PAGES
PAST GLOBAL CHANGES

A CORE PROJECT OF
THE INTERNATIONAL
GEOSPHERE-BIOSPHERE
PROGRAMME IGBP

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BRUNO MESSERLI AND THE INTERNATIONAL GEOOGRAPHICAL UNION

Professor **Bruno Messerli**, Director of PAGES and member of the Scientific Steering Committee has been elected President of the International Geographical Union for the next three years.

PAGES IN PERSPECTIVE

PAGES emerged in the context of a paleo-community traditionally divided along conintental-terrestrial, marine and polar lines, as well as in other ways reflecting the broad range of specialisms and environmental archives employed.Thus, one of the most important initial activities of PAGES has been the development of a coherent scientific plan that brought together the marine, terrestrial and polar research communities.

One of the most vital roles of PAGES so far has been to set research agendas and thereby shift, sometimes even transform, the perceptions and priorities of the scientific community with whom it works. This process began with the first statements about Priorities and Time Streams and has continued, reinforced by each successive PAGES publication. In this way, PAGES has taken the lead in achieving the first true integration of the research agendas of terrestrial, marine and polar paleoscientists.

At the core of the scientific community whose interests focus on the environmental record of the last 200,000 or 2000 years are a wide variety of researchers who might be broadly regarded as 'Quaternary Scientists'. Creating within that wider field a series of criteria and foci that reflect the PAGES agenda, and seeing the agenda so defined become increasingly recognised and explicitly referred to in the mission statements and research priorities of both national and international funding agencies, is one of the major achievements of PAGES. Beyond the group of scientists who might feel reasonably comfortable under the 'banner' of Quaternary research, are a vast range of environmental scientists of almost every kind whose research orientation has also been changed by PAGES, especially through the recognition given by funding councils to the value of its emerging research agenda.

By the end of this year, the **PAGES Status Report and Implementation Plan** will have been completed, for subsequent publication by IGBP. It is perhaps a good time to take stock and to invite feedback and comment. This is all the more important since by now, more and more of PAGES Science is 'bottom-up', driven by the realization among fellow researchers that adoption of an approach, definition of a problem and acceptance of a set of criteria consistent with PAGES formulations may improve the chance both of funding and of full recognition, for the results obtained, as contributions to Global Change Research.

The Table provides an updated summary of the various PAGES Foci, Activities and Tasks. The extent to which each of these has been achieved, or even articulated, varies greatly. In all cases, PAGES shares the research agenda with a wide range of scientists.

You are hereby invited to contact us with any ideas you may have for advancing our work.

Any suggestions should not necessarily be limited to the scheme outlined, since there are other major themes of potential relevance to PAGES not even listed. One example is the history of land- and sea-level change. A Workshop report later in the Newsletter identifies one area of involvement in this theme, but it is potentially a much wider concern. At the same time, other groups are coordinating major research efforts in this and other fields. Where can PAGES best focus its efforts?

As well as inviting input from the full range of interested scientists, we also propose, in future Newsletters, to recognise the extent to which PAGES has moved from agenda setting to implementation. We shall do this by including more comprehensive accounts of the scientific achievements of the ongoing Activities. The first issue of 1997 will focus on the PEP Transects. **Look forward to a bumper, new-style Newsletter early in the New Year.**

Meanwhile, it is important to note some of the key developments in our understanding of Global Change that have come about largely through the activities of the PAGES research community broadly defined. These are set out in the statements that follow:

1. Climate variability at both a regional and a global scale has, even within the boundary conditions prevailing during the Late-Holocene, been significantly greater than has been recorded during the short, recent period for which instrumental records of climate variation exist. This is conclusively demonstrated by recent research, is of crucial significance for predicting future climate change and is not recognized in the recent IPCC Report. Any future anthropogenic forcing will be superimposed on and interact with underlying, natural variations of greater amplitude than has been postulated.

