Conferenza nazionale sulla ricerca in Antartide.
Roma, Accademia Nazionale dei Lincei, 20-21 ottobre 2015.

Workshop 7
Human presence and contamination in Antarctica

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Scientific bases

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Leonid Ivanovich Rogozov

Russian: Леонид Иванович Рогозов, 14 March 1934 – 21 September 2000)

was a Soviet General Practictioner who took part in the sixt Soviet Antarctic Expedition in 1960–1961. He was the only doctor stationed at the Novolanzarevskaya Station and, while there, developed appendicitis, which meant he had to perform an appendicectomy on himself, a famous case of self-surgery.

Rogozov V, Bermel N, Auto-appendectomy in the Antarctic: case report. BMJ, 2009; 339:b4965, Dec 2009

“A job like any other, a life like any other”

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Edward Leichester Atkinson

(South Upperwind Island, Nov, 23rd, 1881–
Mediterranean Sea, Feb, 20th, 1929)

English surgeon and explorer.

1908 joints Royal Navy. 1910 party of the Terra Nova Expedition of Robert Falcon Scott in Antarctica. Will be Atkinson to lead the rescue expedition of remain party from South Pole and to find the tent with the body of the death Scott, Henry Robertson Bowers and Edward Adrian Wilson.

Atkinson is at the center of controversies about the managing of the sledge dogs to help the Scott party on their way back and about suspect signs of scurvy in the Scott group.

During the first world war he participates to the Gallipoli battle.

To Atkinson is dedicated the Atkinson Cliffs in the Victoria Queen Land in Antarctica.

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BIBLIOGRAPHY

- 1.Front Microbiol. 2015 Sep 30;6:1058. Emerging spatial patterns in Antarctic prokaryotes. Chong CW(1), Pearce DA(2), Convey P(3).
- 2. Brain Behav Immun. 2014 Jul;39:23-32. Terrestrial stress analogs for spaceflight associated immune system dysregulation. Crucian B, Simpson RJ, Mehta S, Stowe R, Chouker A, Hwang SA, Actor JK, Salam AP, Pierson D, Sams C.
- 3. Telemed J E Health. 2013 Mar;19(3):186-91. Evaluation of tele-ultrasound as a tool in remote diagnosis and clinical management at the Amundsen-Scott South Pole Station and the McMurdo Research Station. Otto C, Shemenski R, Scott JM, Hartshorn J, Bishop S, Viegas S
- 4. Mini Rev Med Chem. 2013 Apr;13(4):617-26. Bioactive natural products from the antarctic and arctic organisms. Liu JT(1), Lu XL, Liu XY, Gao Y, Hu B, Jiao BH, Zheng H.
- 5. Hist Psychiatry. 2012 Jun;23(90 Pt 2):194-205. Psychology during the expeditions of the heroic age of Antarctic exploration. Guly HR(1).
- 6. Chronobiol Int. 2012 May;29(4):379-94. Biological rhythms during residence in polar regions. Arendt J(1).
- 7. Neural Plast. 2012;2012:784040. NGF, brain and behavioral plasticity. Berry A, Bindocci E, Alleva E.
- 8. J R Coll Physicians Edinb. 2011 Sep;41(3):270-7. Dr William Wilson Ingram (1888-1982): doctor-soldier, physician and Antarctic expeditioner. Pearn JH.
- 9. Dermatol Online J. 2010 Jan 15;16(1):16. A review of the practices and results of the UTMB to South Pole teledermatology program over the past six years. Sun A, Lanier R, Diven D.
- 10. Microb Ecol. 2009 May;57(4):640-8 Evaluation of the airborne bacterial èpopulation in the periodically confined Antarctic base Concordia. Van Houdt R, De Boever P, Coninx I, Le Calvez C, Dicasillati R, Mahillon J, Mergeay M, Leys N.

