

AYUSH research

This is with reference to the opinion article titled 'AYUSH advisory presents ominous outlook for research in traditional Indian healthcare systems' by Lakhotia *et al.*¹.

The Ministry of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH) is a governmental body in India purposed with developing, education and research in the field of alternative medicine, including ayurveda, yoga, unani, naturopathy, siddha and homoeopathy. AYUSH is one of the multiple regulators of higher education in the country. The unacceptable and inappropriate advisory released by AYUSH is a reflection of how our higher education regulators are functioning in the country. The classification of AYUSH researchers and non-AYUSH researchers is indeed absurd. The wisdom pertaining to ayurveda, etc. of our ancestors needs to be validated and also must be taken to the next level of knowledge base through appropriate and relevant interdisciplinary as well as contemporary research avenues. However, these kinds of shortsighted policies will never make any ayurvedic drug a global brand. There-

fore, AYUSH must be on par with other branches of science, with all the stringent guidelines and methodologies. Instead of a blame game, it is better to design protocols/guidelines to be adopted by all those who are practising teaching, learning, evaluation and research related to AYUSH. Different higher education regulators as well as funding agencies need to interact and evolve a system for further progress.

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1. Lakhotia, S. C., Patwardhan, K. and Rastogi, S., *Curr. Sci.*, 2019, **116**(9), 1459–1460.
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Response:

We appreciate the assertive comments of Ranganath. We agree with his observation that the proposed division of science as 'AYUSH' and 'non-AYUSH' is not

only arbitrary and unnatural, but also unproductive, detrimental and regressive to the growth of knowledge as a whole. Research gets biased if one decides to disrespect, disregard and discard ideas that differ but accept only those that appreciate perception of the AYUSH ministry. This is unacceptable in any research. Any system of health-care has its own advantages and limitations. Denying these limitations on the pretext of incompetency is undesirable. Adopting a policy of inclusivity is obviously more productive for the growth of AYUSH.

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MEETING REPORT

Science of the earth system*

A workshop on 'Advances in Earth System Science' was held last year at the Banaras Hindu University (BHU), Varanasi. An editorial board meeting of the *Journal of Earth System Science* (published by the Indian Academy of Sciences (IASc), Bengaluru) was also held during that time. About 50 delegates belonging to various domains of earth system science, viz. earth, planetary, atmosphere and oceans, gathered on a

common platform to deliberate on different contemporary topics. Five technical sessions were convened and 21 talks were delivered during the workshop.

The inaugural lecture was delivered by Vinod Gaur (CSIR-Fourth Paradigm Institute, Bengaluru), who emphasized the importance of first principles approach to address fundamental problems in planetary sciences research and education. New views on the origin of the solar system were updated by J. N. Goswami (Physical Research Laboratory (PRL)). The Himalaya is one of the regions where seismicity is a grave concern. V. C. Thakur and B. R. Arora (Wadia Institute of Himalayan Geology) provided an overview of seismotectonics of the domain and stressed on the role of plate

boundary and wedge-thrust earthquakes. The evolution of various branches of earth sciences and their culmination into earth system science was traced by R. N. Singh (Indian Institute of Technology-Gandhinagar). Crustal architecture and Moho topography beneath the eastern Indian and Bangladesh margins from latest marine datasets were presented by K. S. Krishna (University of Hyderabad). Based on the diffusion chronometry of garnet grains, S. K. Bhowmick (Indian Institute of Technology-Kharagpur (IIT-KGP)) highlighted pulsed tectonic patterns in the evolution of early earth hot orogens. Based on the presence of Martian rare mineral jarosite, Saibal Gupta (IIT-KGP) postulated that analogous environment can be found in the Rann of

*A report on the workshop on 'Advances in Earth System Science' organized by the Department of Geology, Banaras Hindu University, Varanasi and the Indian Academy of Sciences (IASc), Bengaluru during 31 October–1 November 2018 at Varanasi as a part of the 84th Annual Meeting of IASc.

Kutch and documented the presence of jarosite. R. Bhutani (Pondicherry University, Puducherry) summarized the various radiogenic isotopic clocks used to understand the evolution of the earth, and summarized their pros and cons. The importance of self-potential method in subsurface exploration of mineral deposits was demonstrated by A. Biswas (BHU).

