ANNUAL REPORT
2019-2020

Indian Academy of Sciences
Bengaluru

About this report

This report provides information on the vision, mission and objectives of the Indian Academy of Sciences, Bengaluru and details the activities implemented during the financial year 2019-20.

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M/s. AA ADVERTISING & COMMUNICATIONS PVT. LTD

Published by:

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Current Science Association

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(विज्ञान एंव प्रौद्योगिकी विभाग, भारत सरकार के तत्वावधान में एक वृत्तिक निकाय)
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INDIAN ACADEMY OF SCIENCES
(A Professional body under the aegis of Dept. of Science & Technology, Govt. of India)
P. B. No. 8005, C V Raman Avenue, Bengaluru – 560 080, INDIA

Professor PARTHA P. MAJUMDER
President

Foreword

The year 2020 began with a bang. We introduced a new lecture series titled Frontiers of Science, which was flagged off on 6th January 2020 by Dr Eric D. Green, Director, National Human Genome Research Institute, US National Institutes of Health. The year 2019 had also ended with a bang. We woke up to the news of a novel coronavirus having been discovered in China. The virus has subsequently changed the course of our lives; we are unsure when we may be able to regain our normal lives.

During the year under reporting (April 2019 through March 2020), we have been able to continue our regular activities. We have recognized the best of Indian scientists and have elected them to our Fellowship. A total of 32 Fellows were elected. We have also recognized scientists who early on in their careers have placed heavy stamps on various domains of science and who have the potential of growing to scientists of international renown. We selected these young scientists as Associates; this year we selected 25 Associates.

The eminent mathematician Ken Ono visited the Academy as the Jubilee Chair and delivered lectures in many national institutions. Many Fellows and Associates were able to hold detailed discussions with him.

We have done our best to promote science at various levels, notably among citizens and among school and college students. We organized a large number of Public Lectures on a diversity of scientific topics. Some of these Lectures were organized in local languages. We organized lectures for improvement of scientific knowledge and inculcation of scientific temper among school and college children.

As you will see in this Annual Report, we have organized technical workshops, seminars and discussion meetings throughout the year in different places and a variety of institutions---research institutes, universities and colleges. In celebration of the birth centenary of the eminent statistician, C. Radhakrishna Rao,

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President

a Fellow of our Academy, we organized a two-day conference in December 2019 in which students and colleagues of Professor Rao delivered lectures on various themes that were mostly pioneered by Professor Rao. The conference was attended by a large number of students of statistics from various colleges in and around Bangalore.

We continued to seriously undertake one of our lead activities on promotion of science through providing summer research fellowships to students, on behalf of all the three national science academies. The programme has become highly competitive; we were able to offer 2243 fellowships from among 22653 applications that we received. Our summer fellows were placed in highly reputed institutions and carried our summer projects mostly under the guidance of a Fellow of one or more of our science academies. We also supported fifteen lecture workshops and refresher courses this year.

Our journals continued to attract the submission of high-quality papers and gain greater international attention. All papers published in the Academy's journals continue to be downloadable without any charge through the Academy's website.

Sadly, we have lost 16 of our Fellows and 2 Honorary Fellows who had provided guidance to our Academy and brought us laurels over many years. We will miss them.

As you will realize, it is impossible for me to function effectively without the help of the Secretariat, the Council, the members of various Committees including the Editorial Boards of the journals, and the staff of the Academy. I am immensely grateful to them. I am also grateful to many of our past Presidents and senior Fellows who have enthusiastically provided guidance to me.

Partha P. Majumder
3 November 2020

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01. Introduction

> The Academy commenced functioning with 65 Fellows and the formal inauguration took place on 31 July 1934 at the Indian Institute of Science, Bangalore.

The Indian Academy of Sciences was founded in 1934 by Sir C V Raman with the main objective of promoting the progress and upholding the cause of science (both pure and applied). It was registered as a Society under the Societies Registration Act on 27 April 1934. The Academy commenced functioning with 65 Fellows and the formal inauguration took place on 31 July 1934 at the Indian Institute of Science, Bangalore. On the afternoon of that day, the first general meeting of Fellows was held during which Sir C V Raman was elected its President and the draft constitution of the Academy was approved and adopted. The first issue of the Academy Proceedings was published in July 1934. The present report covering the period April 2019 to March 2020 represents the eighty-fifth year of the Academy.

Vision

To play a crucial role in national regeneration by all means at its disposal in order to promote the progress and uphold the cause of science, and contribute not only to the flowering of science in India but also to national character.

Mission

Promoting original research and disseminating scientific knowledge to the community, through its activities of publication of scholarly journals, organizing scientific meetings, discussions, seminars, symposia, and lectures. Recognizing the special relationship of scientific creative activity with the process of education and course of discovery. Identifying and nurturing of scientific talent amongst the young. Upholding the principle of social responsibility for all effort, individual or corporate, facilitated by the Fellowship of the Academy.

Objectives

To promote the progress and uphold the cause of science, both in pure and applied branches.

To encourage and publish important research in various branches of science comprehended by the Academy and to represent internationally the scientific work of India.

To publish books, memoirs, journals, proceedings and transactions relating to scientific researches in pure and applied branches initiated by the Academy and those conducted under the direction of Provincial Academies, the Universities and Government Scientific Institutions.

To organize and arrange meetings of the Congresses, Committees and Conferences for reading and discussing papers submitted to the Academy, advising Government and other bodies on scientific and other matters referred to the Academy and to co-operate with the National Research Council when instituted.

To co-operate with the existing Provincial Academies having similar objectives, and with others when founded.

To undertake, control and direct scientific enterprises of all-India significance and to participate in similar international activities.

To secure and administer funds, grants and endowments for the furtherance of scientific research.

To collect, sort and disseminate information concerning industrial, economic and labour problems relating to India and other progressive countries.

To undertake and execute all other acts which shall assist and promote the usefulness, aims and purposes of the Academy.

02.
Role of the Academy

The Indian Academy of Sciences endeavours by all means at its disposal to promote the progress and uphold the cause of science, both in pure and applied branches. The Academy has laid the responsibility on all its Fellows, individually and collectively, of promoting original research and of disseminating scientific knowledge to the community, through its activities of organizing meetings, discussions, seminars, symposia and publications. The Academy recognizes the special relationship of scientific creative activity with the process of education and holds that the course of discovery includes the identification and nurturing of scientific talent amongst the young. Aware of the fundamental contributions science and technology can and must make to national regeneration, the Academy upholds that the principle of social responsibility for all scientific effort, individual or corporate, is entirely consistent with individual freedom and that the quest for knowledge and truth cannot be reconciled with any dogma.

In order to meet the needs of the times, the Council of the Academy has carefully considered the steps to be taken to further the objects of the Academy. Taking cognizance of the enormous and continuing increase in scientific knowledge and the application of this knowledge virtually to every sphere of human activity, and

considering the growth of scientific activity within India and the numbers of scientific institutions and scientists working in various fields, the Council has, as a first step, expanded the Fellowship, in order to have within the Academy a fuller representation of the Indian scientific community in its corporate body so that the objectives and obligations of the Academy could be more effectively fulfilled. The other steps proposed are aimed at: (a) ensuring that there is full representation in the Academy of all branches of science, fundamental and applied; (b) placing special emphasis on bringing into the fold of the Academy, through election to the Fellowship, outstanding young scientists; (c) promoting high quality journals in order to provide publication opportunities to Indian scientists at the international level; (d) conducting symposia and seminars and encouraging other similar activities in order to provide means of exchange of scientific knowledge among scientists and to bring new knowledge to the attention of the whole scientific community; (e) recognizing further, and honouring excellence in various areas of science by the institution of special awards (in the form of medals, lectureships, etc.); (f) giving special encouragement to young scientists by the award of scholarships and fellowships to enable them to pursue their particular interests; (g) promoting international understanding in science through the institution of special chairs and professorships, which will allow scientists from abroad to visit India for specific periods and provide means for travel for Indian scientists to visit other countries; (h) taking up integrated studies in specific fields where co-ordinated scientific activities tend to be neglected.

The Academy affirms that the rightful place for science and the men who rigorously cultivate it can be assured in society primarily through their devotion to the principles of objectivity, integrity and freedom from dogmas rather than through any formal processes of recognition. Not unmindful of the crucial role the Academy can play in national regeneration, the Academy adheres to the belief that this ideal would be best served by preserving the independence of the Academy from all official, State or Organization-related channels.

In a situation where almost every facet of life needs to be revitalized retaining a clear perspective for the nurturing of the scientific temper is of the utmost importance. In a country beset with prejudices, rules and bureaucratic formalisms, it is of the greatest value that working scientists, specially Fellows of the Academy, promote by personal as well as collective example, the principle of rational thought of function and relevance, rather than precedents. By applying rigorous standards of scientific criticism at all levels in a constructive sense, the Academy considers that the scientific community has a unique contribution to make not only to the flowering of science in India but also to national character.

COUNCIL 2019-2021

Prof. Partha P Majumder
President

Prof. R Ramaswamy
Previous President

Prof. Manindra Agarwal
Vice-President

Prof. M.K. Chaudhuri
Vice-President

Prof. S K Tandon
Vice-President

Prof. R Varadarajan
Vice-President

Prof. V A Raghunathan
Treasurer

Prof. Renee M Borges
Secretary

Prof. Umesh V Waghmare
Secretary

Dr Sharmila Bapat
Member

COUNCIL 2019-2021

Prof. Gautam Biswas
Member

Prof. Rohini M Godbole
Member

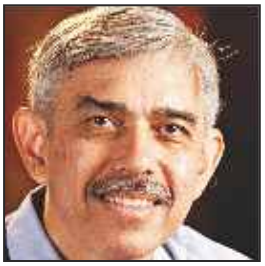
Prof. Vikram Jayaram
Member

Prof. V Nagaraja
Member

Prof. K.H. Paranjape
Member

Prof. T.P. Radhakrishnan
Member

Prof. Mythily Ramaswamy
Member



Dr. Imran Siddiqi
Member

Prof. D C Srivastava
Member

Prof. Nikhil Tandon
Member

Fellowship

The Indian Academy of Sciences endeavours by all means at its disposal to promote the progress and uphold the cause of science, both in pure and applied branches. The scientific strength of the Academy is its elected Fellows. The Academy has laid the responsibility on all its Fellows, individually and collectively, of promoting original research and of disseminating scientific knowledge to the community, through its activities of organizing meetings, discussions, seminars, symposia and publications. The Fellows of the Academy are elected annually from a pool of distinguished scientists nominated by Fellows of the Academy.

TABLE 1: Subjectwise Gender Distribution of the Fellowship

SUBJECT	MEN	WOMEN	TOTAL
Mathematical Sciences	93	7	100
Physics	199	12	211
Chemistry	193	2	195
Engineering and Technology	146	1	147
Medicine	68	26	94
Earth and Planetary Sciences	85	3	88
Animal Sciences	40	15	55
Plant Sciences	54	4	58
General Biology	125	22	147
TOTAL	1003	92	1095

Fellowship

TABLE 2: Details of nominations received/elected for Fellowship during 2016-2020

SUBJECT	2016 (N/E)	2017 (N/E)	2018 (N/E)	2019 (N/E)	2020 (N/E)	TOTAL
Mathematical Sciences	21/3	21/2	20/3	18/3	21/3	101/14
Physics	60/5	62/5	58/4	59/4	86/4	325/22
Chemistry	106/6	98/6	111/6	119/4	114/7	548/29
Engineering & Technology	47/3	53/4	55/1	53/1	52/4	260/13
Medicine	51/3	52/2	46/3	42/3	53/3	244/14
Earth and Planetary Sciences	46/1	47/1	42/3	38/2	40/3	213/10
Animal Sciences	32/0	37/2	27/2	26/1	25/1	147/6
Plant Sciences	46/1	46/1	40/1	38/2	33/4	203/9
General Biology	49/4	54/4	58/5	63/3	62/3	286/19
TOTAL	458/26	470/27	457/28	456/23	486/32	2327/136

N/E: Nominations Received/Elected

2020 Newly Elected Fellows

Vivek Agarwal
Indian Institute of Technology, Mumbai

Sp.: Power Electronics, Renewable Energy, Power Quality

Chandrasekhar Bal
All India Institute of Medical Sciences, New Delhi

Sp.: Therapeutic Nuclear Medicine, Nuclear Neuropathy, Positron Emission, Tomography on Oncology

Bijnan Bandyopadhyay
Indian Institute of Technology, Mumbai

Sp.: Control Systems, Variable Structure & Sliding, Mode Control

Dipankar Banerjee
ARIES, Nainital

Sp.: Astrophysics, Solar Physics, Plasma Physics

2020 Newly Elected Fellows

Rinti Banerjee
Indian Institute of Technology, Mumbai

Sp.: Drug Delivery, Nanomedicine, Biomaterials

Anjan Barman
S.N. Bose National Centre for Basic Sciences, Kolkata

Sp.: Experimental Condensed Matter Physics, Magnetism & Spintronics, Ultrafast & High Frequency Spectroscopy & Dynamics