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Human presence and contamination in Antarctica

BIBLIOGRAPHY

- 11. BMJ, 2009; 339:b4965, Dec 2009. Auto-appendectomy in the Antarctic: case report.
- Rogozov V, Bermel N.
- 12. Aviat Space Environ Med. 2005 Jun;76(6 Suppl):B74-7. Behavioral health in Antarctica: implications for long-duration space missions. Lugg DJ(1).
- 13. Int J Circumpolar Health. 2004 Dec;63(4):356-64. Telemedicine in the British Antarctic survey. Grant IC.
- 14. Aviat Space Environ Med. 2004 Jul;75(7 Suppl):C14-21. Evaluating teams in extreme environments: from issues to answers. Bishop SL(1).
- 15. Endeavour. 2004 Sep;28(3):114-9. Shackleton's men: life on Elephant Island. Piggott JR.
- 16. Acta Astronaut. 2004 May;54(9):639-47. Social support and depressed mood in isolated and confined environments. Palinkas LA, Johnson JC, Boster JS.
- 17. Am Psychol. 2003 May;58(5):353-63. The psychology of isolated and confined environments. Understanding human behavior in Antarctica. Palinkas LA.
- 18. Fiziol Zh. 2003;49(3):70-4. [Medical and biological studies of Ukrainian scientists in Antarctic region Ukrainian]. Moiseienko IeV..
- 19 . Immunol Cell Biol. 2002 Aug;80(4):382-90. Trends in mucosal immunity in Antarctica during six Australian winter expeditions. Francis JL, Gleeson M, Lugg DJ, Clancy RL, Ayton JM, Donovan K, McConnell CA, Tingate TR, Thorpe B, Watson A.
- 20. Trends Pharmacol Sci. 2002 Oct;23(10):487-90. Antarctica: a review of recent medical research. Olson JJ (1).

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Human presence and contamination in Antarctica

BIBLIOGRAPHY

- 21. Aviat Space Environ Med. 2000 Jun;71(6):619-25. Predictors of behavior and performance in extreme environments: the Antarctic space analogue program. Palinkas LA, Gunderson EK, Holland AW, Miller C, Johnson JC.
- 22. Int J Circumpolar Health. 2000 Jan;59(1):63-73. Sleep and mood during a winter in Antarctica. Palinkas LA, Houseal M, Miller C
- 23. Int J Circumpolar Health. 1999 Jul;58(3):150-1. The SCAR Working Group on Human Biology and Medicine: 25 years on. Lugg DJ.
- 24. Int J Circumpolar Health. 1998;57 Suppl 1:682-5 Telemedicine: have technological advances improved health care to remote Antarctic populations? Lugg DJ.
- 25. Epidemiol Infect. 1988 Apr;100(2):271-8. A microbial culture system for use in remote field environments. Grimmond TR.
- 26. Immunol Cell Biol. 1995 Aug;73(4):316-20. Cell mediated immunity in Antarctic wintering personnel; 1984-1992. Muller HK(1), Lugg DJ, Quinn D.
- 27. J Telemed Telecare. 1995;1(2):63-8. Telemedicine in the British Antarctic Survey Medical Unit. Siderfin CD (1), Haston W, Milne AH.
- 28. Arctic Med Res. 1995;54 Suppl 2:9-15. Circannual changes in thyroid hormone physiology: the role of cold environmental temperatures. Reed HL.
- 29. Soc Sci Med. 1992 Sep;35(5):651-64. Going to extremes: the cultural context of stress, illness and coping in Antarctica. Palinkas LA.
- 30. J Spacecr Rockets. 1990 Sep-Oct;27(5):471-7. Psychosocial effects of adjustment in Antarctica: lessons for long-duration spaceflight. Palinkas LA.

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Human presence and contamination in Antarctica

BIBLIOGRAPHY

- 31. J Human Stress. 1985 Winter;11(4):161-4. Human experimentation during the International Biomedical Expedition to the Antarctic (IBEA). Taylor AJ, McCormick IA.
- 32. Med J Aust. 1980 Nov 29;2(11):587-8. International Biomedical Expedition to the Antarctic (IBEA). Lugg DJ.
- 33. Med J Aust. 1975 Aug 23;2(8):295-8. Antarctic medicine, 1775-1975. I. Lugg DJ.

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Horizon Scan, 2014 : 80 most important scientific questions on direction of Antarctica Science.

BIOMEDICAL RESEARCHES:

80. How will humans, diseases and pathogens change, impact and adapt to the extreme Antarctic.

56. How will climate change affect the risk of spreading emerging infectious diseases in Antarctica?

(Cross-cuts "Human")

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Horizon Scan, 2014: 80 most important scientific questions
on direction of Antarctica Science.