Biomass burning is a major hazard, especially in North India. Chemical characterization of carbonaceous aerosols and their implications to atmospheric radiative forcing and climate were elucidated by M. M. Sarin (PRL). Glacial melting due to enhanced temperature is a global problem. S. K. Bhattacharya (IIT-KGP) demonstrated, using oxygen isotopes, a decrease in snow/glacier melt contribution during 2002–2004. Prediction of monsoon and climate is a challenging problem. A. K. Sahai (India Meteorological Department) enumerated the challenges involved in subseasonal predictions. The atmosphere and oceans are coupled systems, and this aspect was further explored by V. V. S. Sarma (Council of Scientific and Industrial Research–National Institute of Oceanography), who provided evidence for modification of coastal waters by atmospheric pollutants. Depleting groundwater is a major concern in the northern Indian plains, and A. Mukherjee (IIT-KGP) delineated the measures for groundwater security in India. The role of tropical Indian ocean warming and its impact on regional climate was highlighted by C. Gnanaseelan (Indian Institute of Tropical Meteorology, Pune). Using a time-varying model, temporal evolution of hydroclimatic teleconnection and long-term prediction of Indian summer monsoon rainfall were demonstrated by R. Maity (IIT-KGP).

An exclusive session was devoted to the Young Associates of IASc. Various methods to estimate spatio-temporal variations of surface water availability at regional scales, and their challenges and opportunities were provided by Riddhi Singh (IIT-B). Dating of lunar surface morphology by various remote sensing techniques was discussed by K. Yhosu (Nagaland University, Lumami). Evidence for high rates of nitrogen fixation in the Arabian Sea was presented by Arvind Singh (PRL). A numerical method for flood-risk assessment was provided by N. Hazarika (Nagaland University).

The valedictory session was addressed by Ram Ramaswamy (President, IASc) and Rakesh Bhatnagar (BHU). Several delegates expressed their views regarding future courses of action, which are summarized below:

- Atmospheric deposition of iron dust, via dry-fallout and wet-scavenging, is a dominant external source of iron to the open ocean. Further studies are needed to consider these issues and the impact on ocean surface biogeochemistry using a wide range of approaches from fundamental chemistry, through modelling and field work.

- Although no quantitative estimates are available at present for the rapidly changing greenhouse gas (GHG) budget of Asia, the direct/indirect evidences of ocean acidification due to CO₂ and other anthropogenic gases are gaining attention of the scientific community. A systematic study comprising modelling combined with regional air-to-sea fluxes of the relevant species is essential to assess relative impacts of CO₂ versus the other anthropogenic gases to coastal waters.

- Similar workshops should be organized routinely for free interaction between various disciplines of earth system science. In future, such workshops may also be thematically oriented to include scientists from at least one different discipline other than earth sciences, to foster interdisciplinary work. For example, a workshop on ‘Societal Contributions of Earth Science: Past, Present and Future’ can also include some social scientists and economists, who will help move forward the discussion on policy implications of earth science research.

- The way human beings are altering natural hydrologic cycles through various interventions should be looked into. We need to understand how these alterations can be managed to sustain the coupled humans–natural systems. This effort requires a combination of data collection as well as modelling exercises.

- In view of the likely known impacts of climate change, understanding hydrology of the river basins of North India is crucial. Impacts on agriculture, and availability of drinking water for the large masses are socially relevant. Previous studies are either confined to smaller regions, or look at a specific science issue. What is required is to consider at the problem holistically and on

the basin scale. This requires a networked, coordinated large project with expertise of many individuals and organizations. It also requires strong scientific leadership.

- India has had mission launched to the Moon and Mars in the past, and looking forward to future missions like to the Moon (Chandrayaan-2), Mars (Mangalayaan 2) and Venus. The earth system science group should proactively participate in generating ideas, formulating science objectives of the missions and also in designing instruments.

- There is a need to establish a theoretical physical mineralogy branch in India, which requires strong integration of thermodynamics and computational chemistry.

- More interactive ocean–atmosphere studies are needed to unravel how oceanic and atmospheric processes influence biogeochemistry. Understanding the role of intensified oxygen minimum zone in influencing the pelagic and benthic organism community. Development of coupled biogeochemical–physical model for the Indian Ocean is call of the hour.

- Integration of geology and geophysics departments in the country under one umbrella ‘Department of Geosciences’ or ‘Department of Earth Sciences’.

- Inclusion of programmes like hydrology in geosciences; although many civil and agriculture departments have already included them in their courses and research.

- Some introductory courses on fluid dynamics as related to mantle convection should be included. Emphasis should be more on quantitative research rather than subjective, like palaeo research.

The main takeaway from the workshop is the need for integration of various disciplines of earth system science to address scientific problems of contemporary importance. The role of modelling and addressing the global scientific problems by pan-Indian large working groups was also highlighted. The sessions were well attended by about 300 students, research scholars and faculty of BHU.

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