Abstract Volume

12th Man in Space Symposium

The Future of Humans In Space

June 8-13, 1997
Washington, DC

IAA ACADEME INTERNATIONALE D'ASTRONAUTIQUE

NASA

12TH MAN IN SPACE SYMPOSIUM
ABSTRACT VOLUME

International Academy of Astronautics
P. O. Box 1268-16
F-75766 Paris Cedex 16, France

National Aeronautics and Space Administration
Washington, D.C. 20546-0001
U.S.A.

Universities Space Research Association Division of Space Life Sciences
3600 Bay Area Boulevard
Houston, TX 77058 U.S.A.

Universities Space Research Association Division of Space Life Sciences operates under Cooperative Agreement NCC9-41 with the National Aeronautics and Space Administration.

Abstracts in this volume may be cited as:
Author: Title of paper. 12th Man in Space Symposium: The Future of Humans in Space, June 8-13, 1997, Washington, D.C., pp. *xxx.*

FOREWORD

The National Aeronautics and Space Administration (NASA) is pleased to host the 12th IAA Man in Space Symposium. A truly international forum, this symposium brings together scientists, engineers, and managers interested in all aspects of human space flight to share the most recent research results and space agency planning related to the future of humans in space.

As we look out at the universe from our own uniquely human perspective, we see a world that we affect at the same time that it affects us. Our tomorrows are highlighted by the possibilities generated by our knowledge, our drive, and our dreams. This symposium will examine our future in space from the springboard of our achievements.

SCIENTIFIC AND ORGANIZING COMMITTEE

Honorary Chairmen

O. Gazenko (Russia) K. Klein (Germany)
A. Nicogossian (USA)

Honorary Vice Chairmen

A. Grigoriev (Russia) A. Guell (France)
K. Yajima (Japan)

Chairmen

J. Vernikos (USA) R. White (USA)

Vice Chairmen

G. Gargir (France) R. Gerzer (Germany)
A. Mortimer (Canada) S. Watanabe (Japan)
H. Oser (ESA) D. Short (USA)

Members

V. Baranov (Russia) A. Berthoz (France)
V. Blüm (Germany) V. Bogomolov (Russia)
J. Contant (France) R. Fassold (Canada)
M. A. Frey (USA) H. Hinghofer-Szalkay (Austria)
I. Kozlovskaya (Russia) L. Macho (Slovakia)
T. Mano (Japan) S. Nagaoka (Japan)
V. Petrov (Russia) J. Rummel (USA)
G. Ruyters (Germany) C. Sawin (USA)
V. Schneider (USA) J. Seylaz (France)
Y. Sinyak (Russia) I. Skoog (Sweden)
F. Sulzman (USA) H. Wegmann (Germany)
J. Wei (China)

TABLE OF CONTENTS

Mechanisms of Orthostatic Intolerance During Real and Simulated Microgravity 1-1

Orthostatic Tests After 42 Days of Simulated Weightlessness
A.P. Traon, D. Sigaudo, P. Vasseur, A. Maillet, J.O. Fortrat, G. Gauquelin-Koch, C. Gharib 2

Effects of 12 Days Exposure to Simulated Microgravity on Central Circulatory Hemodynamics in the Rhesus Monkey
S.C. Koenig, V.A. Convertino, V.P. Krotov, J.W. Fanton, V.I. Korolkov, E.V. Trambovetsky, A. Truzhennikov, R.D. Latham 3

Increased Sensitivity and Resetting of Baroreflex Control of Exercise Heart Rate After Prolonged Bed-Rest
P. Sundblad, J. Spaak, B. Tedner, P.E. di Prampero, D. Linnarsson 4

Complex Cardiovascular Dynamics and Deconditioning During Head-Down Bed Rest
J.O. Fortrat, D. Sigaudo, G. Gauquelin-Koch, C. Gharib 5

Evetts and Russomano (1995). The cardiovascular effects of 6 hours of head-down tilt upon athletes and non-athletes
S. Evetts, Russomano 6

Individual Susceptibility To Post-Spaceflight Orthostatic Intolerance: Contributions of Gender-Related and Microgravity-Related Factors
J.M. Fritsch-Yelle, T.E. Brown, P.A. Whitson 7

Cassiopee Mission 1996. Comparison of Cardiovascular Alteration After Short and Long-Term Spaceflights
D. Sigaudo, J.O. Fortrat, A. Maillet, J. Frutoso, C. Andre'-Deshays, R. Kaspranski, I. Fountova, A. Guell, G. Gauquelin-Koch, C. Gharib 8

Cerebral and Femoral Flow Response to LBNP during 6 Month MIR-Spaceflights (93-95)
Ph. Arbeille, G. Fomina, I. Alferova, M. Porcher, J. Coulon, A. Kotovskaya, V. Poliakov 9

Cerebrovascular Changes Due To Space Flight and PostFlight Presyncope
A.P. Blaber, R.L. Bondar, P. Moradshahi, F. Stein, M.S. Kassam, T.E. Brown, J.M. Fritsch-Yelle 11

Biological Life Support Systems 13-2

Crew Regenerative Life Support in Long-Duration Space Missions
N.M. Samsonov, A.I. Grigoriev, Ju. I. Grigoriev 14

Bioconversion Systems for Food and Water on Long Term Space Missions
M.A. Benjaminson, S. Lehrer, D.A. Macklin 15

Novel Laboratory Approaches to Multi-Purpose Aquatic Biogenerative Closed-Loop Food Production Systems
V. Blum, M. Andriske, K. Kreuzber, U. Paassen, M.P. Schreibman, D. Voeste 17

Artificial Neural Network Derived Plant Growth Models
F. Zee 19

Six-Month Space Greenhouse Experiments - A Step to Creation of Future Biological Life Support Systems
T.N. Ivanova, P.T. Kostov, S.M. Sapunova, I.W. Dandolov, V.N. Sytchov, M.A. Levinskikh, I.G. Podolski, G.E. Bingham, F.B. Salisbury, D.B. Bubenheim, G. Jahns 20