BIOMEDICAL RESEARCHES:

-Legal medicine issues

-International cooperation/autonomous health system

77. How will the use of Antarctica for peaceful purposes and science be maintained as barriers to access change?

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Biomedical research:

- Human adaptation
- Phisiology
- Psicology
- Immunology
- Nutrition
- Telemedicine
- Medical personnell training
- Medical procedure techniques
- Medical equipments
- Legal medicine issues

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Peculiarity of biomedical researches:

- **statistical data value: time.**
- **consensus**
- **invasiveness**
- **privacy**

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- **Environments ICE:**
  Isolated Confined Extreme

Concordia Station.

Many stressor characteristics of long duration deep space missions.

Extreme isolation and confinement, a useful analogue platform for research relevant to space medicine.

During the winter the crew are:

- without possibility of evacuation or deliveries for 9 months

- for a prolonged period in total darkness,

- at altitude almost equivalent to 4000m at the equator.

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- **Environments ICE:**
  Isolated Confined Extreme

Concordia Station.

The physiological and psychological strains on the crew are marked. Concordia station is particularly useful for the study of

chronic hypobaric hypoxia,
stress secondary to confinement and isolation,
circadian rhythm,
sleep disruption,
individual and group psychology,
telemedicine,
astrobiology.

Concordia station has been proposed as the one of the highest fidelity real-life Earth-based analogues for long duration deep space missions.

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From the past to the future:

HUMAN ADAPTATION TO LIFE IN ANTARCTICA

BY

OVE WILSON*

Introduction

CONTEMPO UPDATES
LINKING EVIDENCE AND EXPERIENCE

Antarctic Medicine

MEDICINE IN THE ANTARCTIC

Figure. An Operating Room in Antarctica

MEDICINE IN THE ANTARCTIC

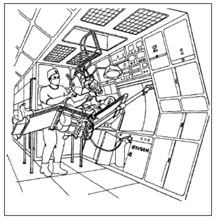
MARSTECHCARE FINAL REPORT Version December 26th, 2002

MARSTECHCARE

NECESSARY BIOMEDICAL TECHNOLOGIES FOR CREW HEALTH CONTROL
DURING LONG-DURATION INTERPLANETARY MANNED MISSIONS

FINAL REPORT

ESA Contract ESTEC N°: 16423/02/NL/LvH



NASA – Drawing.

Authors:
Pr Isabelle BERRY (ADTBM / CHU de Toulouse)
Mrs Audrey BERTHIER (MEDES-Toulouse)
Pr Jacques MARESCAUX, Pr Didier MUTTER, A. BOUABENE (IRCAD Strasbourg)
Dr. Patrick Magee (The University of Bath, Faculty of Postgraduate Medicine)
Dr Bernard COMET (MEDES-Toulouse)

MARSTECHCARE FINAL REPORT Page: 1

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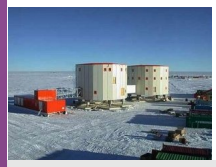
From the past to the future:

LONG TERM MEDICAL SURVEY



esa
European Space Agency

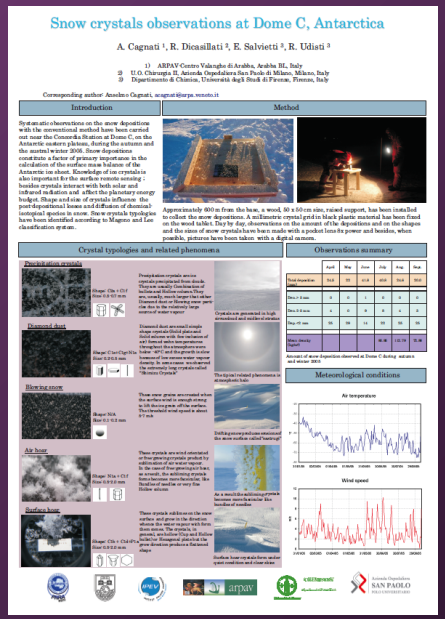
Concordia Station in Antarctica

This activity was approved by the Aurora Board of Participants within the Work Plan 2005-2006 and should be initiated by the end of 2005.
To prepare for a human mission to Mars, it is essential to learn more on the physiology and psychology of human beings when subjected to confinement and extreme environments.
The winter-over crews that will stay about eight months at the Concordia Station (Antarctica) for performing maintenance and scientific work offer a suitable analogue situation to what could be an exploration stay on Mars. Collecting physiological and psychological data will provide extremely valuable information on not only adaptation to extreme environments but also on how to select the best psycho-physiological profiles.
To support that activity, ESA has decided to team up with the Concordia partners in order to study the behaviour and medical parameters of the Concordia crew. Under that agreement, ESA will supply and support a system used to monitor the life and well-being (fitness) parameters of the Concordia Station crews. The data will be available for the medical doctor on site, and recorded data will be transferred to Europe for further processing by scientists.
A competitive study has already been placed for a definition phase of the LTMS system (sensors, data processing and archiving). It is essential to supply all the Concordia winter-over crews with a LTMS system for them to record a set of physiological (and later on psycho-physiological) data. Ideally a prototype should be shipped to the Station end 2005 for refinement of protocols and data transmission check out. The present activity is dedicated to the detailed design study and realization of the prototypes of the operational LTMS system.
Based on the outcome of the definition phase study, the aim of the activity is to perform a phase B study with realisation of a fully functional prototype of the LTMS including sensors, data processing software, hardware and data management system (database).
The prototype is intended to be used on human beings, to test the wireless data transmission and demonstrate it can operate for two subjects at the same time. As the prototype will be used on human beings, it is foreseen to have it fully safety-tested according to the applicable medical standards.
The prototypes should be highly representative of the final version of the LTMS and should also demonstrate all the data processing capabilities, such as extraction of parameters, MMI capabilities and instant access to non-nominal data.
The LTMS prototypes will have to undergo safety assessment to clear them for use on humans. Later the prototypes will be validated by experts for all physiological parameters. After validation, it is intended to test the LTMS prototypes operationally in situ at Concordia, in order to collect additional data for further optimisation and prepare for the operational LTMS systems.
Note: The priority for development is the LTMS sensors, hardware and data processing software.
Depending on the effort actually required to build those, the development of the data management system the database may be scaled down but a system for safety saving, retrieving, distributing and reprocessing the data will be developed.

Start	Expected or actual duration	Status	Prime contractor
TBD	15 months	TBD	TBD

Last update: 17 May 2006

Evaluation of the Airborne Bacterial Population in the Periodically Confined Antarctic Base Concordia



Snow crystals observations at Dome C, Antarctica

A. Cagnati [1], R. Dicasillati [2], E. Salvietti [3], R. Udisti [3]

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3) Dipartimento di Chimica, Università degli Studi di Firenze, Firenze, Italy

Corresponding author: Anselmo Cagnati, acagnati@arpa.veneto.it

Introduction

Systematic observations on the snow deposition with the conventional method have been carried out near the Concordia Station at Dome C, on the Antarctic eastern plateau, during the autumn and the austral winter 2008. Snow deposition constitutes a factor of primary importance in the calculation of the surface mass balance of the Antarctic ice sheet. Knowledge of ice crystals is also important for the surface remote sensing : besides crystals interact with both solar and infrared radiation and affect the planetary energy budget. Shape and size of crystals influence the post-depositional losses and diffusion of chemical-isotopical species in snow. Snow crystals typologies have been identified according to Magono and Lee classification system.

Method

Approximately 600 m from the base, a wood, 60 x 60 cm size, raised support, has been installed to collect the snow depositions. A millimetric crystal grid in black plastic material has been fixed on the wood tablet. Day by day, observations on the amount of the depositions and on the shapes and the sizes of snow crystals have been made with a pocket lens 8x power and besides, when possible, pictures have been taken with a digital camera.

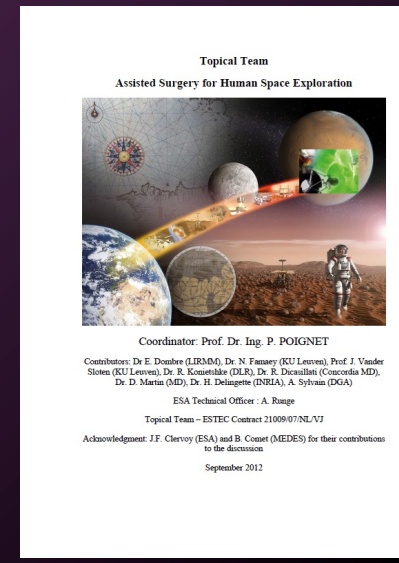
Crystal typologies and related phenomena

