
M-10	MOVEMENT	NA	NA	INCLUDED AS OPERATIONAL PROCEDURE									
M-13	VASCULAR RESPONSE	NA	NA	INCLUDED AS MED. OPS. PROCEDURE									

MA - 9 EXPERIMENTS LOCATION



MSFEB APPROVED MEDICAL EXPERIMENTS FOR APOLLO

EXPERIMENT NO.	EXPERIMENT TITLE
M-1A	CARDIOVASCULAR REFLEX CONDITIONING
M-4A	IN-FLIGHT PHONOCARDIOGRAM
M-5A	BIOASSAYS BODY FLUIDS
M-6A	BONE DEMINERALIZATION
M-7A	CALCIUM BALANCE STUDY
M-8A	IN-FLIGHT SLEEP ANALYSIS
M-9A	HUMAN OTOLITH FUNCTION
M-11	CYTOGENIC STUDY
M-12	EXERCISE ERGOMETER
M-17	THORACIC BLOOD FLOW
M-18	VECTORCARDIOGRAM
M-19	METABOLIC RATE MEASUREMENT
M-20	PULMONARY FUNCTION
M-22	RED BLOOD CELL SURVIVAL
M-23	LOWER BODY NEGATIVE PRESSURE

MM65-10, 996

MEASUREMENTS AND TECHNIQUES

METABOLIC AND NUTRITIONAL (CONT'D)

GENERAL METABOLISM AND NUTRITION:

- METABOLISM AT VARIOUS LEVELS OF ACTIVITY (O_2 CONSUMPTION, CO_2 PRODUCTION, AND CALORIC INTAKE)
- GLUCOSE TOLERANCE
- FAT TOLERANCE
- MEASUREMENT OF ACID BASE METABOLISM (SEE ALSO "RESPIRATORY GAS EXCHANGE")
- PROTEIN METABOLISM (SERUM PROTEINS WITH ELECTROPHORESIS; NPN; BUN; BLOOD URIC ACID)
- FLUID BALANCE
- BODY FLUID DISTRIBUTION (SEE "CARDIOVASCULAR")
- STANDARD CLINICAL URINALYSIS

GASTROINTESTINAL ACTIVITY:

- MEASUREMENT OF GASTRIC MOTILITY AND pH (ENDORADIOSONDE)

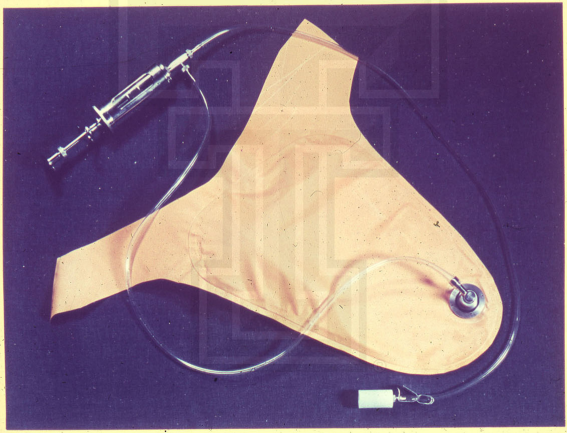
THERMAL REGULATION:

- COMFORT INDEX FOR VARYING THERMAL LOADS
- CARDIOVASCULAR RESPONSE TO THERMAL CHANGE (ORTHOSTATIC TOLERANCE AND CUTANEOUS BLOOD FLOW) (SEE "CARDIOVASCULAR")

* Effects of thermal change on metabolism, fluid and electrolyte balance, and other measurements also to be assessed.

MM65-11,395
11-6-65

URINE COLLECTION BAG ASSEMBLY



PROJECT MERCURY MEDICAL EXPERIMENTS

1. XYLOSE ABSORPTION TEST
2. CALIBRATED EXERCISE (BUNGEE CORD)
3. TILT-TABLE STUDIES WITH FLACK TEST
4. EVALUATION OF HORMONAL OUTPUT
   - A) STEROIDS
   - B) ADRENALIN
   - C) NOREPINEPHRINE

MM 4-1278

MEASUREMENTS AND TECHNIQUES

ENDOCRINE * †

- CLINICAL ENDOCRINE EVALUATION (Hx FORM, AND Px)
- MEASUREMENT OF PITUITARY ACTIVITY (CIRCULATING ACTH; URINARY ADH, AND SPECIFIC GRAVITY)
- MEASUREMENT OF THYROID ACTIVITY (PBI; TBPA)
- MEASUREMENT OF PARATHYROID ACTIVITY (CIRCULATING PARATHORMONE)
- MEASUREMENT OF ADRENAL CORTICAL ACTIVITY (URINARY 17 OHCS, 17 KETOSTEROIDS, AND ALDOSTERONE)
- MEASUREMENT OF GONADAL ACTIVITY (PRE- AND POST-FLIGHT GERM CELL EXAMINATION)
- MEASUREMENT OF NEURO-HUMORAL ACTIVITY (URINARY CATECHOLAMINES AND SEROTONIN)

* The majority of A/A medical measurements and techniques described, particularly under "Metabolism and Nutrition," are applicable to the evaluation of endocrine function. They are too numerous to be listed here.