Clinical and Educational Support for Space Flight via Telemedicine ..... 21 -3

Telemedicine: A User's Perspective
A.E. Nicogossian 22

Health Care in Extreme Environments
J.D. Collier 23

Integration of Emerging Technologies in Information and Telecommunications in Health Care Systems for Space
C.R. Doarn 24

Telemedicine and Environmental Medicine in Russia: A First Step in Basic Medical Education
A.I. Grigoriev, V. A. Loginov, S.V. Boravkov, L.B. Buravkova, O.L. Vinogradova 25

Clinical Utility of Internet Telemedicine
R.C. Merrell, P. Angood, C. Doarn 26

A Web-Based Human Computer Interface for Internet Telemedicine
C.E. Lathan, Dava J. Newman, Marc Sebrechts, Charles Doarn 27

Cognitive Sciences ..... 28 - 4

Face recognition in microgravity: is gravity direction involved in the inversion effect?
S. de Schonen, G. Leone, M. Lipshitz 29

Motor timing under microgravity
A. Semjen, G. Leone, M. Lipshitz 30

Perceived Self-Motion Assessed By Computer-Generated Animations: Complexity and Reliability
D.E. Parker, D.L. Harm, G.R. Sandoz, N.C. Skinner 31

Prolonged Weightlessness, Reference Frames and Visual Symmetry Detection
G. Leone, S. de Schonen, M. Lipshits 33

Mental Representation Of Gravity During A Locomotor Task
T. Pozzo, P. Stapley, A. Berthoz, R. Kaprinski 34

Haptic Perception In Weightlessness: A Sense of Force Or A Sense Of Effort?
J. McIntyre, M. Lipshits 36

Life Sciences Issues for a Mission to Mars ..... **38** -5

Cardiovascular Concerns For A Mars Mission: Autonomic and Biomechanical Effects
D. D'Aunno, J. Yelle, G. Pantalos, T. Brown *39*

Reducing The Risk of Space Radiation Induced Bioeffects-Vehicle Design and Protectant Molecules
M. Stanford, J. Jones, H. Lane, P. Riggs, T. Yang *40*

Musculoskeletal Issues for Long Duration Mission: Muscle Mass Preservation, Renal Stone Risk Factors, Countermeasures, And Contingency Treatment Planning
P. Hilliard, J. Jones, R. Pietrzyk, P. Whitson *42*

Psychological Issues and Crew Selection For A Mars Mission: Maximizing the Mix For The Long Haul
S. Bishop, J. Wood, J. Jones *44*

Issues In Crew Health, Medical Selection and Medical Officer (CMO) Training For A Mission To Mars
C. Jernigan, B. Harris, R. Jennings *45*

Mechanisms of Cardiopulmonary Adaptation to Microgravity - 1 ..... **46** -6

Indices of Baroreceptor Reflex Sensitivity: The Use in Rehabilitation Medicine and Space Cardiology
J. Tank, R.M. Baevsky 47

+Gz and +Gx Tolerance At Healthy Persons of Non-Flying Trades At Primary Selection on The Centrifuge
V. Yu. Lukianiouk, A.R. Kotovskaya, I.F. Vil-Viliams 48

Effect of Dry Immersion on Calf Blood Supply During Sustained Contraction and Upright Exercise in Man
Y.M. Stioda, A.A. Kulakov, O.L. Vinogradova 49

Cardiovascular and Valsalva Responses During Parabolic Flight
T.T. Schlegel, E. Benavides, D. Barker, T. Brown, D. Harm, P.A. Low 50

An Analysis of The Cardiovascular Responses Under Hyper- and Hypo-Gravity Environments Using A Mathematical Model
Y. Hirata, K. Yoshimura, S. Usui, S. Nagaoka 51

Effect of Very Gradual Onset Rate +Gz Exposures on the Cardiovascular System
T. Sasaki, K. Iwasaki, K. Hirayamagi, T. Kinone, A. Miyamoto, K. Yajima 52

NASA Specialized Center of Research and Training (NSCORT) In Integrated Physiology: Mechanisms of Physiological Adaptations To Microgravity
C.G.Blomqvist 55

Plant and Animal Gravitational Biology - 1 ..... 56 · 7

The Interaction of Microgravity and Ethylene on Soybean Growth and Metabolism
C.S. Brown, M.M. Sanwo, W.C. Piastuch, B.V. Peterson, E.C. Stryjewski, E. Hilaire, J.A. Guikema 57

Structure and g-Sensitivity of Root Statocytes Under Different Mass Acceleration
R. Laurinavicius, D. Svegzdiene, V. Gaina 58

Extracellular Production of Taxanes on Cell Surfaces In Simulated Microgravity and Hypergravity
D.J. Durzan, F. Ventimiglia, L. Havel 59

Current Problems of Space Cell Phytobiology
E.L. Kordyum 60

Biological Consequences of Microgravity-Induced Alterations in Water Metabolism of Plant Cells
D.O. Klymchuk 61

Localization of Calcium Ions in Chlorella Cells Under Clinorotation
A.F. Popova 62

Changes of Fatty Acids Content of Plant Cell Plasma Membranes Under Altered Gravity
Yu. Ya. Polulyakh 63

Simulation of Gravity by Non-Symmetrical Vibrations and Ultrasound
O.A. Kuznetsov, A.A. Kuznetsov, K.H. Hasenstein 64

Response to Simulated Weightlessness of In Vitro Cultures of Differentiated Epithelial Follicular Cells from Thyroid
A. Meli, G. Perrella, F. Curcio, F. S. Ambesi-Impiombato 66

Visuo-Vestibular Interactions ..... 67 - 8

Vestibulo-Oculomotor Interaction in Long-Term Microgravity
L.N. Kornilova, C. Mueller, N. Steinhoff, A. Clarke, V. Grigorova 68