Observations summary

Meteorological conditions

Air temperature

Wind speed



Topical Team

Assisted Surgery for Human Space Exploration

Coordinator: Prof. Dr. Ing. P. POIGNET

Contributors: Dr E. Dombre (LIRMM), Dr. N. Famaey (KU Leuven), Prof. J. Vander Sloten (KU Leuven), Dr. R. Konietshke (DLR), Dr. R. Dicasillati (Concordia MD), Dr. D. Martin (MD), Dr. H. Delingette (INRIA), A. Sylvain (DGA)

ESA Technical Officer : A. Runge

Topical Team – ESTEC Contract 21009/07/NL/VJ

Acknowledgment: J.F. Clervoy (ESA) and B. Comet (MEDES) for their contributions to the discussion

September 2012

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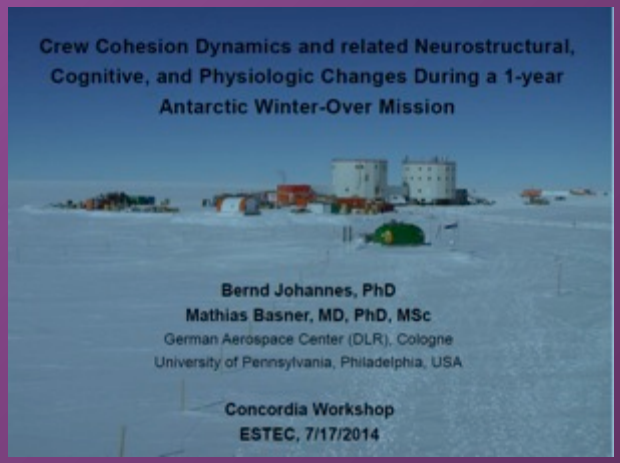