2. On the timescale of the whole Holocene period, the amplitude and broader environmental implications of natural climate variability, especially in lower latitudes, have been well beyond the extremes experienced in recent times and of a magnitude well beyond the range of adaptation of current human social and economic systems in many regions.

3. Climate variability involves changes on all timescales; sudden, rapid changes may be of a magnitude comparable to, or in excess of those plotted as longer term fluctuations in mean values. Moreover the effects of such variations on the changing incidence of extreme events is often underestimated by simple, temporally smoothed reconstructions of mean values.

4. On the timescale of the Late-Quaternary, sudden, major climate shifts, some of an amplitude close to that marking the difference between Holocene and Last Glacial Maximum conditions,have taken place rapidly and frequently. They involve non-linear responses to the transgression of systems thresholds and are both global in their extent and highly regionally differentiated in their expression. These discoveries imply that we cannot exclude the possibility that future climate change will involve equally dramatic 'surprises'.

5. The amplitude of temperature change between the Holocene 'optimum' and the Last Glacial Maximum in Tropical latitudes remains controversial. Recent studies of both terrestrial archives and indicators of sea-surface temperature, suggest that this change was much greater than previously envisioned. If this is correct, it would change significantly our understanding of the coupled climate - ocean dynamics of the LGM, with important implications for our understanding of the climate system.

6. The role of paleodata in model validation is increasing as data quality and global coverage increase and modelers come to recognise the need to test simulations under boundary conditions beyond the range of recent climate variation. Model experiments are also being carried out to simulate transient responses that are consistent with the well documented changes in the earth system in the Late Quaternary.

7. The extent to which records of greenhouse gas concentrations and of paleo-temperature preserved in polar ice cores closely parallel each other lends empirical support to the inferred link between increasing greenhouse gas concentrations and global warming, though the nature and timing of the linkage, especially between CO_2 and temperature change, requires further, more detailed investigation.

PAGES PROJECT ORGANIZATION

PAST GLOBAL CHANGES

FOCUS I Global Paleoclimate and Environmental Variability
PANASH - Paleoclimates of the Northern and Southern Hemispheres

- **Activity 1:** PEP - 1; The Americas Transect
- **Activity 2:** PEP - 2; Austral - Asian Transect
  - **Task 1** - BDP
  - **Task 2** - HIPP
- **Activity 3:** PEP - 3; Afro - European Transect
  - **Task 1** - IDEAL
  - **Task 2** - Paleomonsoon (w/INQUA)
- **Activity 4:** The Oceans
  - **Task 3** - IMAGES (w/SCOR)
- **Activity 5:** PAGES-CLIVAR Interactions
  - **Task 1** - ARTS

FOCUS II Paleoclimate and Environmental Variability in Polar Regions

- **Activity 1:** Arctic Programmes
  - **Task 1** - CAPE
  - **Task 2** - NAD
  - **Task 3** - GISP2/GRIP
  - **Task 4** - ICAPP
- **Activity 2:** Antarctic Programme (w/SCAR)
  - **Task 1** - PICE
  - **Task 2** - ITASE
  - **Task 3** - ANTIME

FOCUS III Human Interactions in Past Environmental Changes

- **Activity 1:** Human Impacts on Fluvial Systems
- **Activity 2:** Human Impacts on Terrestrial Ecosystems

FOCUS IV Climate System Sensitivity and Modelling

- **Activity 1:** Climate Forcing and Feedbacks
  - **Task 1** - Volcanic Influences (w/INQUA)
  - **Task 2** - Solar Influences
  - **Task 3** - Greenhouse Gases and Aerosol Influences
  - **Task 4** - Abrupt Climate Change and Internal Climate System Dynamics
- **Activity 2:** Climate Model - Data Intercomparisons
  - **Task 1** - PMIP
  - **Task 2** - PMAP
    Biome 6000 (w/GCTE/DIS/GAIM)