Effects of Weightlessness on the Spatial Orientation of Visually Induced Eye Movements
G. Clement, S.J. Wood, M.F. Reschke 69

Adaptive Modification of the Three-Dimensional Vestibulo-Ocular Reflex During Prolonged Microgravity
A.H. Clarke, J. Grigull, W. Krzok, H. Scherer 71

The Dynamic Change of Brain Potential Related to Selective Attention to Visual Signals from Left and Right Visual Fields
J. Wei, Lun Zhao, G. Yan, W. Chen, R. Duan, W. Ren 72

Locomotor Errors Caused By Vestibular Suppression
D.G.D. Watt, N. Paquet 73

A novel, image-based technique for three-dimensional eye movement measurement
A.H. Clarke, D. Schucker, W. Krzok, J. Grigull 75

Effect of Microgravity on Bone Tissue and Calcium Metabolism ..... 76 - 9

Human Bone Tissue Changes After Long-Term Space Flight: Phenomenology and Possible Mechanics
V. Organov, V. Schneider, A. Bakulin, V. Polyakov, L. Voronin, V. Morgun, L. Shackelford, A. LeBlanc, L. Murashko, V. Novikov 77

Prediction of Femoral Neck Bone Mineral Density Change in Space
L. Shackelford, A. Feiveson, E. Spector, A. LeBlanc, V. Oganov 78

Dietary Calcium in Space
D. Hatton, D. McCarron, Q. Yue, C. Roullet, H. Xue, K. Otsuka, J. Chapman, T. Phanouvong, J. Roullet, M. Watanabe, K. Nilan, V. Haight, J. Dierckx, J. Demerritt 80

Calcium Metabolism During Extended-Duration Space Flight
S.M. Smith, V.S. Oganov, B.V. Morukov, I.M. Larina, L.E. Nyquist, C.-Y. Shih, M.E. Wastney, S.A. Abrams, H.W. Lane 81

External Impact Loads on the Lower Extremity During Jumping In Simulated Microgravity and the Relationship to Internal Bone Strain
S.E. D'Andrea, B.L. Davis, A.C. Courtney, G.P. Perusek 82

Bone Loss During Long Term Space Flight Is Prevented By The Application of An Short Term Impulsive Mechanical Stimulus
A.E. Goodship, J.L. Cunningham, P. Walker, V.Organov, J. Darling, A.W. Miles, G. Owen 84

Cultural and Gender Issues in Long-Duration Flights 86-16

Psychosocial Issues During Long-Duration International Space Missions
N. Kanas 87

Psychosocial Issues In Crew Selection: Finding the Right Mix of the Right Stuff
S.L. Bishop 88

Culture, Gender and Mission Accomplishment: Operational Experience
A.W. Holland 89

Interpersonal Tension in Multicultural Crews
H. Ursin, G.M. Sandal 90

Personality and Coping in Extreme Environments
G.M. Sandal, H. Ursin 91

Application of Expedition and Polar Work Group Findings For Enhancing Performance in Space
G.R. Leon, V.S. Koscheyev 92

Mechanisms of Cardiopulmonary Adaptation to Microgravity - 2 .....93 -/1

Autonomic Regulation of Circulation and Mechanical Function of Heart at Different Stages of 14-th Month Space Flight
R.M. Baevsky, M. Moser, G.A. Nikulina, V.V. Polyakov, I.I. Funtova, A.G. Chernikova...94

Cardiovascular oxygen transport in exercising humans in microgravity
G. Ferretti, F. Esposito, M. Girardis, D. Linnarsson, C. Moia, D. Pendergast.....95

Venous Hemodynamic Changes Assessed By Air Plethysmography During a 16-Day Spaceflight
F. Louisy, C. Andre'-Deshays, D. Cauquil, M. Lazerges, C. Lafaye, A.L. Camus, G. Fomina.....96

Respiratory Mechanics After 180 Days Space Mission (Euromir'95)
D. Venturoli, D. Negrini, G. Miserocchi.....97

Assessment of The Sympathetic and the Parasympathetic Nervous Activity During Parabolic Flight by Pupillary Light Reflex
K. Yamaji, Y. Hirata, S. Usui, S. Nagaoka.....98

Vascular Response to Different Gravity
F. Valkenberg.....99

Human Factors Research under Ground-Based and Space Conditions - 1....102 -/2

Human Factors Engineering of the International Space Station Human Research Facility
B. Woolford.....103

Structured Methods For Identifying And Correcting Potential Human Errors in Space Operations
W.R. Nelson, L.N. Haney, L.T. Ostrom, R.E. Richards.....104

An Improved Procedure for Selecting Astronauts for Extended Space Missions
A.W. Holland, L. Galarza, R.D. Arvey, K.D. Curtis.....105

The NASA Performance Assessment Workstation: Cognitive Performance During Head-Down Bedrest
R.E. Schlegel, R. Shehab, S.G. Schiflett, D.R. Eddy.....106

Cognitive Performance Aboard the Life and Microgravity Spacelab
D.R. Eddy, S.G. Schiflett, R.E. Schlegel, R.L. Shehab.....107

Psychophysiological Reactivity Under MIR-Simulation And Real Micro-G
B. Johannes, V.P. Salnitski, V. Korsun, A.J. Kaleri, K. Kirsch, O.I. Schewtschenko, F. Fischer, A.V. Dudukin, C. Gunga.....108

Posture and Movement .....109 -/3

Modification of Goal-Directed Arm Movements During Inflight Adaptation to Microgravity
M. Berger, S. Lechner-Steinleitner, I. Kozlovskaya, F. Gerstenbrand.....110

Quantitative Analysis of Motion Control In Long Term μGravity
G. Baroni, G. Ferrigno, A. Anolli, G. Andreoni, A. Pedotti.....111