Bikramjit Basu
Indian Institute of Science, Bengaluru

Sp.: Biomedical Engineering, Engineering Ceramics & Coatings, Solar Reflector / Absorber Materials

P.V. Bharatam
National Institute of Pharmaceutical Education and Research, SAS Nagar

Sp.: Organic Synthesis of Computationally Designed Compounds, Theoretical Organic Chemistry, Pharmacoinformatics

2020 Newly Elected Fellows

G.R. Chandak
CSIR-Centre for Cellular and Molecular Biology, Hyderabad

Sp.: Genomics & Epigenomics of Complex Diseases, Development Programming of Metabolic Syndrome

Rajat S. Hazra
Indian Statistical Institute, Kolkata

Sp.: Probability, Operator Algebra, Statistical Physics

Sanjeev Khosla
Centre for DNA Fingerprinting and Diagnostics, Hyderabad

Sp.: Epigenetics, Developmental Biology

Partha S. Mukherjee
Indian Institute of Science, Bengaluru

Sp.: Supramolecular Chemistry

2020 Newly Elected Fellows

I.N.N. Namboothiri
Indian Institute of Technology, Mumbai

Sp.: Synthetic & Physical Organic Chemistry

Rishikesh Narayanan
Indian Institute of Science, Bengaluru

Sp.: Cellular Neurophysiology, Computational Neuroscience, Neural Coding & Plasticity

Aloke Paul
Indian Institute of Science, Bengaluru

Sp.: Diffusion in Solids, Phase Trasnformation, Microstructure

Amritanshu Prasad
Institute of Mathematical Sciences, Chennai

Sp.: Representation Theory, Combinatorics, Group Theory

2020 Newly Elected Fellows

Rajeev Ranjan
Indian Institute of Science, Bengaluru

Sp.: Materials Science, Ferroelectrics, Piezoelectrics

T. Narayana Rao
National Atmospheric Research Laboratory, Tirupati

Sp.: Radar Meterology, Microphysics & Dynamics of Clouds Precipitation, Monsoon Meteorology

S.P. Rath
Indian Institute of Technology, Kanpur

Sp.: Bioinorganic Chemistry, Physical Inorganic Chemistry, Supramolecular Chirogenesis

Manjula Reddy
CSIR-Centre for Cellular & Molecular Biology, Hyderabad

Sp.: Bacterial Physiology, Genetics

2020 Newly Elected Fellows

Mamiyil Sabu
Malabar Biotechnical Garden and Institute of Plant Sciences, Kozhikode

Sp.: Taxonomy of Angiosperms, Reproductive Biology, Anatomy Palynology

Mahesh Sankaran
National Centre for Biological Sciences, Bengaluru

Sp.: Climate Change, Ecosystem Ecology, Savanna Ecology

Saket Saurabh
The Institute of Mathematical Sciences, Chennai

Sp.: Theoretical Computer Science, Graph Algorithms & Graph Theory, Parametrised Complexity

B. Senthilkumaran
University of Hyderabad, Hyderabad

Sp.: Reproductive Biology, Molecular Endocrinology, Endocrime Toxicology

2020 Newly Elected Fellows

Maya Shankar Singh
Banaras Hindu University, Varanasi

Sp.: Organic Synthesis Methodology, Chemistry of ..-Ketodithioesters & Related Systems, Visible-light Mediated Photocatalytic reactions

Alok K. Sinha
National Institute of Plant Genome Research, New Delhi

Sp.: Plant Molecular Biology, Plant Biochemistry, Plant Physiology

Binod Sreenivasan
Indian Institute of Science, Bengaluru

Sp.: Earth & Planetary Magnetism, Dynamo Theory, Magnetohydrodynamics

A. Sundaresan
Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru

Sp.: Superconductivity, Magnetism, Multiferrorics

2020 Newly Elected Fellows

K.M. Sureshan
Indian Institute of Science Education and Research, Thiruvananthapuram

Sp.: Supramolecular Chemistry, Crystal Engineering

V.M. Tiwari
CSIR-National Geophysical Research Institute, Hyderabad

Sp.: Exploration Geophysics, Gravimetry, Geodynamics

Anil K Tripathi
BHU, Varanasi

Sp.: Bacterial Genetics & Genomics, Plant Microbe Interaction, Bacterial Diversity

M.K. Verma
Indian Institute of Technology, Kanpur

Sp.: Turbulence, Nonlinear Dynamics, Nonequilibrium Statistical Physics

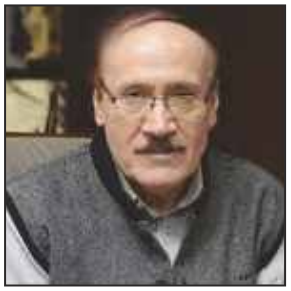
Honorary Fellow

Bishnu S. Atal
University of Washington, Seattle, USA

The best scientists from all over India and particularly the young ones were elected into this Academy. Raman used his personal prestige and that of the Academy to encourage scientific talent wherever it was found and in whatever field it showed itself.

-- C V Raman: A Pictorial Biography

Deceased Fellows (April 2019 to March 2020)



Bhan Maharaj Kishan
Date of Birth: 09-11-1947
Sp.: Paediatrics, Gastroenterology, Infectious Diseases and Nutrition
Year Elected: 1991
Date of Death: 26-01-2020

George Manapurathu Verghese
Date of Birth: 03-10-1928
Sp.: Organic Photochemistry and Laser Chemistry
Year Elected: 1973
Date of Death: 09-12-2019

Gopalan Coluthur
Date of Birth: 29-11-1918
Sp.: Nutrition and Medical Research
Year Elected: 1964
Date of Death: 03-10-2019

Jain Dharam Vir Singh
Date of Birth: 16-06-1933
Sp.: Theoretical Chemistry
Year Elected: 1979
Date of Death: 06-10-2019

Deceased Fellows (April 2019 to March 2020)

Jayaraman Ramamirtha
Date of Birth: 10-10-1937
Sp.: Molecular Biology and Molecular Genetics
Year Elected: 1989
Date of Death: 14-04-2019

Maheshwari Satish Chandra
Date of Birth: 04-10-1933
Sp.: Physiology & Biochemistry of Plant Growth & Development and Plant Molecular Biology
Year Elected: 1975
Date of Death: 12-06-2019

Pandita Pran Nath
Date of Birth: 01-01-1949
Sp.: Theoretical High Energy Physics and Astroparticle Physics
Year Elected: 2005
Date of Death: 12-06-2019

Pandya Sudhir Pradyumna
Date of Birth: 11-09-1928
Sp.: Nuclear Physics
Year Elected: 1974
Date of Death: 30-06-2019

Deceased Fellows (April 2019 to March 2020)

Ramaswamy Melkote Krishnarao
Date of Birth: 04-01-1931
Sp.: Nuclear Physics, Positron Annihilation, Logistics and Computer Systems Quality & Security
Year Elected: 1963
Date of Death: 01-01-2020

Roy Tuhin Kumar
Date of Birth: 01-08-1923
Sp.: Hydrometallurgy, Fluidization and Mixing
Year Elected: 1974
Date of Death: 04-08-2019

Rudraiah Nanjundappa
Date of Birth: 10-08-1932
Sp.: Fluid Mechanics, Magnetohydrodynamics, Electrodynamics, Stability of Flows, Heat & Mass Transfer, Biomechanics, Dispersion Phenomena
Year Elected: 1976
Date of Death: 19-09-2019

Santhanam Vaidyanathaswamy
Date of Birth: 31-07-1925
Sp.: Plant Breeding & Genetics, Research Management and Cotton Development
Year Elected: 1974
Date of Death: 05-06-2019

Deceased Fellows (April 2019 to March 2020)

Shankar Pattamadai Narasimhan
Date of Birth: 13-08-1944
Sp.: Engineering Science and Fluid Dynamics
Year Elected: 1992
Date of Death: 15-04-2019

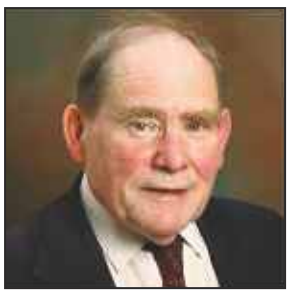
Sreekantan Badanaval Venkata
Date of Birth: 30-06-1925
Sp.: Cosmic Rays and High Energy Physics
Year Elected: 1965
Date of Death: 27-10-2019

Swaminathan Sambasiva
Date of Birth: 20-04-1923
Sp.: Organic Chemistry
Year Elected: 1969
Date of Death: 24-02-2020

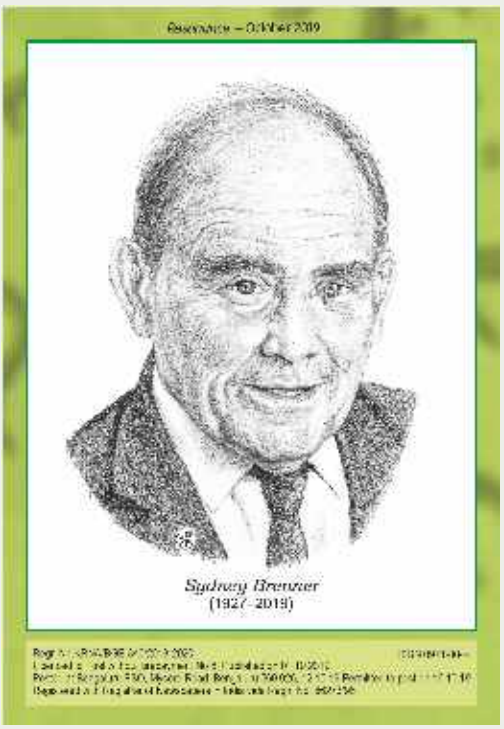
Venkatesan Kailasam
Date of Birth: 29-04-1932
Sp.: Chemical Crystallography
Year Elected: 1981
Date of Death: 31-12-2019

Honorary Fellows deceased during April 2019--March 2020

Anderson Philip Warren
Date of Birth: 13-12-1923
Year Elected: 1997
Date of Death: 30-03-2020



Brenner Sydney
Date of Birth: 13-01-1927
Year Elected: 1989
Date of Death: 05-04-2019



Associateship

Associateship

The Associateship programme of the Academy aimed at encouraging young scientific talents, was initiated in 1983. The Associateship, which follows a online nomination by Fellows of the Academy and other heads of institutions of national importance such as IITs, NITs, IISERs, CSIR laboratories, Central University departments (limited to pure and applied sciences including engineering), is tenable for a minimum period of 3 years or a maximum period of 6 years.

TABLE 3:Details of nominations received / selected for Associateship during the past 5 years (2015-19)

SUBJECT	2016 (N/E)	2017 (N/E)	2018 (N/E)	2019 (N/E)	2020 (N/E)	TOTAL
Mathematical Sciences	6/1	9/2	8/4	9/5	13/3	45/15
Physics	14/4	14/3	12/3	20/5	28/5	88/20
Chemistry	12/3	15/3	9/3	10/2	18/5	64/16
Engineering & Technology	12/2	16/3	18/6	25/6	22/5	93/22
Earth and Planetary Sciences	4/2	4/1	13/6	10/3	9/2	40/14
Life Sciences	9/2	21/5	14/4	20/2	25/5	89/18
TOTAL	57/14	79/17	74/26	94/23	115/25	419/105

N/E: Nominated/Elected

Associates Selected in 2019

Aloke Kumar
Indian Institute of Science
Bengaluru

Sp.: Complex Fluids, Microfluids, Biophysics

Siddharth Barman
Indian Institute of Science
Bengaluru

Sp.: Theoretical Computer Science, Algorithms, Game Theory, Approximation

Sayantani Bhattacharyya
National Institute of Science Education and Research, Bhubaneswar

Sp.: Theory of Gravity, Fluid Dynamics, Quantum Field Theory

Charu Lata
National Botanical Research Institute
Lucknow

Sp.: Crop Genomics, Stress Biology, Plant Microbe Ineraction

Associates Selected in 2019

Bata Krishna Das
Indian Institute of Technology Mumbai

Sp.: Multivariable Operator Theory, Quantum Stochastic Analysis, OperatorAlgebra

Dibyendu Das
Indian Institute of Science Education and Research, Kolkata

Sp.: Systems Chemistry, Driven Self-Asembly, Peptide Nanotechnology

Kiranmoy Das
Indian Statistical Institute Kolkata

Sp.: Bayhesian Semiparametric Models, Longitudinal Data Analysis

Basudeb Dasgupta
Tata Institute of Fundamental Research Mumbai

Sp.: Astroparticle Physics, Supernova, Neutrinos, Dark Matter

Associates Selected in 2019

Dinesh Kumar
Centre of Bio-Medical Research Lucknow

Sp.: Biomolecular NMR, Structural Biology of Proteins, Metabolomics by NMR

Joyram Guin
Indian Association for the Cultivation of Science, Kolkata

Sp.: Organic Synthesis, Radical Chemistry, Asymmetric Synthesis & Catalysis

Kabeer Jasuja
Indian Institute of Technology Gandhinagar

Sp.: Nanomaterials, Nanohybrid Architetures, Nanosheets

Sanjay K Mishra
Physical Research Laboratory Ahmedabad

Sp.: Plasma Physics, Dusty Complex Plasma, Planetary Exosphere

Associates Selected in 2019

Ajaya K Nayak
National Institute of Science Education and Research, Bhubaneswar

Sp.: Condensed Matter Experiment, Magnetic Materials, Spintronics

Praneeth Netrapalli
Microsoft Research Bengaluru

Sp.: Machine Learning, Optimisation, Signal Processing

Sourav Pal
Indian Institute of Technology Mumbai

Sp.: Functional Analysis, Operator Theory, Several Complex Variables

Pooja Devi
Central Scientific Instruments Organisation, Chandigarh

Sp.: Materials Engineering, Sensors, Solar Energy Harvesting Devices

Associates Selected in 2019

Rajarshi Samanta
Indian Institute of Technology Kharagpur

Sp.: Transition Metal Catalysis, Asymmetric Synthesis, natural Products

B S Sasidhar
National Institute for Interdisciplinary Science and Technology Thiruvananthapuram

