

## Executive Summary

Main results of the Camp Zero-2 Workshop

The Hague, April 28, 2017

### I. Introduction

A three-day Workshop, organized and sponsored by the Zero Project, was held in New Delhi from April 4 – 6, 2017, with the aim of filling in the details of the proposed Zero Project's academic research program. The current document provides a brief summary of the main results of the Workshop.

### II. Results of the Workshop

Originally, the aim of the Workshop was to formulate a small number (four or five) of Ph.D.-track research projects on various subjects pertaining to the origin of the zero in India and its philosophical context. Deviating slightly from this plan, the Workshop concentrated not only on said Ph.D.-track research projects but also on formulating the contents of a monograph that would be written by the participants of the Workshop, supplemented by a number of (still to be appointed) additional experts. This monograph is not intended as final deliverable of the Zero Project's research program, but an initial phase and a useful stepping stone towards the eventual comprehensive research program.

The monograph will clearly present what is already known and what is not regarding zero's origin in India. It will pinpoint critical knowledge gaps that badly need patching up. In a next phase, follow-up work will be done in the form of Ph.D.-track projects under Zero Project sponsorship preferably as regular Ph.D. projects funded by collaborating universities in India or abroad. The monograph will serve as invaluable reference source for the researchers in the Ph.D. programs, and at a later stage qualify for publication.

Appendix A below contains the synopsis of the proposed monograph as drafted at the Workshop. Thanks are due to Prof. Mayank Vahia of TIFR for drafting this text and former Ambassador Mrs Neelam D. Sabharwal for valuable inputs in its overall format, based on substantive contributions by all participants to the workshop.

There were a number of specific discussion points during the Workshop that we wish to mention here:

1. What are the chances of finding hitherto unknown antique documents that date from earlier times than the 5th century CE, that would shed light on the origin of the zero in India? (The end of 5th century is taken as a reference point, because that's roughly when the oldest well-known author mentioning the decimal positional system, the famous mathematician and astronomer Aryabhata flourished). Suffice it to say that all avenues of inquiry shall be vigorously pursued, as detailed below in Appendix A.

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2. If relevant paper documents (or other perishable information carriers) are not available anymore, which alternative potential sources of information are there on "zero"? A number of sources were discussed in the workshop: inscriptions on stone (possibly found at archaeological sites), coins, copies of architectural temple drawings, etc. All of these sources of information merit study, but all of them suffer from specific drawbacks and difficulties: lack of precise dating methods, lack of a well-defined context, etc.
3. An additional potential source of collaborators was also suggested: early-retired Indian IT-specialists, some of whom might be sufficiently interested and resourceful to participate in the Zero Project through 2020.

## APPENDIX A: The focus areas in the study of zero

Proposed chapters of a monograph on the origin of zero in India:

### 1) Early Indic thought

- a. Zero and the concept of shunya and Shunyata in early Indic thought/philosophy (*students of Early Vedic literature, by Annette van der Hoek*).
- b. Evolution of zero in literature and monuments – in art, numismatics, architecture, iconography along with literature [shunya, shunyata, purna, lopa, a variety of ideas like moksha, nirvana and related ideas in Hindu, Buddhist and Jain literature on non-existence, disappearance and context, Paninian grammar] (*numismatist – Mr Jyoti Nambiar -, archaeologists - Prof.Dutta - , musicologists and students of fine art, - Prof. Ramasubramanian, Dr Narinder Mohkamsing -, philologist, a disciple of Prof. Staal on Paninian grammar?*).
- c. Vaishesika, anu (infinitesimal) and physical zero (*A student of Vaisheshika*).

### 2) Utilitarian zero

- a. Mercantile zero (*Merchant – researcher, someone proposed by Dr. Shailendra Raj Mehta*).
- b. Physical manifestation of zero in numerals, words, Katapayadi (and other similar) systems, Standardized use of '0' to represent zero across writing systems (*Prof. Ramasubramanian and Student of Sanskrit or later period*).
- c. Formal mathematical zero of Aryabhata, Brahmagupta and its impact – algebra, geometry etc. (*Student of history of mathematics in India - Prof. Ramasubramanian,*)
- d. Crucial distinction between zero as number and zero as placeholder (*to be determined*)

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### 3) Zero and other Cultures

- a. Visualization and comprehension of zero – early, learning, tribal learning and understanding of non-existence. (*Archaeologist, cognitive scientist, Dr. Anita Sharma on tribal learning*)
- b. Zero and numbers for counting and measuring in different cultures (*Student of history of mathematics and science (to be determined)*).
- c. Spread of zero across disciplines, connected-histories, circulation of knowledge (*Dr Bhaswati Bhattacharya, and a PhD student?*)
- d. Transmission of zero as a number (not placeholder) from India to China, India to the Islamic world, Islamic world to Europe – the transmission of numeric zero to Europe 12<sup>th</sup> century and philosophical zero 20<sup>th</sup> century (*Historian – Dr Bhaswati Bhattacharya, Prof. Mayank, Nilfur, Mr Jyoti Nambiar; student of Prof Lam Lay Yong from NUSingapore?*).
- e. Fear of zero (*horror vacui*) in Greek / European and other cultures (to be determined)

### 4) Zero in the Sciences and Computers / Quantum computing (Natural Sciences - *Prof. Mayank Vahia*, Computer Science - *someone suggested by Dr. Shailendra Raj Mehta or by Prof. Vahia*).

## APPENDIX B: Participants in the Workshop

The following is a list of participants in the Workshop:

Prof. Dr. H.N. Dutta - former Head of the Directorate of Archaeology Assam under Cultural Affairs Department and presently Vice-chancellor of Nagaland Open University - archaeologist, involved in extensive excavation activities in Assam

Dr. Annette van der Hoek - graduate in Indology of J. Nehru University, research coordinator of the Zero Project and main organizer of the Workshop

Prof. Dr. Shailendra Raj Mehta - Professor of Economics and Business Strategy, Dean of Auro University, (Gujarat, India)

Ms Upasana Neogi - student of Indian archaeo-astronomy (student of Prof. Vahia)

Mr Jyoti Nambiar - numismatist, owner of large collection of antique Indian coins

Prof. Dr. K. Ramasubramanian - expert on Ancient Indian Mathematics and Astronomy - IIT Mumbai

Mrs Neelam D. Sabharwal – former Ambassador of India in the Netherlands, staunch long-time well-wisher of the Zero Project

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Mr Robinder Sachdev - member of the Board of Trustees of the Zero Project, President of the Imagindia Institute, New Delhi co-organizer of the Workshop

Dr. René Samson - Chairperson of the Zero Project, The Hague

Dr. Anita Sharma - graduate in sociology of J. Nehru University, expert on the culture of nomadic tribes in India

Dheerendra K. Singh - colleague of Robinder Sachdev, co-organizer of the Workshop

Prof. Dr. Mayank Vahia – Astrophysicist, expert on Early Indian Astronomy - Tata Institute for Fundamental Research (TIFR), Mumbai

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The Zero Project would like to express its appreciation to all concerned who attended the Workshop and otherwise contributed to its success.

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