Does The Centre Of Gravity Remain The Stabilised Reference During Complex Human Postural Equilibrium Tasks In Weightlessness?
P. Stapley, T. Pozzo, A. Grichine 113

Arm End-Point Trajectories Under Normal And Micro-Gravity Environments
C. Papaxanthis, T. Pozzo, J. McIntyre 115

The German/Russian MIR '97 Mission: An Overview ..... 117 -14

Life Science Experiments During the German-Russian MIR '97 Mission
G. Ruyters, H.-U. Hoffmann 118

Orthostatic Intolerance following Microgravity: A Role for Autonomic Dysfunction
F.J. Baisch, L. Beck, J. Drescher, C.G. Blomqvist, D.L. Eckberg, D. Robertson 119

Heart Rate Variability and Skin Blood Flow in Man During Orthostatic Stress in Weightlessness
J. Drescher, A. Diedrich 121

Effects of Microgravity and Lower Body Negative Pressure on Circulatory Drives from Exercising Calf Muscles
D. Essfeld, K. Baum, U. Hoffmann, D. Leyk 122

The MIR Station in Its Second Decade - Crew Science Operation During MIR '97
R. Ewald 123

Metabolic Ward (Water, Sodium, Calcium and Bone Metabolism) and Endocrinological Experiments During the MIR '97 Mission
C. Drummer, M. Heer, P. Norsk, P. Bie, P. Stehle, A. Zittermann, I. McCarthy, C. Vermeer, C. Alexandre, L. Shakelford, C. Gunga, M. Bidlingmaier, C. Strasburger, P. Rettberg, G. Horneck, V. Oganov, D. Vorobiev 124

Long-Term Monitoring of the Spine-Geometry During the MIR '97 Mission. Introduction of a New Method
K. Baum, D. Essfeld 125

Effects of 20 Days of Microgravity (German/Russian MIR '97 Mission) on the Mechanical and Electromyographic Characteristics of Explosive Efforts of the Lower Limbs and of Cycloergometric Exercises of Mild to Sprint-Like Intensity
G. Antonutto, P. Zamparo, F. Bodem, J. Kass, J. Heine, P.E. di Prampero 126

Long-Duration Space Flight ..... 128 -15

Medical and Physiological Studies During 438-Days Space Flights
A.I. Grigoriev, V.V. Polyakov 129

Human Performance During A 14 Months Space Mission
D. Manzey, B. Lorenz, V. Polyakov 130

Homeostasis in Long-Term Microgravity Conditions
A.I. Grigoriev, A.D., Egorov, A.S. Kaplansky 131

Strategy of Preservation of Health of Cosmonauts in Prolonged and Superprolonged Space Flights
A.I. Grigoriev, V.V. Polyakov, A.D. Egorov 132

Rehabilitation of Cosmonauts' Health Following Long-Term Space Missions
V.V. Bogomolov, I.B. Kozlovskaya, V.I. Pochuev 133

Perfect Cosmonaut: Some Features Of Bio-Portrait
N.G. Lacota, I.M. Larina, V.V. Polyakov 134

Plant and Animal Gravitational Biology - 2 ..... 135 -16

The Asymmetrical Growth of Otoliths in Fish is Affected By Altered Gravity and Causes Kinetosis
R.H. Anken, T. Kappel, H. Rahmann 136

Neurobiological Responses of Fish to Altered Gravity Conditions: A Review
H. Rahmann, R.H. Anken 138

An Age-Dependent Sensitivity of the Roll-Induced Vestibuloocular Reflex To Hypergravity Exposure of Several Days In An Amphibian (Xenopus Laevis)
C. Sebastian, E. Horn 140

Mechanically-Induced Membrane Wounding During Parabolic Flight
M. Clarke, D.L. Feeback 141

Erythropoietin Stimulates Increased F Cell Numbers in Bone Marrow Cultures Established in Gravity and Microgravity Conditions
D. Houston-Hawkins, O.M. Hurst, S. Oduntan, S.O. Fadulu 143

Technology - 1 ..... 145 -17

Physiolab A Cardio Vascular Laboratory
D. Cauquil, C. Laffaye, A.L. Camus, V. Gratchev, I. Alferova, A. Kotovskaya, G. Weerts 146

MEDEX: A Flexible Modular Physiological Laboratory
J. Kass, G. Kampfer 147

A Sensate Liner for Personnel Monitoring Applications
E.J. Lind, S. Jayaraman, R. Rajamanickam, S. Park, R. Eisler, G. Baird, D. Cadogan, T. McKee 149

Secure Remote Access to Physiological Data
R. Gantenbein 150

DARA Vestibular Equipment Onboard MIR
P. Hofmann, A. Kellig, H.-U. Hoffmann, G. Ruyters 152

The Kinelite Project: A New Powerful Motion Analysis System for Spacelab Mission
M. Venet, H. Pinard, J. McIntyre, A. Berthoz, F. Lacquaniti 153

The Technical Evolution of the French Neurosciences Multipurpose Instruments Onboard the MIR Station
J.M. Bois, Y. Matsakis, J. McIntyre, A. Shulenin 155

Extended Ground-Based Research In Preparation For Life Sciences Experiments
M. Schuber, D. Seibt, J. Zange 156

Medes Clinical Research Facility As A Tool To Prepare ISSA Space Flights
A. Maillet, A. P. Traon 157

Human Behaviour in Long-Term Missions ..... 159 -18

Psychological Support for International Space Station Missions
O.P. Kozerenko, O.O. Ryumin, A.D. Sled, A.W. Holland 160

Psycho-Social Training for Man In Space
R. Kass, J. Kass 161

Study of the Physiological Adaptation of the Crew During A 135-Day Space Simulation
E. Rosnet, G. Cazes, A. Vinokhodova 162

Interpersonal Relationships in Space Simulation: The Long-Term Bed Rest in Head-Down Tilt Position
K. Weiss, G. Moser 163