FOCUS V Cross - Project Analytical and Interpretive Activities

- **Activity 1:** Chronological Advances
- **Activity 2:** Development of New Proxies
  - **Task 1** - Isotope Calibration Study
  - **Task 2** - Continental Drilling for Paleoclimate Records
- **Activity 3:** International Paleo-Data System (w/WDC - Paleoclimate)
- **Activity 4:** REDIE (w/START/IAI)

ACRONYMS

BDP - Baikal Drilling Project
HIPP - Himlayan Interdisciplinary Paleoclimate Project
IDEA - International Decade of East African Lakes
IMAGES - International Marine Global Change Studies
SCOR - Scientific Committee on Ocean Research
CLIVAR - Climate Variability and Predictability
ARTS - Annual Records of Tropical Systems
CAPE - CircumArctic Polar Environments
NAD - Nansen Arctic Drilling Project
GISP2 - Greenland Ice Sheet Project - Two
GRIP - Greenland Ice Core Project
ICAPP - International Circum-Arctic Paleoclimate Program
SCAR - Scientific Committee on Antarctic Research
PICE - Paleoenvironments for Ice Cores
ITASE - International Trans-Antarctic Scientific Expedition
ANTIME - Antarctic Ice Margin Evolution
PMIP - Paleoclimate Modelling Intercomparison Project
PMAP - Paleoenvionmental Multiproxy Analysis and Mapping Project
GCTE - Global Change and Terrestrial Ecosystems
DIS - Data and Information System
GAIM - Global Analysis, Interpretation and Modelling
WDC - World Data Center
REDIE - Regional, Educational and Infrastructure Efforts
START - System for Analysis, Research and Training
IAI - Inter-American Institute for Global Change Research

WORKSHOP REPORT

A Workshop on Glaciers, Ice Sheets, and Sea Level, sponsored by SCAR, IASC, IGBP/PAGES, ICSI, and WCRP met in Fjaerland, Norway, on 21-22 June, 1996.
Its principal recommendations were as follows.

1. SCAR, IASC, and ICSI should establish a joint Group of Specialists or Working Group to consider ice and sea level in their global aspects. The Group should be closely linked to the relevant programs of WCRP and IGBP, especially PAGES.

2. An international, interdisciplinary conference on ice and sea level with a particular emphasis on interactions with the oceanographic, solid-earth-geophysics and anthropogenic- change communities concerned with sea-level change should be convened within the next 2 or 3 years.

Part of the context for the recommendations made at the Workshop was the realization that the ice sheets of the world have undergone considerable change over geologic time. Several mechanisms in the ice-sheet/lithosphere system, notably glacio-isostatic adjustments and the effect of temperature on the viscosity of the ice in the deeper layers, have long response times. It is likely that the ice sheets are still reacting to the glacial-interglacial transition between 20,000 and 10,000 years ago. If there has been a significant ice-sheet contribution to the recent sea-level change, it is not clear whether it is a long-term response to the glacial/interglacial transition or a short-term response to, for example, changing accumulation or discharge rates in the last century. Thus it is necessary to consider the history of past ice-sheet changes in order to interpret the present changes and predict those of the future. Furthermore, the paleorecord contained in ice cores enables us to better understand the relationship between accumulation rate, which is sea-level related, and climate.

Several of the specific recommendations made in the Workshop report stress the historical time dimension, notably the following:

- Develop a geographically extensive program of shallow coring for studying changes in surface mass balance and the geochemistry of the near-surface snow over the past few centuries both in Antarctica (the ITASE program) and in the Arctic.

- Use ice-core records from well-selected sites in both the Northern and Southern Hemispheres

  a) to provide evidence of the size and extent of glaciers in the past 150 Kyr;
  b) to study the relationship between past glacier mass balance and past temperatures,
  c) to evaluate recent anthropogenic influences by comparison with natural variations in the past;
  d) to provide for inter-hemispheric comparisons,
  e) to search for information about the extent of ice during the last interglacial.