Sp.: Organic Synthesis, Medicinal chemistry, Phytochemistry

Arun K Shukla
Indian Institute of Technology Kanpur

Sp.: Cellular Signalling, Structural Biology, Drug Discovery

Vibhor Singh
Indian Institute of Science Bengaluru

Sp.: Superconducting Quantum Devices, Nanoelectromechanical Systems

Associates Selected in 2019

P Sreenivas
Indian Institute of Tropical Meteorology, Pune

Sp.: Data Assimilation, Climate Modelling, Monsoon Prediction

K Subrahmanyam
Vikram Sarabhai Space Centre Thiruvananthapuram

Sp.: Remote Sensing, Radars, Clouds, Climate Change

Umakanta Subudhi
Institute of Minerals and Materials Technology, Bhubaneswar

Sp.: DNA Nanotechnology, Molecular biophysics, Chemical Biology

Vishvanath Tiwari
Centaral Univ. Rajasthan, Ajmer

Sp.: Microbial Drug Resistance, Drug Discovery, Vaccine Design

Associates Selected in 2019

Srinivasarao Yaragorla
University of Hyderabad, Hyderabad

Sp.: Asymmetric Total Synthesis of Natural Products

03.
Scientific Activities' Progress Report

Report on activities during 2019-20:

The Indian Academy of Sciences was founded by Professor C. V. Raman (Nobel Laureate) and was registered as a Society under the Societies Registration Act. The Academy strives to meet its objectives through promotion of original research and dissemination of scientific knowledge to the community via a variety of activities that include scientific meetings, discussions, seminars, symposia and science education courses and workshops. Here is the brief account of progress and achievement of the Academy during the year through the implementation of activities and programmes set in furtherance of its objectives.

1. Areas of focus: Publication of scientific journals, election of Fellows and selection of Associates, organize mid-year and annual scientific meetings, curation of Fellows' repository, Chair Professorships, Science education programmes and other activities in promotion and dissemination of science.

2. Major accomplishments: Over 1831 peer-reviewed articles in 21,729 pages have been published in 12 thematic journals and the entire contents are

available on a free access platform. Individuals/universities/other ministries received print version of these journals. The free access journals during the year had around 35,28,608 downloads of refereed articles. 7 special publications of topical interest and 3 books were published. Under the Summer Research Fellowship programme, 1654 students and teachers underwent 2 months' Fellowship and worked with Fellows and other mentors spread across many research institutions of the country. 5 Lecture Workshops and 3 Refresher Courses were held.

3. Important highlights of major programmes:

a) Publication of scholarly journals: The Academy publishes reputed international scientific journals that contain high quality papers and articles by scientists from India and abroad. The number of journals currently published by the Academy is 12 (including one online only journal), covering all major disciplines in science & engineering. The entire contents are available in a free access platform (http://www.ias.ac.in/journals/overview). Over 30,000 print versions of these journals were circulated to individuals/universities/institutions. Worldwide visibility to Academy journals increased with more submission of articles. 10 journals of the Academy are being co-published with Springer and Springer Nature provides access to the journals' content worldwide on its journal platform SpringerLink. The total number of downloads from the Academy website is 35,28,608.

b) Fellowship of the Academy: The academy annually elects distinguished scientists of the country to its Fellowship. It also elects as Honorary Fellows persons, working in institutions outside of India, who are distinguished for their contributions to science or engineering. 32 outstanding scientists from India and one foreign scientist were inducted into the Academy Fellowship and Honorary Fellowship respectively (with effect from 1 January 2020). As on 31 March 2020, the number of Fellows on roll was 1095, and Honorary Fellows 53.

c) Associateship Programme: The Associateship programme was introduced in 1983 to identify and encourage promising young scientists. The programme was assessed for its impact in 2018 by a committee constituted by the Council. Based on the recommendations of the committee the programme was reformed to provide opportunity to young scientists from diverse institutions and

backgrounds to pursue scientific excellence. As per the revised guidelines, the upper age limit is now 38 years. The Associateship is tenable for a minimum period of 3 years or a maximum period of 6 years. During July 2019, 25 promising young scientists were selected. As on 31 March 2020, the number of Associates on roll was 74.

d) Science Academies' Education Programme: Towards attempts to improve the state of higher education and teaching of science in the country, major activities are implemented under this programme. Under the Summer Research Fellowship and FAST-SF programmes, 1577 students and teachers availed of a 2 months' Fellowship and worked with Fellows and other mentors spread across 234 research institutions in the country. The Academy annually supports educational institutions in the country to hold lecture workshops and refresher courses in all major disciplines of sciences. During the period, 6 lecture workshops and 4 refresher courses were held.

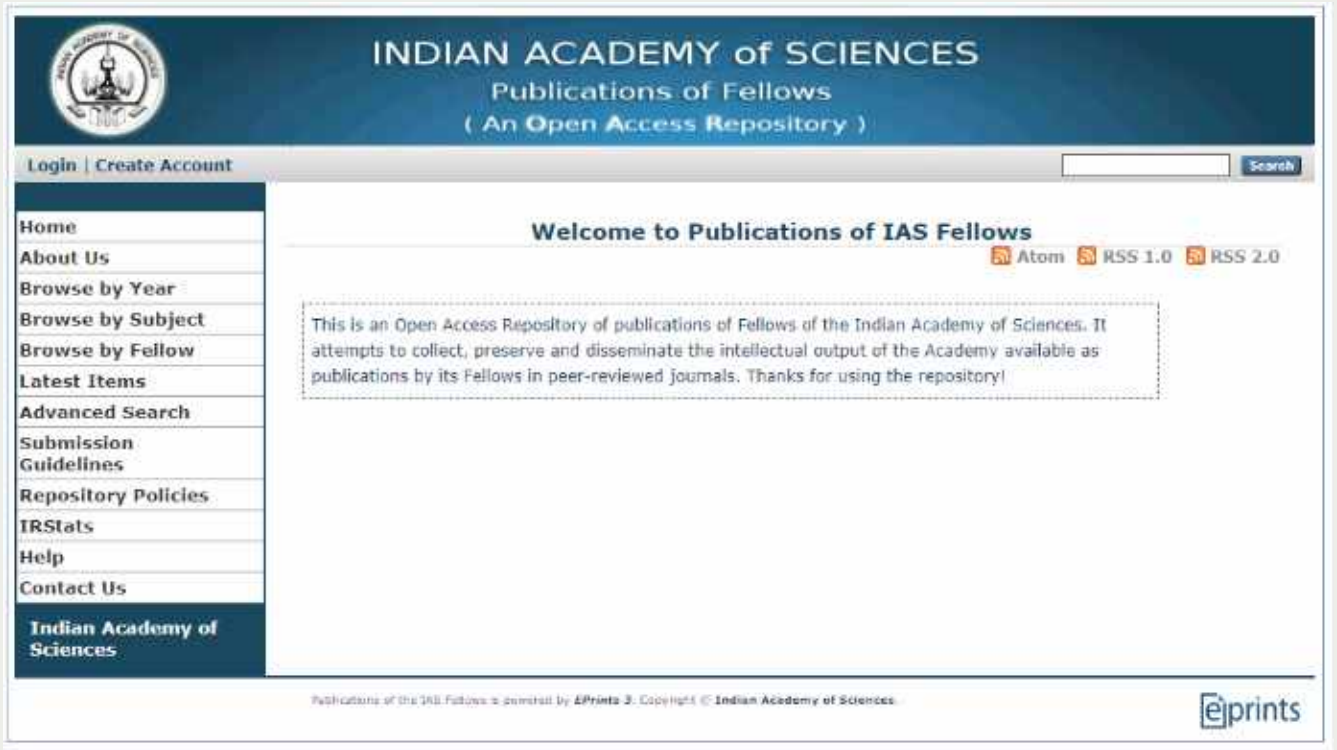
e) Scientific Meetings: The Academy annually holds scientific meetings, symposia and public lectures and encourages other similar activities to provide means of exchange of scientific knowledge among scientists and to bring new knowledge to the attention of the scientific community. During the year, the Academy held two scientific meetings: the 30th Mid-Year Meeting was held on 28-29 June 2019 at the Satish Dhawan Auditorium, IISc, Bengaluru and the 85th Annual Meeting was held during 08-10 November 2019 at University of Hyderabad, Hyderabad. Four discussion meetings on various scientific themes and seven public lectures were organized during the year.

f) Chair Professorships: Under visiting Chair Professorship programme, Jubilee Chair Professor, Prof. Ken Ono, University of Virginia, a Japanese-American mathematician, visited India during December. During his visit, Prof. Ono visited many national science institutions and gave lectures. Prof. Catherine Rosemary Martin, FRS was supposed to occupy the Janaki Ammal Chair. Unfortunately, due to prevalence of COVID-19 she could not travel to India and occupy the chair.

g) Repository of Publications of Fellows: Under an on-going

initiative of the Academy termed the Repository of Publications of Fellows, it is intended to make available research and review papers published by Fellows in peer-reviewed journals. 2220 new records were added to the Repository.

4. Important Collaborations (National and Global) Established: The Academy has collaboration with the other two National Science Academies in the country viz., INSA, New Delhi and NASI, Allahabad for implementing Science Education Programmes. Collaboration with Springer Nature was put in place for marketing online versions of Academy journals overseas.



I. Publications

THE FLAGSHIP PROGRAMME

Among the many activities undertaken by the Academy since 1934, publication of scientific journals and books occupies the place of pride. The Academy is currently the single largest society publisher in the country. The Academy currently publishes twelve journals in all major disciplines in science & technology. The Academy also collaborates with the Current Science Association in bringing out a fortnightly interdisciplinary journal Current Science.

Besides regular journals, special issues of the journals and publications of topical interest are frequently brought out abreast with the current trends in science publishing. In addition, the Masterclass Series of eBooks bring together pedagogical articles on single broad topics taken from *Resonance: Journal of Science Education*.

Primarily directed at students and teachers at the undergraduate level, the journal has brought out a wide spectrum of articles in a range of scientific discipline.

Some salient features of the Academy's publishing programme include

- Twelve Academic Journals in various disciplines of science
- Rigorous peer review system
- Collaboration with the Current Science Association
- Co-publishing with Springer Nature
- Continuous Article Publishing mode
- In-house style-files
- Worldwide full and free access/downloads through the Academy journal portal
- Special issues/publications of topical interest
- Covered by Current Contents/Science Citation Index
- Indexed by major abstracting and indexing services
- No page/author charges

- Online processing of manuscripts using an online submission and review management system Publications on schedule
- Excellent printing and production standards
- Enhanced impact factor of journals

Impact Factor of Journals

Journals	2019
Pramana--Journal of Physics	1.688
Journal of Astrophysics & Astronomy	1.273
Proceedings--Mathematical Sciences	0.272
Journal of Earth System Science	1.423
Bulletin of Material Science	1.392
Journal of Chemical Sciences	1.406
Sadhana	0.849
Journal of Biosciences	1.645
Journal of Genetics	0.993

Resonance – journal of science education

has featured the following scientists (April 2019--March 2020)

Hermann Joseph Muller (1890--1967), Jean Bourgain (1954--2018), Luigi Luca Cavalli-Sforza (1922--2018), Gilbert N Lewis (1875--1946), Murray Gell-Mann (1929--2019), Veeravalli S Varadarajan (1937--2019), Sydney Brenner (1927--2019), M G K Menon (1928--2016), Nikolai Ivanovich Vavilov (1887--1943), Herbert Alexander Simon (1916--2001), John Torrence Tate Jr (1925--2019), Chien-Shiung-Wu (1912--1997)

Book/eBooks Published

1. *From So Simple A Beginning: The Expansion Of Evolutionary Thought* Compiled and Edited by T N C Vidya (2019) [*Resonance* Masterclass].
2. *C V Raman - A Pictorial Biography* (2nd edition 2019)
3. *Journey into Light - by G. Venkataraman -- epub*

Promotional Activity

Workshop/Symposia:

25th CRSI Meeting held at IIT Kanpur during 19-21 July 2019, represented by *Journal of Chemical Sciences*

Mini-Symposium 'Genetics and Evolution: Intertwined Strands' held between 30th September and 1st October 2019 at Ashoka University, Sonipat, India organized by *Journal of Genetics*

Journals from which two best poster prize was sponsored:

Popular lectures held on 26 July 2019, at Maharani Govt. College, Palace Road, Bangalore, represented by *Journal of Biosciences*

Symposium CRSI held on 2 October 2019, at CSIR-CLRI Chennai, represented by *Journal of Chemical Sciences*

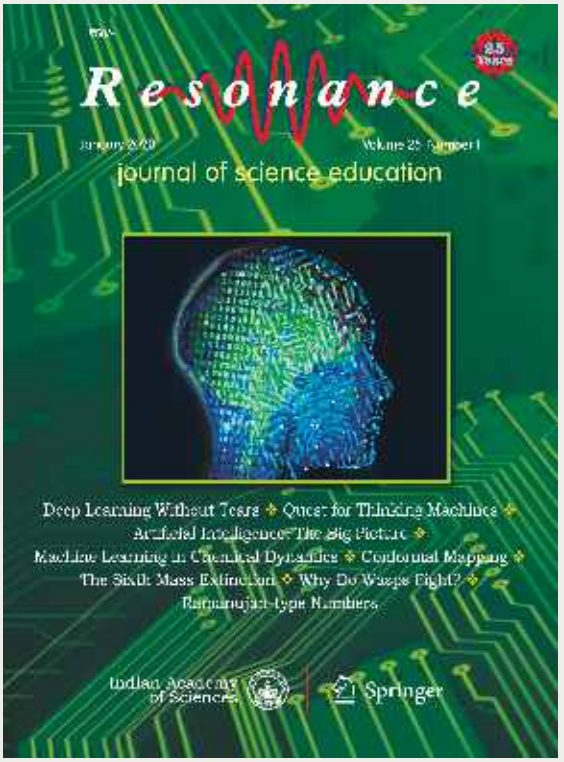
'ISEB 1: celebrating Ecology and Evolution in India'organized by T N C Vidya on behalf of the Indian Society of Evolutionary biologists (ISEB) at JNCASR on October 24-25th represented by *Journal of Genetics* and *Resonance – journal of science education*

Symposium on Atoms, Molecules & Materials held at Academy/MAHE, Manipal, on 22 November 2019 organized by *Bulletin of Materials Science*

ISEB2: Indo-Swiss Meeting on Evolutionary Biology held on 12-14 December, 2019, at Center for Human Genetics, Bengaluru represented by *Journal of Genetics*

16th The Asian Congress of Fluid Mechanics (ACFM), held at JNCASR, Bengaluru during 13-17 December 2019, represented by *Sadhana*.

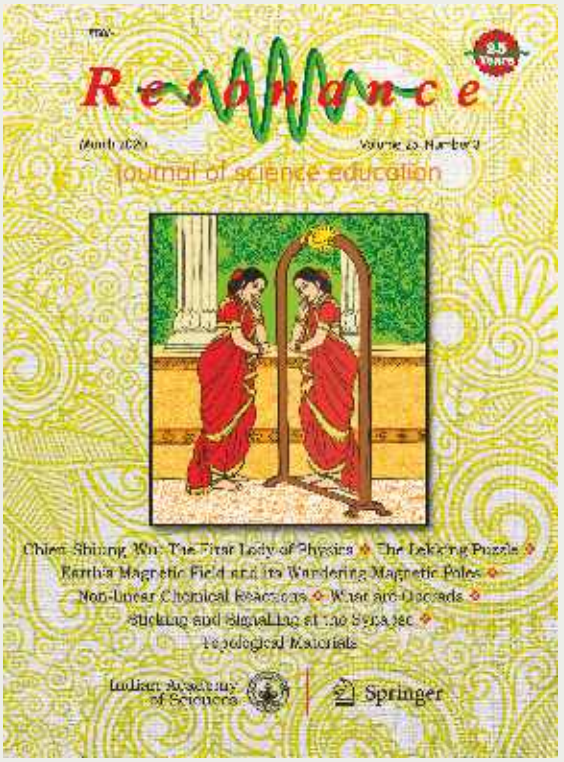
Special issues published in Journals



Resonance, Vol.25, No.1, January 2020:

Issue on Artificial Intelligence and Machine Learning

Artificial intelligence (AI) and machine learning (ML) seem to dominate every aspect of our daily lives now, from the way we shop to the way we elect our leaders, from the way sports teams are trained to the way teaching material is organized. Are AI and ML one and the same, or do they mean different things? What does it mean for a computational system to learn? The special issue of January 2020 was dedicated to addressing these questions. The issue carries four articles that cut through the hype and convey some of the real excitement underlying this hot new area. The scientist featured on the back cover of this issue is Herbert Simon. Simon was considered one of the pioneers of AI research.

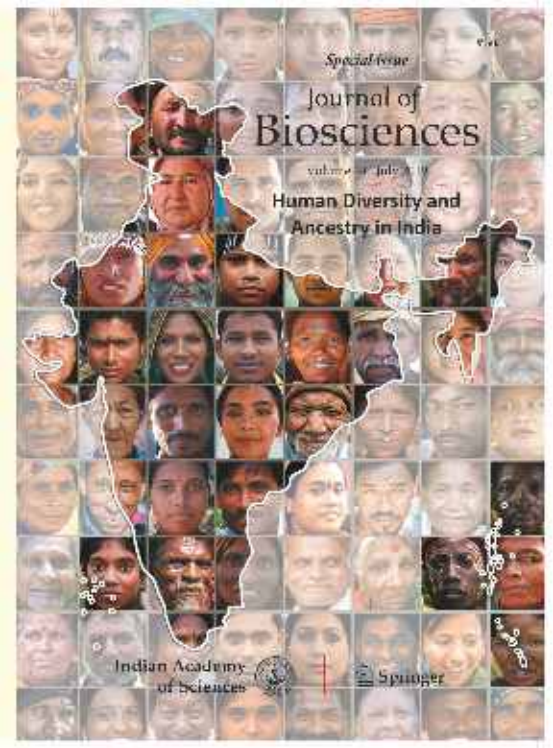


Resonance, Vol.25, No.3, March 2020

Women's Special Issue Featuring Chien Shiung-Wu

Guest Editors: Arti Kashyap and Varsha Singh

Acknowledging the spirit of International Women's Day, the March issue of *Resonance* was a Women's Special Issue, celebrating the contributions of women in science. The issue featured acclaimed physicist Chien Shiung-Wu, popular in the scientific community as the 'First Lady of Physics'. All the articles in the issue has been authored/ coauthored by women researchers. The issue was also guest edited by women researchers. This issue carries articles on the life and work of Dr Wu who made fundamental contributions to our understanding of the nature of weak interactions and enabled the correct theory of such interactions to be written down. Besides this, the issue carries articles spanning various subjects such as mating behaviour, signalling at the neuromuscular junction, new quantum phase of matter, non-linear chemical reactions, operads, wandering magnetic poles, etc. The issue also carries a Face-to-Face with Fabiola Gianotti, Director-General, CERN, at Vigyan Samagam. The special issue, aims to encourage budding scientists to find both representations, as well as information, about the established and emerging women scientists and the research they are engaged in.



Journal of Biosciences, Volume 44 Issue 3, July 2019

Human Diversity and Ancestry in India

Guest Editors: Partha P Majumder and Vidyanand Nanjundiah

Few questions have excited as much interest in recent years as who the ancestors of present-day Indians were, where they came from, and when. Studies that address this theme have been carried out in a range of disciplines including archaeology, climatology, history, linguistics, anthropology and, most recently, molecular biology. However, with regard to the broader conclusions that have been drawn, there are significant differences among scholars who approach the issue from diverse areas of study.

The 'units' and terms of discourse used in archaeology, linguistics, history anthropology and genetics are very unlike, and it is not obvious to what extent they can be reconciled. On top of that, disputes regarding classification, sampling, standards of accuracy and interpretation abound within each area of study. As a step towards addressing the state of affairs, a Discussion Meeting titled "Human Diversity and Ancestry in India" was held in Bengaluru during 19–21 September 2018. An aim of the meeting was to bring together experts from a range of disciplines and get them to engage in critical exchanges on the theme.

The meeting was split into fi ve thematic sessions under the heads Archaeology and Prehistory, History and Language, Anthropology and Sociology, Genetics – Ancient DNA and Genetics – Modern DNA. Each session consisted of formal lectures by 'discussion leaders' followed by comments and critiques by 'lead panellists'. Most discussion leaders agreed to provide textual versions of their talks. The primary papers in this special issue of Journal of Biosciences consist of surveys of various aspects of the theme of the meeting. Accompanying each paper is a Commentary. The task assigned to the commentator (who may or may not have attended the meeting) was to tease apart features of the main paper and draw attention to what remains to be done; and to do so from a specialised but subjective viewpoint – rather like a traditional Bha¯shya, in fact. It is for the reader to judge to what extent these goals have been met.

Journal of Biosciences, Volume 44 Issue 5, October 2019

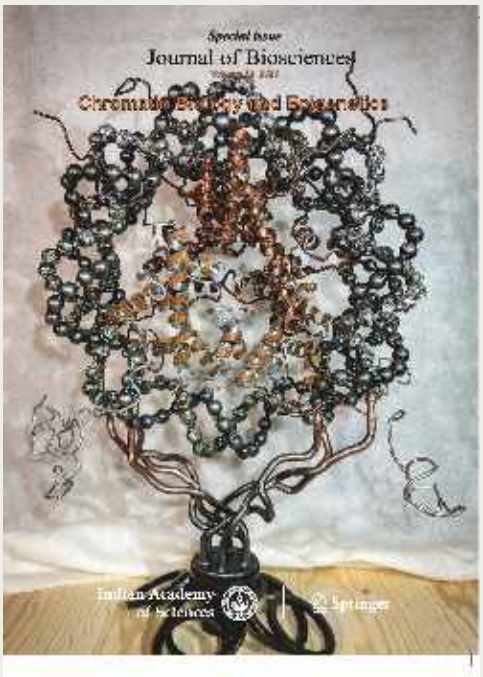
Current Trends in Microbiome Research

Guest Editor: Yogesh Shouche

The rapid advances in the DNA sequencing technology triggered by the quest for human genome sequence has made this technology cheaper and faster. The ability to have a large amount of sequence data generated at a low cost in short time also enabled large-scale sequencing of microbial genomes and metagenomes. The last two decades have seen exponential growth in microbiome research. Worldwide there are several mega projects targeting microbiomes of diverse ecosystems like earth, ocean, plants, ruminants and, of course, the human. The science has rapidly advanced from mere cataloguing of organisms to understanding the specific contribution of individual microbial species and its mechanism at molecular level. Several microbiome-based solutions have come up in recent years especially in the area of human health. The scientific sessions of the International Conference on Microbiome Research 2018 (ICMR 2018) brought together all major areas of microbiome research together and provided a truly international platform for the exchange of ideas. The conference saw sessions on human, environmental and computational microbiome, covering topics ranging from human microbiome in health and disease, plant–microbe interactions, probiotics and functional foods and the latest advances in computational approaches. This conclave saw some of the leading experts from around the world share their ideas and work. The conference was well attended with more than 280 participants from academia and industry. The field of microbiome, which is now picking up fast in India, promises huge potential for betterment of human health and ecosystem service to achieve long-term goals of sustainable development. It was, thus, one of the largest conference on microbiome research in Asia.

This special issue of the Journal of Biosciences brings together the current status of microbiome research in some major areas and also some interesting findings from fast-evolving new branches. The selection of the articles has been carefully curated to project the overall direction in which the field is headed, some of the challenges that the field faces currently and the potential of microbiome science for

translational research. The reviews were invited from the panel of speakers at ICMR 2018 and provide valuable insights for a practicing microbiome researcher. The brief communications and articles have been carefully selected by the reviewers based on the merit of the work. The articles in the review section discuss appropriate methods for reliable data generation, storage, analysis and visualization. These will serve as guidelines for the beginner in the field. The section also contains articles that summarize microbiome research in some important ecosystems like the vagina, International Space Station and gut. The research articles are a diverse assemblage of articles that encompass many ecosystems like the human gut, gut-brain axis, mass bathing event, hydrocarbon-contaminated soils and fuel pool water. These articles give a glimpse of research being done in the microbiome area in India.