Psychological Adaptation in Groups of Varying Sizes and Environments
J. Wood, D. Lugg, D. Eksuzian, D.L. Harm, M. Shepanek 164

Deviance Among Expeditioners: Defining The Off-Nominal Act in Space and Polar Field Analogs
M. Dudley-Rowley 165

Getting Effective Sleep in the Space-Station Environment
W. Rhodes 167

Human Sleep and Circadian Rhythms Are Altered During Spaceflight
A. Gundel, V.V. Polyakov 168

Methodological Approach to Study of Cosmonauts Errors and Its Instrumental Support
A.P. Nechaev, V.I. Myasnikov, S.I. Stepanova, O.P. Kozerenko, G.F. Isaev, S.V. Bronnikov *169*

Human Factors Research under Ground-Based and Space Conditions - 2 .... 170 -19

Training Astronauts Using Three-Dimensional Visualizations of the International Space Station
R. Bagaoutdinov, Barker, G. Bodrikov, Y. Borodin, M. Cheburkov, E. Dahlstrom, D. Ivanov, P. Karpunin, R. Katargin, A. Kiselyev, Y. Kotlayarevsky, N. Maris, D. Nelles, M.J. Rycroft, A. Schetinnikov, F. Tyerlov 171

Measurement and Validation of Bidirectional Reflectance of Shuttle and Space Station Materials for Computerized Lighting Models
L. Fletcher, A. Aldridge, C. Wheelwright, J. Maida 172

Effects Of Environmental Color On Mood And Performance Of Astronauts In ISS
N. Kwallek 174

Psychophysical Measures of Motion and Orientation: Implications for Human Interface Design
A.M. Mead, B.D. Lawson 175

The Sopite Syndrome Revisited: Drowsiness and Mood Changes in Student Aviators
B. Lawson, A.M. Mead, A. Apple, L. Barton 176

Technology - 2 ..... 177 -20

Monitoring Physiological Variables With Membrane Probes
E.M. Janle, L. Yang, P.T. Kissinger 178

Real Time Confocal Laser Scanning Microscopy: Potential Applications in Space Medicine and Cell Biology
Ana Rollan, A.P. McHale 180

Optimum Versus Universal Planetary and Interplanetary Habitats
M.M. Cohen 182

Application of Remote Sensing and Geographic Information System Technologies to the Prevention of Diarrheal Diseases in Nigeria
P.C. Njemanze, S. Dister, B. Lobitz, L. Beck, B. Wood 184

A Small G Loading Human Centrifuge for Space Station ERA
K. Yajima, K. Iwasaki, R. Murai, T. Nakazato, M. Itoh, K. Hirayanaagi, A. Miyamoto, M. Igarashi 185

Use of the Bicycle Ergometer on the International Space Station and Its Influence On The Microgravity Environment
N. Penley, G. Banta 186

Munich Space Chair (MSC) - A Next Generation Body Restraint System for Astronauts
E. Igenbergs, W. Naumann, P. Eckart, E. Pfeiffer 187

Thermoelectric Human-Body Cooling Units Used By NASA Space Shuttle Astronauts
P. Heenan, R. Theisen, B. MathiPrakasam, S. Walker, B. Sauser 188

Radiation: Physical Characterization and Environmental Measurements.... 189 -21

Production of Neutrons From Interactions of GCR-Like Particles
L. Heilbronn 190

Solar Particle Event Dose Distributions: Parameterization of Dose-Time Profiles
E.N. Zapp, C.R. Ramsey, L.W. Townsend, G.D. Badhwar 192

Assessment of Nuclear Events In The Body Produced By Neutrons and High-Energy Charged Particles
R.A. Noulty, H. Ing, E.T.H. Clifford, B. Selkirk, J. Gamero, A. Mortimer 194

Ground-Based Simulations of Cosmic Ray Heavy Ion Interactions In Spacecraft and Planetary Habitat Shielding Materials
J. Miller, C. Zeitlin, L. Heilbronn, T. Borak, T. Carter, K.A. Frankel, S.E. Rademacher, C. Stronach 196

Radiation Measurements in Space Missions
G. Reitz, I. Apathy, R. Beaujean, S. Deme, C. Heilmann, J. Kopp, M. Leicher, K. Strauch 198

Radiation Measurements in Civil Aircraft
R. Beaujean, J. Kopp, F. Roos, G. Reitz 199

Analysis of The Pre-Flight and Post-Flight Calibration Procedures Performed on the Liulin Space Radiation Dosimeter
T. Dachev, J. Semkova, V. Petrov, V. Redko, V. Bengin, T. Kostereva, J. Miller, L. Heilbronn, C. Zeitlin 200

Radiation Environment Monitoring for Astronauts
G. Mackay, I. Thomson, N. Sultan, A. Ng, P. Sullivan 201

The National Space Biomedical Research Institute ..... 203 cont

Panel Discussion & Special Presentations 204

Studies Relating to EVA ..... 205 -22

The Staged Decompression To The Hypobaric Atmosphere As A Prophylactic Measure Against Decompression Sickness During Repetitive EVA
V.I. Chadov, S.N. Filipenkov, L.R. Isseev, S.R. Kislyhin, A.J. Mednih, V.V. Polyakov, G.F. Vorobiev 206

A New Preoxygenation Procedure For Extravehicular Activity (EVA)
J. Webb, A. Pilmanis 207

Metabolic Assessments During Extra-Vehicular Activity
Yu. Yu. Osipov, A.N. Spichkov, S.N. Filipenkov 208

Evaluation of Safety of Hypobaric Decompressions and EVA From Positions of Probabilistic Theory
V.P. Nikolaev 209

Fatty Acid Composition of Plasma Lipids and Erythrocyte Membranes During Simulation of Extravehicular Activity
M.A. Skedina, L.B. Buravkova, V.P. Katuntsev, V.P. Naidina 210