- Establish the record of Pleistocene and, particularly, Holocene changes in the extent of the ice sheets by making extensive geological measurements, both terrestrial and marine, around the perimeter of the ice sheet.

- Develop and refine models of ice-sheet and ice-shelf dynamics and their responses to feasible changes in atmospheric and oceanic forcing.

Thie above has been compiled from a report by
Charles Bentley,
University of Wisconsin,
Madison WI, USA

PEP I

The plan to convene the first "Inter-hemispheric Paleoclimates of the Americas" meeting is taking shape. The meeting will be held in Merida, Venezuela, March 1998. The following topics, to be organized by coordinators, will be discussed: Modern Climate Variability, El Niño/Southern Oscillation, Last 2000 Years Climate Variability, Mid Holocene Climate Optimum/Neoglacial, Late-Glacial Climate Variability, Last Glacial Maximum. Coordinators of each topic session will provide a state-of-the-art interhemispheric synopsis, which is followed by specific comparative presentations from the marine and terrestrial realm, addressing interhemispheric linkages. Presentations will be published subsequently in a book.

The spanish translation of the revised PAGES-PANASH and PEP I portion of the PAGES 95-1 report will go to press shortly. It will also include the updated site inventory of the Latin American Pollen Database, available also on the World Wide Web: (http://www.ngdc.noaa.gov/paleo/paleo/html), and previously published as a Paleoclimatology Publication Series Report No. 4, 1996, (V. Markgraf, L. Anderson, J. Keltner, E. Grimm "The Latin American Pollen Database Site Inventory", World Data Center-A for Paleoclimatology, NOAA Paleoclimatology Program, Boulder, Colorado, 80303). The spanish PANASH/PEP I issue will be widely distributed to the Latin American community using the PAGES mailing list and upon request to Vera Markgraf.

This brief statement serves as a 'trailer' for the full report from PEP I in the next Newsletter which will also summarise Continental Drilling Efforts and a wide range of Research and Workshop Activities linked to PEP I.

From report by
Dr Vera Markgraf,
PEP I Leader, INSTAAR,
University of Colorado,
USA

PUBLISHED WORKSHOP REPORTS:

93-1
High Resolution Record of Past Climate from Monsoon Asia: The last 2000 Years and Beyond. Edited by: Raymond Bradley; September 1993
93-2
An International Decade for the East African Lakes(IDEAL). Edited by: Thomas C. Johnson; July 1993
94-1
Research Protocols for PALE (Paleoclimates of Arctic Lakes and Estuaries). Issued by: PALE Steering Committee; June 1993
94-2
INQUA/PAGES workshop, Paleomonsoons in Africa and Surrounding Oceans: The last 2000 Years.Edited by: Stefan Kroepelin
1994
PAGES-START Workshop, Past Global Changes in Africa. Edited by: Eric Onyango Odada
94-3
International Marine Global Change Study (IMAGES) Science and Implementation Plan. Issued by: IMAGES Planning Committee
95-1
THE PANASH Project, Paleoclimates of the Northern and Southern Hemispheres. Edited by: PANASH Leaders
95-2
GLOBAL PALEOENVIRONMENTAL DATA, A report from the workshop sponsored by Past Global Changes (PAGES). Edited by: D.M. Anderson; Organized by: J.T. Overpeck and J. Pilcher
96-1
Himalayan Interdisciplinary Paleoclimate Project - Science and Implementation Plan. Edited by: C.P. Wake and P.A. Mayewsky
96-2
Land Use and Climate Impacts on Fluvial Systems during the Period of Agricolture. Edited by: Robert J. Wasson
96-3
Climate Effects of Explosive Volcanism. Edited by J. Beget et al.
96-4
Continental drilling for paleoclimate records. Edited by: Steven M. Colman
1996
GNIP Global Network for Isotopes in Precipitation. Edited by: U. Schotterer
1996
The PAGES/CLIVAR Intersection. Providing the paleoclimatic perspective needed to understand climate variability and predictability. Co-organized and Edited by: J.-C. Duplessy and J. Overpeck