† Assays to be done in earth based laboratories on specimens collected and stored in flight.

MM65-11,396
11-6-65

MEASUREMENTS AND TECHNIQUES

ENDOCRINE *

- CLINICAL ENDOCRINE EVALUATION (Hx FORM, AND Px)
- MEASUREMENT OF PITUITARY ACTIVITY (CIRCULATING ACTH; URINARY ADH, AND SPECIFIC GRAVITY)
- MEASUREMENT OF THYROID ACTIVITY (PBI; TBPA)
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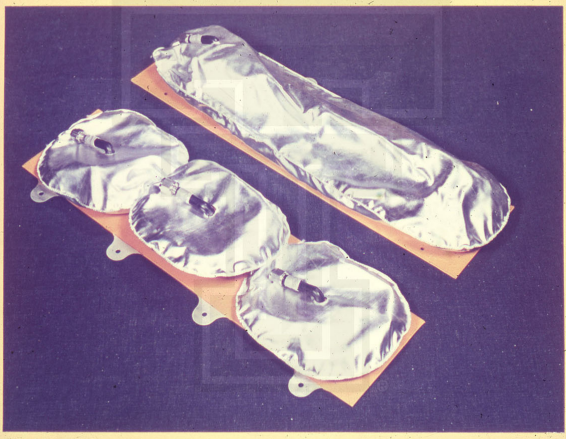
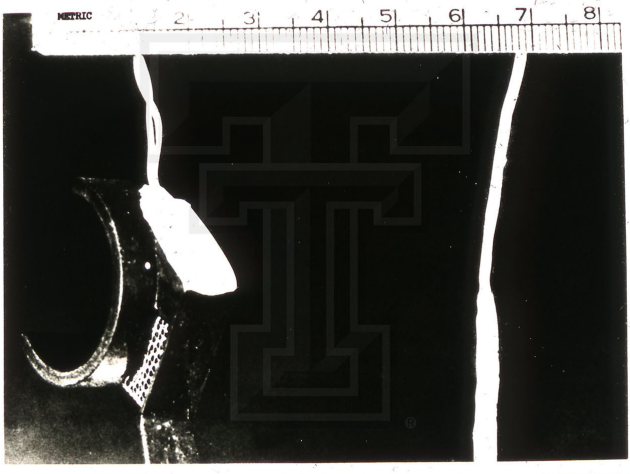
MM65.11,396
11-6-65

URINE TRANSFER SYSTEM





RESPIRATION SENSOR (LEFT) AND DEEP BODY TEMPERATURE PROBE (RIGHT).

MEASUREMENTS AND TECHNIQUES

MICROBIOLOGICAL

- CLINICAL EXAMINATION (Hx FORM, AND Px)
- ASSESSMENT OF CHANGES IN MICROBIOLOGICAL ECOLOGY AMONG FLIGHT CREW MEMBERS (CULTURES OF NOSE, THROAT, GI TRACT, SKIN; COUGH PLATES; CULTURES OF CABIN AND SUIT ECS)

MM65.11,398
11-6-65

MEASUREMENTS AND TECHNIQUES

HEMATOLOGICAL

GENERAL:

CLINICAL EVALUATION (Hx FORM AND Px)

CELLULAR CHANGES:

- MEASUREMENT OF HEMIC CELL DYNAMICS (BLOOD CELL COUNTS AND MORPHOLOGY)
- RBC SURVIVAL (ISOTOPE TAGGED RBC'S; RBC FRAGILITY; DIRECT BILIRUBIN - M-22)
- CYTOGENETIC STUDIES (LYMPHOCYTE KARYOTYPING - M-11)

BODY DEFENSES:

- LEUKOCYTE MOBILITY (PHAGOCYTOSIS)
- IMMUNOLOGICAL EVALUATION (GLOBULIN ELECTROPHORESIS; ANTIBODY TITRATION; MEASUREMENT OF COMPLEMENT)

HEMOSTASIS:

- EVALUATION OF HEMOSTATIC MECHANISMS (BLEEDING AND COAGULATION TIMES; ASSAY OF ELEMENTS OF CLOTTING)