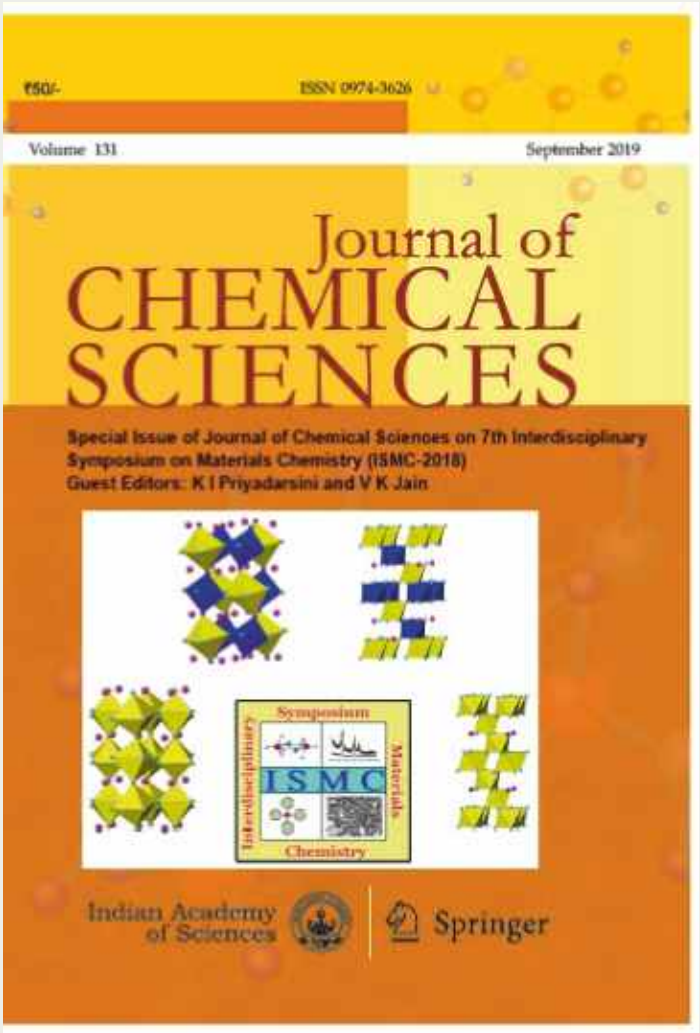
Journal of Biosciences, Volume 45 January 2020

Chromatin Biology and Epigenetics

Guest Editors: Geeta Narlikar and Sanjeev Galande

At an Indo-US conference held in Bangalore in 2018, the many opportunities for collaborations between scientists in the US and India were discussed. Having a regular meeting in India akin to a Gordon conference would provide the continuity to foster such collaborations and also enable experimental workshops and courses analogous to those at Woodshole and CSHL, USA. As a first step, a hands-on laboratory based course on 'Phase Separation in Genome Organization' was conducted by Geeta Narlikar during July-August 2019 at IISER Pune. This course was attended by 15 participants that included Ph.D. students and postdoctoral fellows from various institutions in India.

It would be useful to put together a special issue of the Journal of Biosciences centered around the theme of Chromatin Biology and Epigenetic Regulation. An assemble a collection that consisted of topical reviews by leaders in the field as well as reports of original research or analysis was put together. This issue represents the results of these efforts and includes contributions primarily from scientists in US and India.



Journal of Chemical Sciences, Vol.131, No.9, September 2019

Special Issue on 7th Interdisciplinary Symposium on Materials Chemistry (ISMC-2018)

Guest Editors: K I Priyadarsini and V K Jain

This special issue highlights some of the important deliberations during the 7th Interdisciplinary Symposium on Materials Chemistry (ISMC-2018), organized at the Bhabha Atomic Research Center, Mumbai on 4–8 December 2018. The articles were submitted by the invited speakers of this event, and peer-reviewed by experts in the respective field. Since the inception of the first International Symposium on Materials Chemistry in 2006, this series of biennial symposia are held every even year and are fully sponsored by the Board of Research in Nuclear Sciences (BRNS). The ISMC series was renamed in 2012 as 'Interdisciplinary Symposium on Materials Chemistry' from erstwhile 'International Symposium on Materials Chemistry' highlighting the interdisciplinary nature of the symposium. There are 13 articles covering different contemporary areas of materials chemistry. This includes two articles on hydrogen energy, three on optical materials and four each on biomaterials and special materials related to the nuclear industry.

Journal of Chemical Sciences, Vol.131, 12, December 2019

Special Issue on 150 Years of the Periodic Table

Guest Editors: Eluvathingal D Jemmis, J N Moorthy and Ramaswamy Murugavel

The UNESCO selected 2019 as the Year of the Periodic Table of Elements, commemorating the 150th year of its discovery. The Journal of Chemical Sciences published by the Indian Academy of Sciences and Springer decided to have a special issue celebrating the Year of the Periodic Table of Elements. There are two kinds of articles in this issue. One set dealing with some general aspects of the Periodic Table of Elements, pertaining to several elements or some chemical or physical aspects that spans one or more blocks of the Table, and another set emphasising specific chemistry involving one or more elements. There is no clear demarcation among these two kinds. With this idea, thirty authors were invited to contribute articles. Ultimately eleven articles went through the editorial process successfully and are published in this issue.

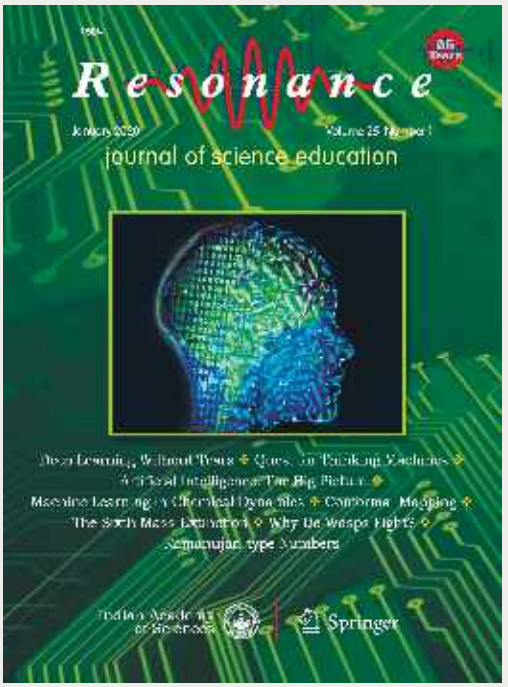
Journal Processing (1 April 2019-31 March 2020): Submission to Final Disposition

		Number of manuscripts received	Accepted	Rejected	In Process (Author, Referee, EBM, CE)
1.	Bulletin of Materials Science	1670	256	1394	20
2.	Journal of Astrophysics & Astronomy	268	44	218	6
3.	Journal of Biosciences	1148	148	967	33
4.	Journal of Chemical Sciences	1246	150	1075	21
5.	Journal of Earth System Science	763	176	556	31
6.	Journal of Genetics	728	87	629	12
7.	Pramana--Journal of Physics	1028	148	821	59
8.	Proceedings--Mathematical Sciences	522	42	453	27
9.	Resonance	282	51	200	31
10.	Sadhana	1858	190	1550	118
11.	Dialogue	27	12	9	6
22.	IASc Conference Series	22	22	0	0
	Total	**9562**	**1326**	**7872**	**364**

Journal Production (1 April 2019-31 March 2020)

	Name of the Journal	No. of Articles Published	No. of Pages Published
1	Bulletin of Materials Science	337	2906
2	Journal of Astrophysics & Astronomy	52	593
3	Journal of Biosciences	178	1826
4	Journal of Chemical Sciences	149	1670
5	Journal of Earth System Science	296	4681
6	Journal of Genetics	105	1315
7	Pramana-Journal of Physics	215	2096
8	Proceedings - Mathematical Sciences	100	1463
9	Resonance	110	1572
10	Sadhana	257	3254
11	Dialogue	10	193
12	IASc Conference Series	22	160
		1831	21729

Silver Jubilee of Resonance



Resonance: Journal of Science Education, is celebrating its 25th year of inception in 2020. *Resonance* was initiated in 1996 and was targeted primarily at science education for undergraduate students and teachers. The journal was the culmination of intensive efforts by the Academy through a panel that studied the state of science education in the country. The journal is focused on enriching the processes of teaching and learning science, thereby stimulating science education in the country.

Marking the silver jubilee of *Resonance*, a workshop 'Resonance@25' was held at St. Joseph's College, Bengaluru, in January 2020. The event comprised a talk by one of the principal architects of *Resonance*, N. Mukunda, titled 'The privilege of creating *Resonance*'. In his talk, Prof.Mukunda reminisced about the history of creation of *Resonance*, and the hopes for the future. The journal was conceived in the summer of 1994 by a committee headed by Roddam Narasimha, the then President of the Academy, to look at the state of post-school science education in the country, prepare a report and make recommendations to the Academy. The committee members included N Mukunda, J Chandrasekhar, R Gadagkar, A Sitaram, S Datta Gupta, M K Chandrashekaran and M Vidyasagar. Following this, the journal was directed to be planned and produced in January 1995, by the then President of the Academy, Professor P Rama Rao. The initial group of Editors of *Resonance* comprised a group of ten editors – Vani Brahmachari, J Chandrasekhar, Mohan Delampady, R Gadagkar, U Maitra, R Nityananda, G Prathap, V Rajaraman, and A Sitaram.

The inaugural January 1996 issue was released at the Indian Science Congress at Patiala, with U R Rao as General President, and the printing was done at Thomson Press, Delhi. Following N Mukunda, the succesive Chief Editors – Rajaraman, Chandrashekaran, Mahadevan, Sebastian, Rajaram Nityananda, and now Sathyamurthy--have constantly strived towards improving the quality of the journal. The Academy is continuously improving the production quality while maintaining high standards in overall design and presentation.

II. Public Lectures

1. The M87 Black Hole Observed by the Event Horizon Telescope

Speaker : Prof. Dr Eduardo Ros

Max-Planck-Institut für Radioastronomie, Bonn, Germany

11 February 2020 at 4.00 p.m.

Raman Research Institute Auditorium

On April 10th, 2019, the Event Horizon Telescope announced its first results. An image obtained after DE convolving the interferometric data provided by an array of radio telescopes at the driest and most remote places in the globe revealed the black hole at the centre of Messier 87, a massive galaxy in the centre of the Virgo Cluster, 55 million light-years from earth, with a mass of 6.5 billion times that of the Sun. These results were the fruit of a complex process involving the arrangement of the telescope array even after re-programming the ALMA telescope, performing the observations with weather decision, correlating the interferometric data, calibrating the amplitude and phase of the observed visibilities, imaging the data with novel methods, and comparing the results with a library of simulated black hole image to determine the physical parameters to be derived from the observational data. This talk reviewed some aspects of this discovery and provided an outlook for potential new findings of the Event Horizon Telescope.

2. Frontiers of Science Lecture "Entering the Era of Genomic Medicine: Realities and Opportunities"

Speaker: Dr Eric D. Green, Director, National Human Genome Research Institute, U.S.A.

06 January 2020, 4.00 p.m. to 5.00 p.m., Faculty Hall , Indian Institute of Science, Bengaluru

3. The Riemann Hypothesis

Speaker: Prof. Ken Ono, University of Virginia

18 December, 2019 from 3:15 – 5:15 p.m. at the Lecture Hall, Department of Mathematics, Indian Institute of Science, Bengaluru

The Riemann hypothesis provides insights into the distribution of Prime numbers, stating that that the nontrivial zeros of the Riemann zeta function have a “real part” of one-half. A proof of the hypothesis would be world news and fetch a $1 million Millennium Prize.

In this lecture, Ken Ono discussed the mathematical meaning of the Riemann hypothesis and why it matters. Along the way, he spoke of the mysteries about prime numbers and highlighted new advances.

This talk concluded with a discussion of recent joint work with mathematicians Micheal Griffin of Brigham Young University, Larry Rolen Georgia Tech, and Don Zagier of the Max Planck Institute, which shed new light on this famous problem.

4. Representing Mega Earthquakes in the Laboratory: The Discovery of Super-Shear, or Intersonic, Earthquake Ruptures

Speaker: Ares J. Rosakis NAS, NAE, Theodore von Kámá Professor of Aeronautics and Professor of Mechanical Engineering, California Institute of Technology, CA, USA

9 September 2019, 11:00 a.m. to 12:00 p.m.

Faculty Hall, Indian Institute of Science, Bangalore

Directly studying earthquakes presents a host of insurmountable difficulties, the least of which is our inability to trigger earthquakes at will and to directly scrutinize their slip behaviour at depth. The lecture described the establishment of the concept of “Laboratory Earthquakes” as well as the speaker's experimental discovery of "super-shear"earthquake ruptures, whose speed exceed the shear wave speed of crustal rock. They developed techniques to produce surrogate laboratory earthquakes and to follow their progress with multiple, ultra-high-speed imaging tools. Their laboratory quakes mimicked actual ones, such as the devastating 1999 lzmit earthquake in Turkey and the 2002 Denali earthquake in Alaska and have shown that their ruptures indeed transitioned to “super-shear”.

The propagating fronts of such "super-shear" ruptures feature a Mach-cone of shear shockwaves similar to that of supersonic aircraft. By analysing their special ground-shaking signatures, The speaker explored unexpected implications to the built environment.