All the above are available on request from the Core Project Office

PAGES Core Project Office
Bärenplatz 2
CH-3011 Bern, Switzerland
Tel: +41-31/312-31-33
Fax: +41-31/312-31-68
E-mail: pages@ubeclu.unibe.ch

Newsletter Editor: **Frank Oldfield**

PAGES CALENDAR

(* Open meetings. All intersted scientists are invited to attend)

*January 3 - 7, 1997: "Desert margin changes in Africa since 135ka; implications for water, carbon and mankind". University of Nouakchott, Mauritania. Contact H. Faure (FAX: (33) 4 91 41 38 79; E-MAIL: faure@riou.univ-mrs.fr).

*January 13 - 14, 1997: Holocene Miniconference in Lamont , Palisades NY on 'Modes and Mechanisms of Holocene Climate Variability'. Contact Peter de Menocal, E-MAIL: peter@lamont.columbia.edu.

January 11 - 22, 1997: Workshop on "Continental Signals of Paleomonsoon Dynamics in Africa: Interhemispheric perspectives". Siwa Oasis, Egypt. Contact: S. Kroepelin (FAX: (49) 30 841 00363; E-MAIL: skroe@zedat.fu-berlin.de).

Late February 1997: PAGES workshop on "Deriving Hydro-meteorological Parameters from High Resolution Isotope Records" Bern, Switzerland. Contact: U.Schotterer (FAX: (41) 31 312 31 68; E-MAIL: uschotterer@pageigbp.unibe.ch)

* March 5 - 10, European Research Conference on "Glacial-Interglacial Sea-level Changes in Four Dimensions: Evidence of sea-level and of linked Environmental Changes at the Land Ocean Interface", Blarney, Ireland. Contact: J Hendkovic (FAX: (33) 3 88 36 69 87; E-MAIL: euresco@esf.org.fr

* April 4 - 8, 1997: Circum Arctic Paleoenvironments (CAPE) Synthesis Workshop: "Holocene Spatial and Temporal patterns of environmental change in the Arctic" Lammi, Finland. Contact: S. Hicks (FAX: (358) 8 553 1484; E-MAIL: sheila.hicks@oulu.fi

* April 14 - 18, IAEA Vienna; International Symposium on 'Isotope Techniques in the Study of Past and Current Environmental Changes in the Hydrosphere and the Atmosphere' Contact Ms. T. Niedermayr, Conference Service Section, e-mail: niederma@adpo1.iaea.or.at

*April 21 - 25, 1997: European Geophysical Society, Vienna, Austria. See especially Session OA13, "Climate variability, observation and modelling", sub-session "Reconstruction of past climates through Modelling and Observation". Contact: Ramstein (E-MAIL: ramstin@asterix.saclay.cea.fr).

*August 24 - 30, 1997: Siberian Transect Workshop on "Spatial-temporal dimensions of High-Latitude Ecosystem Changes" Krasnoyarsk, Russia. Contact: V.A. Koptyug (FAX: (7) 3832 35 48 46; E-MAIL: evag@ifor.krasnoyarsk.su).

*August 28 - September 2, 1997: "Seventh International Symposium on Palaeolimnology" Heiligkreutz/Riedlingen, Ge8. rmany. Contact: J. Merkt (FAX (49) 511 643 3667; E-MAIL: merkt@gate1.bgr.d400.de). This Symposium is followed by a scientific celebration of the 80th birthday of Herbert E. Wright, Jr. at Wengen, Switzerland (Sept. 8 - 11). Contact: B. Ammann (FAX: (41) 31 332 20 59).

* Late April 1998: "PAGES-Quaternary Research Association Open Meeting". Contact PAGES CPO.

* May 16 - 23, 1998: "Environmental Change in Atlantic Islands". Torshavn, Faroe Islands. Contact: C. Caseldine, Department of Geography, University of Exeter, UK.