Biomedical Studies Relating To Decompression Stress With Simulated EVA: Overview
B.D. Butler, T. Little, M. Powell, R.R. Robinson 211

The Joint Angle and Muscle Signature (JAMS) System - Current Uses and Future Applications
C.U. Ranniger, D.L. Akin 213

Experimental Investigation of Cooperative Human-Robotic Roles in An EVA Work Site
D.L. Akin 215

Body Fluid Regulation and Hemopoiesis in Space Flight ..... 217 -23

Bodymass And Fluid Distribution During Longterm Spaceflight With and Without Countermeasures
K. Kirsch, F. Baartz, H.C. Gunga, E. Koraleweski, B. Johannes 218

Plasma Volume, Extracellular Fluid Volume, and Regulatory Hormones During Long-Term Space Flight
H.W. Lane, B.V. Morukov, I.M. Larina, S.M. Smith, A.I. Grigoriev, C.S. Leach 219

Effect of Microgravity and Its Ground-Based Models on Fluid Volumes and Hemocirculatory Volumes
V.I. Lobachik, V.V. Polyakov, S.A. Chupushtanov, S.F. Voronov 220

Seventeen Weeks of Horizontal Bed Rest, Lower Body Negative Pressure Testing, and the Associated Plasma Volume Response
C. Lathers, J. Charles 221

Evaporative Waterloss In Space Theoretical And Experimental Studies
Fa. Baartz, K.Kirsch, F. Castrucci, H.C. Gunga, E. Koralewski 222

Erythropoietin Under Real And Simulated Micro-G Conditions In Humans
H.C. Gunga, K. Kirsch, A. Maillet, F. Baartz, C. Gharib, W. Nalishiti, I. Rich, L. Rocker 223

Vertebral Bone Marrow Changes Following Space Flight
A. LeBlanc, C. Lin, H. Evans, L. Shackelford, S. West, T. Hedricks 224

Effect of Real and Simulated Microgravity on Muscle Function ..... 226 -24

Changes in Calf Muscle Performance, Energy Metabolism, and Muscle Volume Caused By Long Term Stay on Space Station MIR
J. Zange, K. Muller, M. Schuber, H. Wackerhage, U. Hoffman, R.W. Gunther, G. Adam, J.M. Neuerburg, A.O. Bacharev, V.E. Sinitsyn, O.I. Belichenko 227

Vibrografic Signs of Autonomous Muscle Tone Studied In Long Term Space Missions
E. Gallasch, T. Kenner, IB. Kozlovskaya 229

Reduction of Muscle Strength After Long Duration Space Flights Is Associated Primarily With Changes In Neuromuscular Function
S.F. Siconolfi, I.B. Kozlovskaya 230

The Effects of a 115-Day Spaceflight on Neuromuscular Function in Crewman
Y. Koryak, I.B. Kozlovskaya 231

Effects of 17-Day Spaceflight on Human Triceps Surae Electrically-Evoked Contractions
M. Narici, B. Kayser, P. Barattini, P. Cerretelli 232

Effects of Muscle Unloading on EMG Spectral Parameters
S. Roy, E.J. Kupa, C.J. De Luca, S.C. Kandarian, P. Bonato 234

Myofiber Wound-Mediated FGF Release and Muscle Atrophy During Bedrest
M. Clarke, M.M. Bamman, D.L. Feeback 236

Education and Space: NASA Reaches for the Stars ..... **238** ONIT

Panel Discussion & Special Presentations 239

Neurolab: A Space Shuttle Mission Dedicated To Neuroscience Research ... **241** -25

NASA/NIH Neurolab Collaborations
J.B. Snow 242

The Neurolab Mission: An Example of International Cooperation
A. Guell 243

NEUROLAB: An Overview of the Planned Scientific Investigations
J.L. Homick 244

EDEN: A payload for Neurolab dedicated to Neuro Vestibular Research
F. Bellossi 246

Neurolab Experiments on the Role of Visual Cues in Microgravity Spatial Orientation
C.M. Oman, I.P. Howard, T. Carpenter-Smith, A.C. Beall 248

The Role of Space in the Exploration of the Mammalian Vestibular System
M.D. Ross 249

Medical, Psychophysiological, and Human Performance Problems During Extended EVA ..... **250** -26

New Developments In The Assessment of the Risk of Decompression Sickness in Null Gravity During Extravehicular Activity
M.R. Powell 251

The Dynamic of Physiological Reactions of Cosmonauts Under the Influence of Repeated EVA Workouts: The Russian Experience
A.S. Barer, N.K. Gnoevaia, V.P. Katunczev, U. U. Osipov 252

Medical Emergencies In Space
S.L. Pool 253

The Evolution from 'Physiological Adequacy' to 'Physiological Tuning'
P.A. Hancock, V.S. Koscheyev 254

Five Zones of Symmetrical and Asymmetrical Conflicting Temperatures on the Human Body: Physiological Consequences
V.S. Koscheyev 255

Human Performance and Subjective Perception in Nonuniform Thermal Conditions
G.R. Leon 256

The Hand as a Control System: Implications for Hand-Finger Dexterity During Extended EVA
T.J. Smith, M.G. Wade 257

Understanding the Skill of Extravehicular Mass Handling
P.V. McDonald, G.E. Riccio, B.T. Peters, C.S. Layne, J.J. Bloomberg 258

Metabolic and Regulatory Systems in Space Flight ..... 259 -27

The Dynamics of Blood Biochemical Parameters in Cosmonauts During Long-Term Space Flights
V. Polyakov, A. Markin, L. Strogonova, T. Tigner 260

Efficiency of Functional Loading Test for Investigations of Metabolic Responses to Weightlessness
I.A. Popova, I.V. Zabolotskaya, O.I. Balashov, L.B. Buravkova 261

Human Cellular immunity and space flight
A. Lesnyak, G. Mitirev, I. Vorotnikova, E. Antropova, G. Levicheva, I. Konstantinova ... 262