MM65-11,397
11-6-65

SPAMAG RECOMMENDATIONS

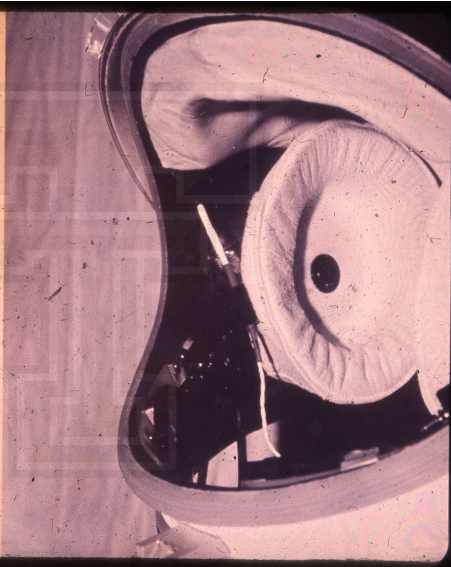
1. LIFE SUPPORT
   (CONTROLLED ENVIRONMENTAL FACTORS)

2. MEDICAL EXPERIMENTS
   (UNCONTROLLED ENVIRONMENTAL FACTORS)

3. ORL DECISIONS
   (SPECIFICATIONS AND OPERATIONS)

MM4-1273

ORAL
TEMPERATURE
PROBE
INSTALLATION



MEASUREMENTS AND TECHNIQUES

METABOLIC AND NUTRITIONAL (CONT'D)

GENERAL METABOLISM AND NUTRITION:

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MM65-11,395
11-6-65

MEASUREMENTS AND TECHNIQUES

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- ASSESSMENT OF CHANGES IN MICROBIOLOGICAL ECOLOGY AMONG FLIGHT CREW MEMBERS (CULTURES OF NOSE, THROAT, GI TRACT, SKIN; COUGH PLATES; CULTURES OF CABIN AND SUIT ECS)

MM65-11,398
11-6-65

SOURCES OF MEDICAL AND BEHAVIORAL IN-FLIGHT EXPERIMENTS

BIOMEDICAL EXPERIMENT WORKING GROUP
(IN-HOUSE - ARC - LRC - MSC - HDQRS. REPRESENTATIVES)

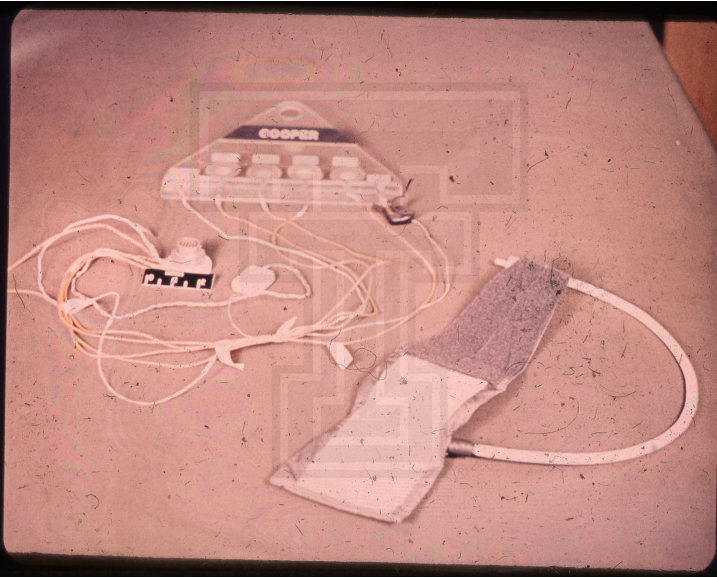
TECHNICAL ADVISORY COMMITTEE ON MEDICAL BEHAVIORAL IN-FLIGHT EXPERIMENTS
(IN-HOUSE - ARC - LRC - MSC - HDQRS. REPRESENTATIVES)

INDUSTRY STUDIES
(NORTH AMERICAN - REPUBLIC - LOCKHEED)

SPACE MEDICINE ADVISORY GROUP
(SCIENTIFIC COMMUNITY)

INDIVIDUAL INVESTIGATORS

MM65-11, 308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MM4-4749

MEASUREMENTS AND TECHNIQUES

HEMATOLOGICAL

GENERAL:

CLINICAL EVALUATION (Hx FORM AND Px)

CELLULAR CHANGES:

- MEASUREMENT OF HEMIC CELL DYNAMICS (BLOOD CELL COUNTS AND MORPHOLOGY)
- RBC SURVIVAL (ISOTOPE TAGGED RBC'S; RBC FRAGILITY; DIRECT BILIRUBIN - M-22)
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MM65-11,397
11-6-65

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LOCATION OF FILM BADGES