5. Heterogeneity and Cancer

Speaker: Dr Marsha R. Rosner, Charles B. Huggins Professor

Ben May Department for Cancer Research

Gordon Center for Integrative Sciences, W428

University of Chicago, USA

27 June 2019, 11.00 a.m.

CSIR-Indian Institute of Chemical Biology

TRUE Campus, Bidhannagar, Kolkata

Cancer is the second leading cause of death, but unlike heart diseases, it has been a difficult disease to effectively understand or treat. The reason relates to the complexity and heterogeneity of the disease. Most tumors have complicated origins and are driven by rare mutations. Furthermore, different tissues have distinct cancers, individual tissues have multiple cancer subtypes, and tumors are composed of cells that are both genetically and phenotypically diverse. Thus, every tumor is unique and dynamic. The cause of lethality in most solid tumors such as breast cancer is the metastatic dissemination of tumor cells throughout the body. Metastasis is characterized by many distinct properties that are driven by changing stresses in the tumor micro environment.

The speaker's group has identified regulators of metastasis that control multiple processes within the tumor cell microenvironment including metabolism and invasion. More recently, their studies led them to potential therapeutic treatments based on the concept of reprogramming signalling networks in cells to sensitize tumors to therapeutic agents.

6. CONFLUENCE -- A Public Lecture Series In Association with Science Gallery Bengaluru

Two lectures in Kannada by writers K.Y. Naranaswamy and Gajanana Sharma was

also included.

1. 325 participants attended the public lectures on topics ranging from history, ecology, physics to literature, including talks on discovering new frontiers in water science and how water and culture are interrelated.

2. The young participants represented a diverse demographic of disciplines, including journalism, engineering, data analytics, sciences and literature.

III. Scientific Meetings

Mid-year Meeting

The 30th mid-year meeting of the Indian Academy of Sciences, Bengaluru was held at Satish Dhawan Auditorium, Indian Institute of Science, Bengaluru between 28 June and 29 June 2019. The two-day meeting comprised several scintillating talks by the elected Fellows and Associates, a public lecture by Tony Joseph, a symposium on P.C. Mahalanobis' scientific contributions and some special lectures, among other things.

The meeting started with the launch of the second edition of the book, *C V Raman – A Pictorial Biography*. The book launch was followed by a special lecture by **N. Mukunda (IASc, Bengaluru)**. His talk covered the vast historical ground about the creation of the field of quantum mechanics. He spoke about the early period of its discovery (1920s) and gave an impressionistic account of the developments in the field. He spoke about the contributions of stewards like Werner Heisenberg, Paul Dirac and Erwin Schrodinger. While lauding the discovery and the successes of quantum mechanics, he also spoke about the many puzzling questions still remain to be answered and continue to be pursued till today. In all, his talk gave a brief overview of the broad topic of quantum mechanics, which was delivered in a palatable and engaging manner.

Rupinder Kaur (CDFD, Hyderabad) underscored the clinical and economic burden posed by hospital-acquired fungal bloodstream infections (BSIs). Focusing particularly on the infections caused by *Candida glabrata*, the speaker

highlighted the challenges involved in tackling these infections. She discussed her work on understanding the pathogenicity of *C. glabrata*, particularly in the context of drug resistance and interaction with host immune cells.

Amit Kumar (IIT Delhi) spoke about a large class of optimization problems called packing and covering problems. He explained lucidly, using simple day-to-day examples, how online algorithms can be used to model problems where the input is revealed over time and how an optimum solution can be obtained.

Devanjan Sinha (BHU, Varanasi) in his talk, highlighted the role of specialized proteins called chaperones or heat shock proteins (Hsps) in maintaining mitochondrial health. Elaborating on his work in this area, the speaker discussed his findings on Hsp70s that are involved in the protein transport machinery in mitochondria of higher animals. He further talked about the associated multifunctional J proteins which drive these complex machineries. The speaker's findings on J proteins have underpinnings in understanding many pathophysiological conditions such as cancer.

Rajeev Patnaik (Panjab University, Chandigarh) delivered another interesting talk. The mammalian dental enamel is an extremely resilient tissue and remains preserved for millions of years, thus preserving the history of development of that individual. His talk focused on how carbon isotope composition of the enamel could be used to elucidate the diet and water intake of that particular organism. He uses this approach to understand the diets of extinct species using fossilized enamel and has found that several herbivores have shifted consumption from C3 to C4 plants over the geological past.

Mandar Deshmukh (TIFR, Mumbai) spoke about his research on how electrons flow in 2D materials. He spoke about how interesting properties arise in graphene monolayers because of the symmetry of the honeycomb lattice. Further, he discussed how few-layer graphene systems break these simple symmetries and give rise to interesting opportunities to study the effect of the interactions of these flowing electrons.

Rohini Garg (Shiv Nadar University, Noida) spoke on abiotic stresses that impact crop production and how plants adapt to stressful environments. Focusing

on her research on rice and chickpea cultivars, the speaker shared her discoveries on epigenetic differences between various cultivars that regulate various abiotic stress response networks in plants. The talk emphasized the implications of such epigenetic studies in crop improvement.

Smriti Mahajan (IISER, Mohali) in her talk, explored the role of the intermediate-density environments common in large-scale filament areas of galaxies in star formation and the subsequent evolution of galaxies. The speaker presented the case study involving the analysis of multi-wavelength properties of Coma supercluster, indicating that filaments are crucial to the evolution of galaxies in the nearby universe.

Jagannath Mondal (TIFR-TCIS, Hyderabad) discussed an innovative simulation method for biomolecular recognition of ligands in drug discovery. The technique, which overcomes the limitations of conventional docking methods, aim to capture the end to end process of ligand diffusion to the protein cavity at atomistic resolution in real-time. The speaker shared his team's results on the simulation of T4 lysozyme/benzene and cytochrome P450/camphor systems.

Beula Christy (L V Prasad Eye Institute, Hyderabad) spoke about her work in enabling equal education opportunities for the visually impaired students. Her talk outlined the challenges involved in teaching the visually impaired and how institutional changes could help foster their inclusion in the education system. She spoke about how facilities such as availability of teaching materials in an accessible format, accommodations in laboratory procedures, teacher training programs, etc., could help lift several challenges and pave a path for their inclusion in science education.

The first day of the meeting concluded with a public lecture by **Tony Joseph** (Author *Early Indians: The Story of Our Ancestors and Where We Came From*). The talk focused on the four prehistoric migrations that shaped Indian demography and population structure. The speaker described in detail the migration of early humans out of Africa under the influence of climatic changes followed by the Neolithic, Bronze and Colonial Ages, which has concluded in the inhabitation of the Indian subcontinent. Discussing in detail the role played by

genetic mapping studies in tracing the history of mankind, the speaker empathized how various disciplines – history, archaeology, linguistics, population genetics, philology and epigraphy – have come to interlocking evidence on the origin and migration of mankind which are independent of each. The speaker ended on the note 'We are all Indians. And we are all migrants.'

The second day of the mid-year meeting began with a symposium on the scientific contributions of Prasanta Chandra Mahalanobis, to commemorate his birth anniversary. **Poornima Paidipathy (London School of Economics, UK)** touched upon the National Sample Survey launched by Mahalanobis in 1950 to provide a comprehensive picture of Indian's domestic economy. She also discussed his contributions as the architect of the second five-year plan and his role as an international network builder who brought global experts in statistics to the Indian Statistical Institute (ISI) to assist in the statistical work of economic development. His involvement in planning also led him to devise fractile graphical analysis, a statistical method which was used to compare the socioeconomic conditions of people across different groups.

Probal Chaudhuri (ISI, Kolkata) discussed the incidents in the life of Mahalanobis which led him to the field of statistical sciences. His interactions with Nelson Annandale and Gilbert Walker in 1922 led to his appointment as a chief meteorologist at Alipore Observatory in Calcutta, a part-time position that he held in addition to his full-time job as a physics professor at Presidency College Calcutta University. During his stint at the meteorology department, he became interested in agriculture, which led him to publish a paper in an agricultural journal in 1925. Renowned statistician Ronald Fisher saw this paper, and this was the beginning of a very long and fruitful friendship between the two stalwarts in statistics. On Fisher's suggestion, Mahalanobis was offered a grant from the ICAR that formed the seed money for ISI. The year 1936 saw the beginning of Mahalanobis' contributions to the theory and methodology for large scale sample surveys such as the jute survey of Bengal in 1940.

Partha P. Majumder (NIBG) talked about the contributions of Mahalanobis to the human genetic studies in India. In 1925, Mahalanobis raised statistical and quantitative questions on the measure of the distance between population groups based on anthropometric measurements. In 1926–27, in Karl Pearson's laboratory, Mahalanobis undertook an extensive analysis of anthropometric data on European population and examined Pearson's 'Coefficient of Racial Likeness'

(CRL) for measuring population relationships. In 1930, the statistical shortcomings of CRL became clear to him and, this led him to formulate the D^2 statistic, derive its properties and applications, which are the most profound contributions of Mahalanobis. Mahalanobis started the Indian Statistical Institute in 1931. This was followed by two large scale surveys – Anthropometric survey of the United Provinces (1941) and the Bengal anthropometric survey of (1945). With these studies, Mahalanobis realized that anthropometry has to be supplemented by physical, genetic and serological data to get the ethnic origins about Indian populations. This led to the formation of the Anthropometry and Human Genetics Unit of ISI, the contributions of which were also discussed by Majumder.

B. N. Gangadhar (NIMHANS, Bengaluru) discussed the therapeutic applications of yoga in psychiatry, especially in the treatment of cognitive impairment and depression. Proposing a theoretical model of how the practice of yoga can be linked to molecular and physiological changes associated with cognitive improvement, the speaker presented some indirect and direct evidence to support the model. The speaker called for more support to a single comprehensive study to understand the antidepressant effects of yoga.

Subi George (JNCASR, Bengaluru) spoke on the emerging field of molecular machines and supramolecular assemblies. While supramolecular aggregates that follow biological principles and mimic biological molecules are becoming common, the speaker discussed his work on the development of chemical fuel controlled supramolecular systems which can be regulated temporally through various molecular cues.

The last speaker of the day, **Sulochana Gadgil (Pune)** highlighted that understanding and predicting the monsoon and its variability is one of the most challenging problems in atmospheric science today. She discussed the physics of the monsoon variability and presented the challenges ahead for prediction of the inter-annual variation of the monsoon.

85th Annual Meeting

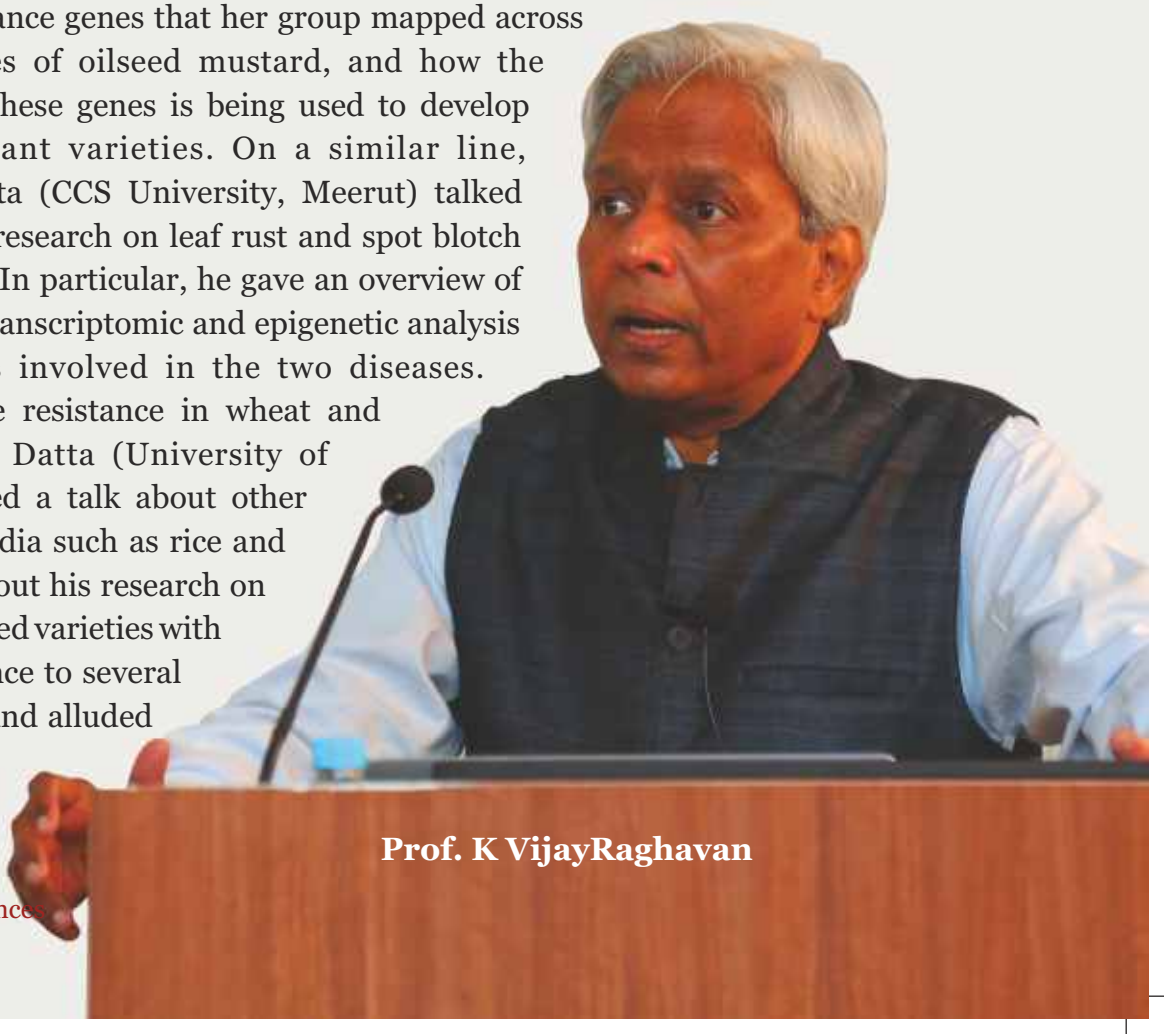
The 85th annual meeting of the Indian Academy of Sciences (IASc) comprised several talks, including inaugural lectures by Fellows/Associates, special lectures and symposiums.