Cytokine Production And Head-Down Tilt Bed Rest
D.A. Schmitt, A. Cogoli, M. Abbal 263

Plasma and Urine Amino Acids During Human Space Flight
T.P. Stein, M.J. Leskiw, M.D. Schluter 264

DNA Fingerprinting: Applications to Space Microbiology
D.L. Pierson, S.K. Mehta, C. Brauning, G. M. Weinstock 265

Gravitational Biology: The Rat Model 266-28

Morphology of brain, pituitary and thyroid in the rats exposed to altered gravity
I.B. Krasnov, L.N. Dyachkova, E.I. Alexeev, V.I. Loginov, K. O'Mara, W. Hinds 267

Biochemical Properties of *B* Adrenoceptors After Spaceflight (LMS-STS78) or Hindlimb Suspension In Rats
S. Fagette, L. Somody, F. Bouzeghrane, N. Gallo-Bona, L. Eward, M. Viso, C. Gharib, G. Gauquelin 269

Influence of Hypergravity on the Development of Monoaminergic Systems in the Rat Spinal Cord
M. Gimenez y Ribotta, A. Privat 270

A Vestibular Evoked Potentials (VsEPs) Study of the Function of the Otolith Organs in Different Head Orientations with respect to Earth Gravity Vector in the Rat
M. Plotnik, M. Mager, J. Elidan, H. Sohmer 271

Quantitative Observations on the Structure of Selected Proprioceptive Components in Adult Rats That Underwent About Half of Their Fetal Development in Space
M. DeSantis, E. Eldrid, C. Helmick, J. Hines, A. Wong 272

Effects of a Nine-Day Shuttle Mission on the Development of the Neonatal Rat Nervous System: A Behavioral Study
D. Sulica, C. Heffernan, L. Benavides, D. Anschel, K. Walton 274

Muscle Atrophy Associated To Microgravity In Rat: Basic Data For Countermeasures
M. Falempin, Y. Mounier 275

Simulated Weightlessness By Unloading In The Rat. Results Of A Time Course Study Of Biochemical Events Occuring During Unloading And Lack of Effect Of A rhBMP-2 Treatment On Bone Formation And Bone Mineral Content In Unloading Rats
E. Zerath, X. Holy, A. Malouvier, B. Noel, M. Hott, C. André, S. Renault, P.J. Marie 276

Cytological Mechanism Of The Osteogenesis Under Microgravity Conditions
N.V. Rodionova, V.S. Oganov 277

Biological Bases of Space Radiation Risk .... **279** -29

Hematopoiesis Dynamics in Irradiated Mammals: Mathematical Modeling
O.A. Smirnova 280

Estimating Health Risks in Space from Galactic Cosmic Rays
F.A. Cucinotta, J.W. Wilson, J.F. Dicello, J.R. Williams, Mack Mabry 281

Failure of Heavy Ions to Affect Physiological Integrity of the Corneal Endothelial Monolayer
J.P. Koniarek, B. V. Worgul 282

Application of an Unbiased Two-Gel cDNA Library Screening Method To Expression Monitoring of Genes in Irradiated Versus Control Cells
E.K. Balcer-Kubiczek, S.J. Meltzer, L.H. Han, X.F. Zhang, M.-S. Zhong, G.H. Harrison, J.M. Abraham 284

Detection of Radiation-Induced DNA Strand Breaks In Mammalian Cells By Enzymatic Post-Labeling
S. Nagaoka, Y. Taniguchi, S. Endo, T. Onizuka, M. Hirano, K. Fujitaka, T. Ohnishi 286

Evaluation of Bleomycin-Induced Chromosome Aberrations Under Microgravity Conditions in Human Lymphocytes, Using "Fish" Techniques
P. Mosesso, M. Schuber, D. Seibt, A. Schatz, A. Fosci, E. Fonti, F. Palitti 287

Technical Description of the Space Exposure Biology Assembly Seba on ISS
P. Hofmann, P. Rank, J.U. Schott, H. Konig 288

Cytogenetic Research in Biological Dosimetry
V. Shevchenko, G. Snigiryova, V. Petrov, B. Fedorenko, S. Druzhinin 289

The Cooperative U.S./Ukrainian Experiment: An Overview .... **290** -30

History of the Cooperative U.S./Ukrainian Experiment (CUE)
J.A. Guikema, E.L. Kordyum, E. Hilaire, J.E. Leach 291

The Collaborative Ukrainian Experiment: Science Overview
C.S. Brown 292

Double Fertilization of Inquiring Minds: Teachers and Students Investigating Plants in Space for the Collaborative Ukrainian Experiment
P.H. Williams 293

Mission Operations for the Collaborative Ukrainian Experiment
C. Martin 294

Countermeasures for Maintenance of Cardiovascular and Muscle Function in Space Flight ..... **295** - 31

Effects of Repeated Long Duration +2Gz Load on Man's Cardiovascular Function
K. Iwasake, K. Hirayanagi, T. Sasaki, T. Kinoue, M. Ito, A. Miyamoto, M. Igarashi, K. Yajima 296

Certain Approaches To the Development of On-Board Automated Training System
V.D. Sonkin, I.B. Kozlovskaya, V.V. Zaitseva, M.V. Bourchick, V.I. Stepantsov 298

Cardiac, Arterial and Venous Adaptation to 0g during 6 Month MIR-Spaceflights With and Without "Thigh Cuffs" (93-95)
Ph. Arbeille, G. Fomina, I. Alferova, M. Porcher, J. Coulon, A. Kotovskaya, V. Poliakov 300

Space Cycle ™ Induced Physiologic Responses
A. Kreitenberg, V. Caiozzo 302

Muscular Deconditioning During Long-term Spaceflight Exercise Recommendations To Optimize Crew Performance
N. Bachl, H. Tschan, R. Baron, I.B. Kozlovskaya, Yu. Koryak, M. Mossaheb, R. Albrecht 303