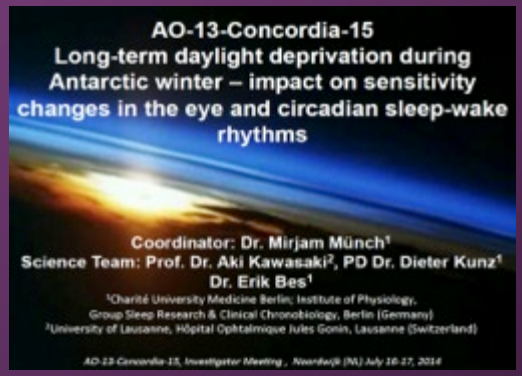

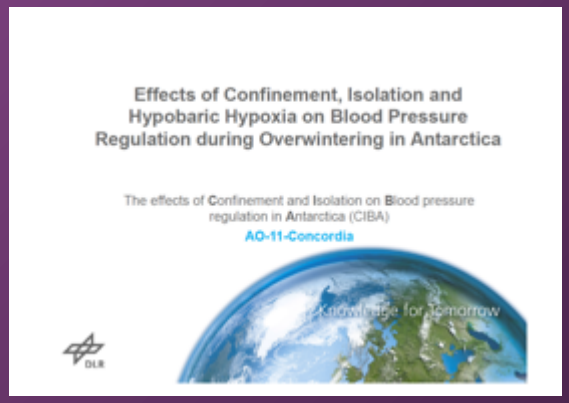

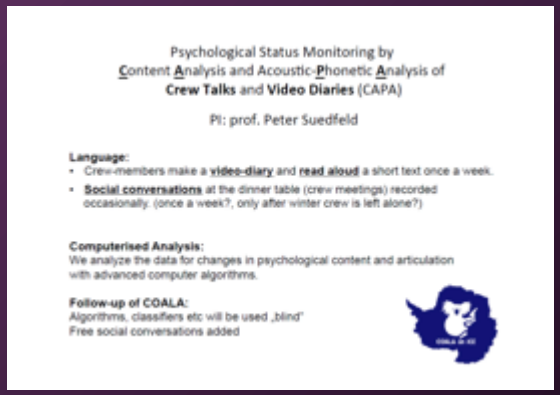

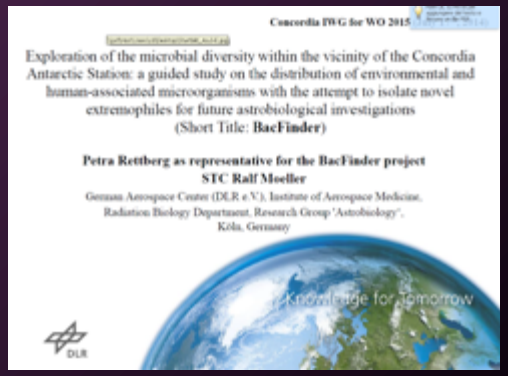

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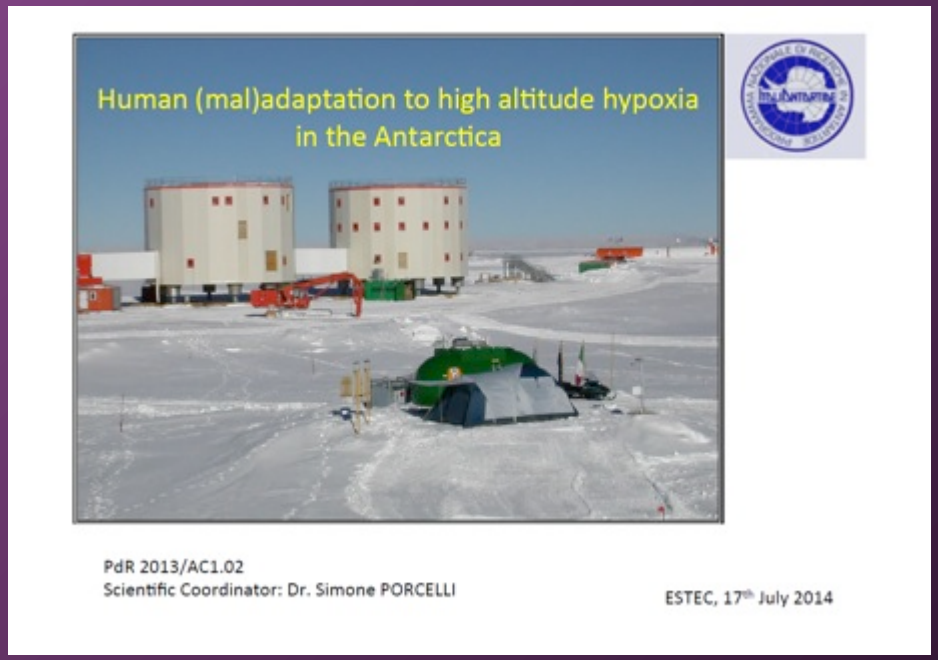

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BIOMEDICAL RESEARCHES:

emerging issues:

"concordance"

"citizen science"

Human adaptation

- Immunology
- Psychology
- Neurotoxicology (endocrine disruptors)
- Physiology

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BIOMEDICAL RESEARCHES:

Immunology:

Stress affects immune functions resulting in increased risk of immune-related diseases.

Salivary IgA levels are potential biomarkers to evaluate the effects of environmental stress.

IgA is the predominant antibody present in mucosal fluids distingueshed into IgA1 and IgA2 subclasses.

We propose to evaluate the effects of environmental stress at Concordia station by:

- Periodically monitoring IgA1 and IgA2 levels in comparison with IgM and IgG levels both in blood serum and saliva
- Quantifying IgA^{+}-B cells
- Evaluating the expression level of the polymeric Ig Receptor involved in the transcytosis of secretory IgA

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BIOMEDICAL RESEARCHES:

Stress, physiology, psychology and behaviour:

- Stressful factors regulating cognition (e.g. attention, memory, execution of tasks)
- Role of social group (e.g. how the group influences individual performance)
- Individual adaptation to ICE (Isolated, Confined and Extreme) environment

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BIOMEDICAL RESEARCHES:

Neurotoxicology (in close collaboration with "human presence and contamination"):

Role of endocrine disruptors on physiology and behaviour.

- **Investigate whether and how endocrine disruptors influence individual behaviour and stress physiology in experimental models.**

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BIOMEDICAL RESEARCHES:

Physiology:

(Mal) adaptation to chronic hypoxia.

- Crews selection
- Possible treatment on the field
- Enormous relevant feed back on general population: cardiovascular and degenerative neurologic pathologies.

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BIOMEDICAL RESEARCHES:

- Telemedicine
  - Communications
  - Video Assisted Procedures
  - Robotic surgery
- Medical personnel training
  - Different Medical Specialties
- Medical procedure techniques
  - Evidence based medicine
- Medical equipments/procedures
  - eg. blood analogues
- Legal medicine issues
  - International cooperation/autonomous health system

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**Literature was formerly an art and finance a trade;
today it is the reverse"**

Joseph Roux (1834-1905)

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MANY THANKS FOR YOUR ATTENTION.