The meeting commenced with a special lecture by Partha P. Majumder (President, IASc), who covered aspects of non-familial cancers, and the genes and genomic alterations that drive their growth. He cited his work in identifying the drivers of oral cancer, the most common form of cancer among Indian males. He found that the genes associated with oral cancer in the Indian scenario are predominantly concerned with tumour-suppressors. Any alterations to these tumour-suppressor genes hinder their normal functioning of suppressing uncontrolled cell growth, one of the hallmarks of cancer. Identifying such drivers provides insights into tumour evolution, nature of alterations in genes and pathways in cancers and the complex alterations that result in the spread of cancer. This understanding could also lead to improved handles on prediction, prevention and treatment of the disease, and enable learning of new processes in biological evolution.

The special lecture was followed by inaugural lectures by the elected fellows. Sandeep Kunnath (TIFR-CAM, Bengaluru) spoke about his research interests in studying inequalities that exist in mathematics, for example, Poincaré inequality, and Sobolev inequality, and provided a framework for understanding them. Tapas

Maji (JNCASR, Bengaluru) gave a brief overview of his research on low molecular-mass gelators and shared a few novel applications of such new materials. Raghavan Sunoj (IIT Bombay) in his talk highlighted some of the present-day themes in the domain of asymmetric multi-catalytic reactions and drew rationalizations of experimental observations to provide guidelines for improvement in the design of asymmetric catalysis. Such recent developments in computational chemistry have enabled high-accuracy computations in understanding the mechanism of catalytic reactions. Santosh Kapuria (IIT Delhi) described the analysis of wave propagation in solids. Conventional finite element (FE) methods either require great computational effort and time, or they yield inaccurate solutions. He proposed a wave packet enriched FE formulation for multifield 1D and 2D wave propagation problems that generate better accuracy at much lesser computational cost, and can be readily extended to 3D wave-propagation problems.

Next there was a symposium on how plants and pathogens interact. Appa Rao Podile (University of Hyderabad) gave an overview of his team's research on using biological methods for controlling fungal diseases in plants. He also spoke about the mechanism behind these interactions between plants and pathogens, and how its understanding could be exploited for immunizing plants. Jagreet Kaur (University of Delhi) spoke about her research on disease resistance in oilseed mustard, in two particular cases: white rust and *Alternaria* blight. She discussed the disease resistance genes that her group mapped across different varieties of oilseed mustard, and how the introgression of these genes is being used to develop improved resistant varieties. On a similar line, Pushpendra Gupta (CCS University, Meerut) talked about his team's research on leaf rust and spot blotch disease in wheat. In particular, he gave an overview of his work on the transcriptomic and epigenetic analysis of several genes involved in the two diseases. Following disease resistance in wheat and oilseed, Swapan Datta (University of Calcutta) delivered a talk about other major crops in India such as rice and jute. He spoke about his research on genetically modified varieties with enhanced resistance to several plant pathogens and alluded



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to prospects of his work. Rajeev Varshney (ICRISAT, Hyderabad) spoke about his research on fungal pathogen interaction in groundnut. He presented his work on the crosstalk between *Aspergillus flavus*, a fungus responsible for aflatoxin contamination in groundnut and discussed solutions that provide resistance against *A. flavus*. The day ended with a public lecture by Sonal Mansingh, an eminent classical dancer and a Member of Parliament. She shared her knowledge about Indian dance forms and the rich cultural and historical background associated with them. The talk was followed by a cultural programme titled 'Sankalp Se Siddhi', which highlighted themes of contemporary importance depicted through classical stories.

The second day of the meeting started with a special lecture by K. VijayRaghavan (Principal Scientific Adviser to the Government of India). He began with a brief overview of how earth and life on this planet came into being, and how science has made possible the understanding of such phenomenon. He then spoke about the challenges that India faces in the field of science and technology (S&T) in the

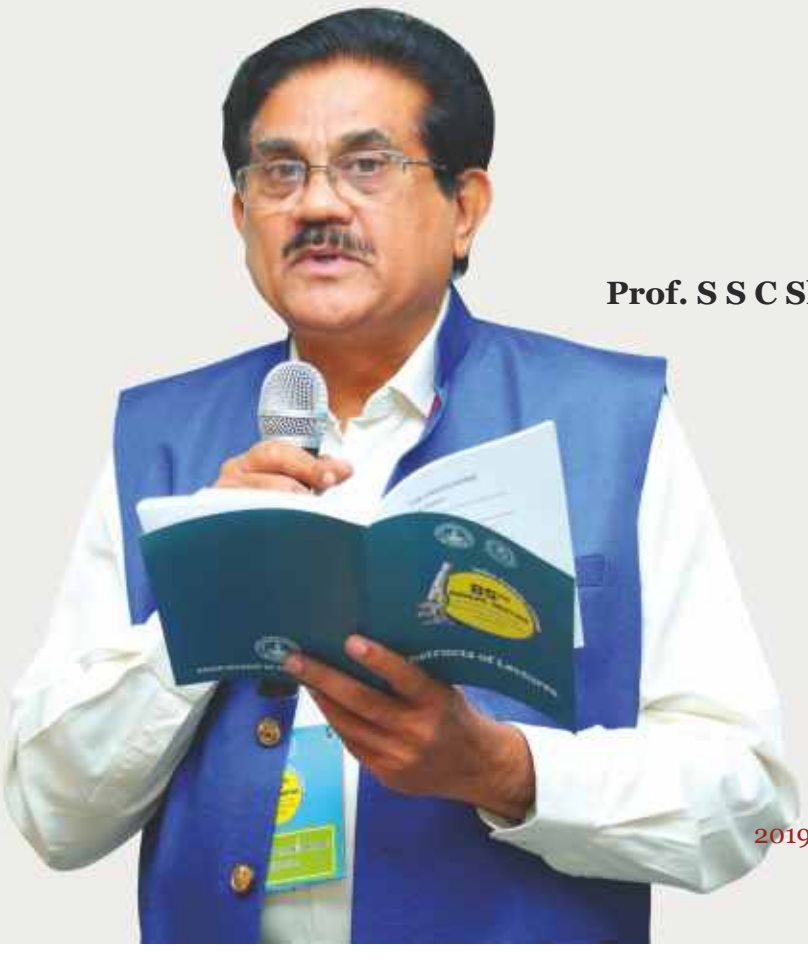
current epoch, the Anthropocene. He also underscored the problems that Indian science faces as a collective, for example, the fear of change, nativist ideologies, competence without comprehension, etc., Further, citing several articles from scientists and philosophers, he also talked about the future of S&T, and highlighted significant concerns of our times like environmental and climate change, data security, etc. and emphasized the role scientists in India and around the globe play in shaping the future.

Following the special lecture, V. V. S. S. Sarma (NIO, Visakhapatnam) in his talk pointed out that the present biogeochemical models are not projecting the real trends of factors that influence the biogeochemical processes in the Bay of Bengal. He cautioned that care must be taken while interpreting model outcomes and that new information on processes must be incorporated to predict how the ocean ecosystem is expected to modify due to climate change.

SrinivasaraoYaragorla (University of Hyderabad) discussed the strategic approach of in situ allene synthesis and nucleophilic cyclization reactions to develop new chemical entities with synthetic, medicinal and material applications. Next there was a symposium titled 'E. C. G. Sudarshan: Physics, Person and Times' with Debajyoti Choudury (University of Delhi) reviewing the initial understanding of weak interactions, challenges in discovering the V–A theory and how the V–A theory of Marshak and Sudarshan played a crucial role in the establishment of the Standard Model. Subhash Chaturvedi (IISER, Bhopal) discussed Sudarshan's contributions to quantum dynamics. He presented the paper by Sudarshan, Mathews and Rau that envisaged a generalization of the integrated form of the Schrödinger equation. He also discussed the paper by Gorini, Kossakowski and Sudarshan that provided the final form of the evolution equation for open quantum systems. R. Simon (IMSc, Chennai) discussed the heralding of non-classical optics with the discovery of diagonal coherent state representation for arbitrary states of quantum optical fields by Sudarshan. He provided the context and importance of this paper with reference to those of Roy Glauber in the same year. RohiniGodbole (IISc, Bengaluru) presented the 'quantum Zeno paradox' or 'quantum Zeno effect', a phenomenon of the inhibition of (spontaneous or induced) transitions between quantum states by frequent measurements. In 1977, Misra and Sudarshan gave a theoretical demonstration of its existence. Shiraz Minwalla (TIFR, Mumbai) reviewed Sudarshan's discovery of the V–A interactions and brought out excerpts from an oral history interview conducted for TIFR archives. N. Mukunda (IASc) gave an account of the life and works of Sudarshan and shared some memories from his long association with Sudarshan. Mukunda also highlighted two critical contributions in the area of symmetry, not

often remembered, and also spoke of their collaboration in the 1960s on Dirac theory of constrained Hamiltonian dynamics and unitary representations of the Lorentz group.

Following the symposium, Subeer Majumdar (NIAB, Hyderabad) talked about therapeutic proteins like insulin and interferons, and how they could be produced in the milk of larger animals to increase affordability. He spoke about his research on genetically engineering mice to produce human gamma interferon successfully and proposed a plan to scale up experiments in rabbits and buffaloes. Mohammad Ashraf (Jamia Millia Islamia, New Delhi) spoke about the physiological effect of high altitude on humans and its impact on human health. Among other effects, he spoke in-depth about thromboembolism and his research about hypoxia-induced thrombosis. Nissim Kanekar (NCRA, Pune) delivered a talk on the fundamental constants and their evolution over cosmological time. He cited his work with the hydroxyl (OH) molecule to present his arguments and concluded that we have no statistically significant evidence to suggest a change in the fundamental constants. Utpal Nath (IISc) started with an unassuming question about how a leaf grows. Using this example, he explained the scaling laws that lie beneath the growth of leaves and other living beings, including humans. The second public lecture of the meeting was delivered by the renowned Indian jurist, J. Chelameswar. He has served as a Judge of the Supreme Court of India and has delivered several landmark judgements. He spoke about what the Indian Constitution really means. He also highlighted the basic principles of the constitutional theory and provided a



Prof. S S C Shenoi

layman understanding of fundamental laws and justice systems in India. The talk was well-received following an engaging Q&A session.

The last day of the meeting began with a talk by Vaishnavi Ananthanarayanan (IISc) on the role of cytoskeleton and motor proteins. She gave an overview of her work on the dynamics between microtubules and mitochondria, and the cellular mechanism involved in it. Chandra Venkataraman (IIT Bombay) talked about atmospheric particles or aerosols in the context of air pollution and climate change. She spoke about her research on broadly asking questions about how pollution has an effects on climate change and the reverse feedback. K. Geetharani (IISc) spoke about her research with cobalt-based complexes and how these can be applied to catalytic borylation reactions.

The morning talks were followed by another session by Fellows and Associates. Functional data analysis is increasingly becoming common in areas such as genetics, biophysics, imaging, energy, environmetrics, etc. Statistical analysis of functional data requires such data to be considered as elements of appropriate infinite-dimensional spaces. Since standard statistical methods are far from useful in analysing such data, there is a need to develop a new branch of mathematical

statistics with aspects such as geometry, randomness and complexity playing a crucial role. Anirvan Chakraborty (IISER, Kolkata) discussed some statistical procedures to analyse such data. Stochastic approximation algorithms are a class of iterative schemes that converge to a sought value through a series of successive approximations and find application in areas such as adaptive control, signal processing, communication networks, reinforcement learning, etc. Shalabh Bhatnagar (IISc) gave an overview of stochastic approximation algorithms, and on-going and future work in the area. Charu Lata (NISCAIR, New Delhi) discussed the role of plant growth promoting rhizobacteria (PGPR) in abiotic stress tolerance and agricultural sustainability. PGPR alter physio-biochemical as well as the molecular mechanism of plants to withstand adverse environmental conditions which are especially significant in the context of changing climate. She concluded that SN13 and RA could be formulated and used as biofertilizers and abiotic stress busters in rice and chickpea respectively.