Structure And Function of Knee Extensors After Long-Duration Spaceflight In Man: Effects of Countermeasure Exercise Training
B.S. Shenkman, I.B. Kozlovskaya, S. Siconolfi, G.H. Gilbert, T.L. Nemirovskaya, I. A. Cheglova, V.I. Stepantsov, V.V. Stepantsov, Yu.A. Koryak 304

Force and power characteristics of an exercise ergometer designed for use in space
H.E. Berg, P. A. Tesch 305

The simulating of overgravity conditions for astronauts' motor apparatus at the conditions of the training for orbital flights
A.N. Laputin 306

Results From the Joint U.S.-Russian Sensory-Motor Investigations ..... **307** - 32

The Effect of Long Duration Space Flight on the Acquisition of Predictable Targets in Three Dimensional Space
M.F. Reschke, I.B. Kozlovskaya, W.P. Huebner, W.H. Paloski, J.M. Krnavek, J.A. Krug, J.J. Bloomberg, D.L. Harm, E.R. Eichelman 308

Effects of Microgravity on Spinal Reflex Mechanisms
I.B. Kozlovskaya, N.I. Burlachkova 310

Three Dimensional Head Movement Control During Locomotion After Long-Duration Space Flight
J.J. Bloomberg, A.P. Mulavara, P.O. Riley, C.S. Layne, P.V. McDonald, S.L. Smith, I.B. Kozlovskaya 312

Human Body Shock Wave Transmission Properties After Long Duration Space Flight
P.V. McDonald, C.S. Layne, J.J. Bloomberg, I.B. Kozlovskaya 313

Adaptation of Neuromuscular Activation Patterns During Locomotion After Long-Duration Space Flight
C.S. Layne, G.W. Lange, C.J. Pruett, P.V. McDonald, L.A. Merkle, S.L. Smith, I.B. Kozlovskaya, J.J. Bloomberg 314

Balance Control Deficits Following Long-Duration Space Flight
W.H. Paloski, I.B. Kozlovskaya, M.P. Shestakov, S.C. Nicholas, A.M. Ivanov, M.F. Reschke 316

Influence of Weightlessness on Postural Muscular Activity Coordination
M.P. Shestakov, W.H. Paloski, I.B. Kozlovskaya, A.M. Ivanov 318

The Use of Inflight Foot Pressure as a Countermeasure To Neuromuscular Degradation
C.S. Layne, A.P. Mulavara, C.J. Pruett, P.V. McDonald, I.B. Kozlovskaya, J.J. Bloomberg *320*

Operational Aspect of Space Radiation ..... **321** – 33

Solar Particle Events and the International Space Station
J. Baker, R. Turner 322

Radiation Environment on Mir and ISS Orbits During the Solar Cycle
M.V. Teltsov, M.I. Panasyuk, V.F. Bashkirov 323

New approach to Radiation Risk Assessment
E.E. Kovalev, O.A. Smirnova 324

A Industrial Method To Predict Major Solar Flares for a Better Protection of Human Beings in Space
M.C. Calvet, J. Bourrieau, P. Lantos 325

Description of the Space Radiation Control System for the Russian Segment of ISS
M. Panasyuk, A. Biryukov, A. Myasnikov, A. Akulin, S. Filipuchev, S. Svertilov, M. Teltsov, V. Bashkirov, A. Lobakov, V. Lyugushin, Ts. Dachev, J. Semkova, B. Tomov, Yu. Matviichuk, P. Dimitrov, V. Petrov, R. Beaujean, G. Reitz 326

Orbit Selection and Its Impact on Radiation Warning Architecture for a Human Mission to Mars
J. Levine, R. Turner 327

Space Nuclear Power: Technology, Policy and Risk Considerations in Human Missions to Mars
V.P. Friedensen 328

Poster Session ..... **329** – 34

Development of correlative measures for the assessment of attention and memory
J. DeFrance, J. Degioanni, C. Hymel, F. Schweitzer, S. Estes, R. Calkins, F. Kutyna, I. Tarkka *330*

Biodynamical Responses of the Crewmember Head/Neck System During Emergence Ejection
T. He, R. L. Huston, Dajun Zhang 331

Fecundation in the Sky: A Ten Years Old Experiment in Microgravity
Luc Henriet 332

A Modified Botex Incubator As A Transport System For Developing Crickets Into Space
E. Horn, S. Pfalzer, P. Riewe, C. Sebastian, G. Kamper, U. Friedrich, P. Junk 334

Chromosomal Aberrations In Peripheral Lymphocytes Of Cosmonauts And Astronauts After Space Flights
I. Johannes, N. Heckeley, K. Hallman, G. Obe 335

Method for Establishing Long term Bone Marrow Cultures Under Microgravity Conditions
N.N. Khan, S.O. Fadulu 336

Reproduction Under Simulated Weightlessness ....Mammalian in vivo Experiments Under Suspension
T. Kinoue, M. Ito, S. Kita, Y. Ohira, R. Hashizume, H. Katoh, N. Yamaguchi, R. Maru, K. Yajima 337

Towards Human Movement Analysis Without The Use of Markers
F. Marzani, T. Pozzo, L. Legrand, M. Venet 339

Habitability Requirements For A Cogent Mars Mission
Susmita Mohanty 341

The Saucer Concept for Space Habitats
Susmita Mohanty 342

New Way In Modeling The Growth Of The Organism
L. Novak 343

The Fractionation of Hydrogen and Oxygen Stable Isotopes By Life Support Systems of Space Station "MIR"
R. L. Sauer, I. E. Siniak, V.B. Gaidadimov, B.G. Pokrovski 345

Effect of Space Flight on Neutrophil Function
R. Stowe, S. Mehta, I. Kaur, M. Jones, D. Feeback, A. Barrett, D. Pierson 346