The last special lecture of the event was delivered by Manindra Agrawal (IIT Kanpur) on the hype and substance of artificial intelligence (AI). He narrated the history of AI over the years. AI began in the 1950s. The 1960s–70s saw several unmet expectations from AI, since developments in complexity theory showed that many tools were trying to solve NP-hard problems which could not be done efficiently. The 1980s saw AI become a knowledge repository that laid the foundation for advances in the area that took place in the 1990s–2000s. The 2010s has been a decade of tremendous progress that saw a profound learning revolution with techniques such as hidden Markov models and support vector machines outperforming all other AI techniques in many domains. Thus, AI has progressed in: (1) deep learning which is being applied in vision and speech, biology, games and is also expanding to new domains; (2) more modern methods like reinforced learning

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which are developing rapidly; (3) SATsolvers, and (4) old methods like Bayesian learning and clustering which have also made rapid advances. Agrawal concluded that while some predictions state that computers will become more intelligent than humans by 2050 (reminiscent of the hype in the 1960s), it is not at all clear how to make the same algorithm do a large number of different types of tasks intelligently. Hence, he was of the opinion that such claims need to be taken with a pinch of salt.

IV. Discussion Meetings

1. "Advanced Materials and Microscopy" organized at Orange County, Coorg

A discussion meeting on "Advanced Materials and Microscopy" was organized by Prof. Kamanio Chattopadhyay of IISc, Bangalore at Evolve Back (formerly, Orange County), Coorg, during December 5-8, 2019. This meeting was attended by 17 scientists from academia, national labs and one industry. In particular, the delegates were Pan IITs (viz., IIT Bombay, IIT Kanpur, IIT Kharagpur, IIT Mandi, IIT Roper), from IISc, Bangalore, national laboratories (BARC, IGCAR, DMRL) and also from an US company (i.e., Rockwell Automation). The lectures were intended to discuss the state-of-the art and the challenges pertaining to scientific aspects in the field of advanced materials (viz., both, metals and ceramics) and advanced microscopy, pertaining to applications ranging from structural to energy storage. The emphasis was on understanding the issue in the respective field that require a short-term goal or a long-term research programme.

The meeting was kick-started in the afternoon of the 5th of December by Prof. K. Chattopadhyay, welcoming the participants and setting the tone for some brain-storming discussions in an informal environment. In his talk, Prof. Chattopadhyay also stressed upon the importance of inquisitive experimental research; citing his own examples related to the development of high temperature alloys by unique alloy design approach. Following that, Dr G. K. Dey from BARC, Mumbai, elaborated on the importance of high quality imaging and analyses with electron microscope, towards the development of materials for advanced structural applications. The roles played by electron microscopy at each stages of product development, production and degradation during targeted applications, were elucidated with examples. This did set the right tone for Dr Arup Dasgupta from IGCAR, Kalpakkam, to touch upon some of the basic aspects associated with atomic column contrast variation during imaging in aberration-corrected HRTEM, with explicit examples of bulk nano crystalline commercially pure Ti. The roles of aberration corrected microscope in detecting substructures within grains of deformed alloys were discussed at length.

The focus in the second (evening) session was towards understanding salient

aspects in the context of applications in the area of aerospace (ultra-high temperature ceramics) and electrochemical energy storage (i.e., alkali metal-ion batteries). Prof. Bikramjit Basu from IISc Bangalore, presented an overview of the processing challenges associated with the transition metal borides (an important class of ultra-high temperature ceramics), focussing on the correlation between the sintering conditions and properties. The speaker emphasized on the need for computational analysis to understand the stresses and deformation of UHTCs in simulated extreme aerothermodynamics environment. Prof. Basu also stressed upon the need for performance limiting experiments to translate the laboratory scale research towards component development. Followed by this, Dr Amartya Mukhopadhyay from IIT Bombay, highlighted the issues that are presently being envisaged as the major challenges towards Li-ion battery technology to fulfil the promises in terms of much higher energy-cum-power densities, cycle life and safety aspects. Other issues are concerned with the development of alternate alkali metal-ion battery systems, such as the Na-ion batteries. With the help of examples from his own work, the issues that were highlighted are at the core of materials and electrochemical science/engineering. The need for concerned effort towards rendering the electrochemical energy storage systems achieve the desired performances and sustainability was emphasized.

Day 2 (i.e., December 6, 2019) started with discussion on the interesting aspects and issues associated with the development of magnetic materials, as talked about by Dr Mithun Palit from DMRL, Hyderabad. Some interesting aspects related to lithiation induced changes in the magnetic properties were also brought to the fore, together with electric field induced modulation of magnetic properties. Following this, Dr Anirudh Biswas from BARC, Mumbai, talked about quantification of elemental segregation in phases formed due to spinodal decomposition in alloys by atom probe tomographic technique. The talk led to a fundamental level discussion on the differences/similarities between phase transformations occurring via nucleation-growth and spinodal decomposition.

This was followed by several talks on novel material design concepts, detailing the need of combination of computational and experimental approaches. Dr Krishanu Biswas from IIT Kanpur discussed about the advent and progress of research on multi-principle and multi-component alloys, popularly known as High Entropy Alloys. He discussed three fundamental issues -- measurement and tuning of lattice distortion, design alloy compositions to circumvent strength-ductility trade

off and machine language approach to design novel catalysts for various reactions. Dr Chadra Sekhar Tiwary from IIT Kharagpur discussed unique design strategies for various geometrically stabilized natural materials, including tubeline and schwatzite for impact resistance with potential application as light weight bullet resistance materials. He also discussed the use of 2D materials for environmental cleaning. After this, Dr R. Tiwary of BARC, Mumbai, discussed about the use of high-resolution microscopy towards solving various phase transformation related issues in Nb--Zr alloys. The importance of combining crystallography and composition mapping-cum-analysis via 3D atom probe towards establishing the most probable mechanism of phase transformation was highlighted with examples from his own work. This was followed by Dr B. Viswanath from IIT Mandi talking about monitoring mechanical behaviour across phase transformations and also the important issues with the growth of quality 2D materials, as well as imaging defects by TEM. He also discussed about the stability of metastable phases in CVD grown 2D materials including WS_2, MoS_2 and their heterostructures. In particular, he elaborated the role of defects in controlling IH, IT and IT phase and their properties. Dr Nilesh P. Gurrao from IIT Kanpur discussed the methodology to carry out high throughput experiments using in-situ Electron Backscatter Diffraction in metallic materials to understand fundamental aspects of plastic deformation processes, like twinning. The critical role of twinning and de-twinning in uniaxial tension, load-reversal and low cycle fatigue was elaborated. Strain hardening behaviour of Al--Mg--Si alloy was used as model system to develop strain hardening behaviour of FCC materials as a function of intrinsic and extrinsic parameters.

The third day (i.e., December 7, 2019) started with a talk by Dr Abhay Gautam from IIT Gandhinagar, who discussed the in-situ TEM techniques to understand the vapour phase de-alloying, early stage of nucleation and grain boundary characteristics of various materials.

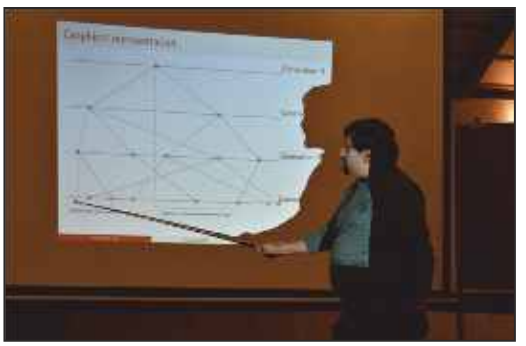
From 23rd to 27th February 2020, a meeting was arranged on Probability and Stochastic Processes under the auspices of the Indian Acdemy of Sciences.

There were three courses planned

Gaussian Membrane Model - *Rajat Hazra (Indian Statistical Institute, Kolkata)*

Determinantal point processes and non-colliding Brownian motions - *Makoto Katori (Chuo University, Tokyo)*

Weak convergence of point processes and its applications - *Parthanil Roy (Indian Statistical Institute, Bangalore)*



“Materials and Metallurgy Curriculum”

Held on 5-8March 2020
at Evolve Back, Orange County, Coorg
Supported by
Indian Academy of Sciences, Bengaluru

Along with information technology and biology, the technological achievements of the last Six decades have been made possible by developments in materials of all kinds: metals, semiconductors, polymers, ceramics and hybrids of all kinds. There is little or no unification in the syllabi of undergraduate programmes of the various Indian institutes that cover these diverse materials classes. While many concepts are common to all, others are not. Computational tools to execute practical problems are now extensively used in industry and in research, but have yet to make inroads into syllabi. Employment opportunities for graduates of this discipline in India are stagnated. Much of materials activity in industry concerns production of well known compositions using well established flow sheets. The skill sets needed for such jobs are more in general engineering ability to execute projects than a detailed understanding of how properties come about. This workshop was intended to bring together representatives from the major materials departments in the engineering faculty across India to brainstorm and

identify current weaknesses in the curriculum that should be addressed in Indian institutions given the existing eco-system of how students choose their career and the opportunities available to them.

The aim of the meeting was to build on at the earliest, TEQUP-sponsored, workshops to address, in a unified manner, the broad issues of curriculum design and delivery. The discussions ranged from improving analytical and computing skills, employability and most importantly, in making the learning process interesting to the students. There were a total of 20 participants selected from IITs, NITs and IISc (whose names are listed at the end) and who were grouped in five domains: Structures and Physical Metallurgy, Mechanical Behaviour/ Mechanics, Functional Materials, Materials and Process Modelling, Manufacturing/ Materials Processing. A little over half the time was spent on the undergraduate curriculum with balance on the needs of masters and research programmes. Individual presentations by group leaders were followed by intense discussion which formed the basis of an exhaustive report that is currently under preparation and will be shared with faculties in institutions across India.

The discussions revolved around : (i) present Materials and Metallurgy curriculum in IITs and NITs, (ii) identifying the challenges, (iii) providing recommendations for a bare essential undergraduate curriculum which can be adopted across India to ensure a certain uniformity in delivery of content and output, and (iv) issues with postgraduate education such as including a core content, bearing in mind the diversity of intake, and (v) how to improve curriculum delivery to ensure better absorption. The primary idea behind curriculum design, especially at the undergraduate level, is that it should provide interesting as well as challenging course work and impart diverse set of skills to prepare students for a variety of occupations including the core discipline and should gradually evolve with time adopting contemporary ideas and methodologies. The principal problems with existing materials curricula are that they (i) are heavily theory-centric and lack hands-on approach, (ii) do not utilize mathematical concepts learnt early in the programme, and (iii) lack exposure to and training in modern computational methods or softwares. It was felt that the curriculum should be designed to: (i) focus on the unification of concepts regardless of the type of material, (ii) provide linkages and avoid repetition between various courses so that the number of courses can be minimized, (iii) make courses mathematical and quantitative which requires formulation of problems utilizing the basic mathematical skills acquired at an earlier stage. The latter also requires exposure to computational techniques and software packages. The courses can be grouped as fundamentals, properties, processing and applications and can progress in the fashion suggested.

The way in which laboratories are conducted requires a complete overhaul to ensure that a wide array of topics is covered, and concepts and techniques learnt at early stages are finally implemented in the form of student projects such as capstone projects which are not linked to faculty research projects. For the PG curriculum, it was felt that the core part should be kept to a bare minimum with a sizeable number of electives to ensure a broad and/or in-depth exposure to the students depending on their interests and career aspirations. However, departments may ensure a certain minimum core course-work for the students lacking enough exposure to materials.

V. National Conference

C.R. Rao Birth Centenary Conference on Statistics

The Academy celebrated the birth centenary of Professor C. Radhakrishna Rao on December 12 and 13, 2019, in the Raman Research Institute auditorium in Bangalore. The celebrations were co-hosted by the Indian Statistical Institute and Bangalore University CSIR-HRDG provided the financial support.

Calyampudi Radhakrishna Rao, FRS known as C R Rao (born 10 September 1920) is an Indian-American mathematician and statistician. He is currently Professor Emeritus at Pennsylvania State University and Research Professor at the University at Buffalo. Rao has been honoured by numerous colloquia, honorary degrees, and festschrifts and was awarded the US National Medal of Science in 2002. The American Statistical Association has described him as "a living legend whose work has influenced not just statistics, but has had far reaching implications for fields as varied as economics, genetics, anthropology, geology, national planning, demography, biometry, and medicine." The Times of India listed Rao as one of the top 10 Indian scientists of all time. Rao is also a Senior Policy and Statistics advisor for the Indian Heart Association non-profit focused on raising South Asian cardiovascular disease awareness.

The conference was attended by a large number of graduate students in Statistics, and members of the faculty, from the Department of Statistics, Bangalore University, Oxford Science College and Department of Agricultural Statistics, University of Agricultural Sciences (UAS). A few fellows of the Academy and some members of the faculty of the ISI, Kolkata, and Bangalore, Department of Statistics, Bangalore University, Oxford Science College and GKVK also participated. The talks were mostly expository in nature and attempted to emphasize the initiation of research in various sub-domains of statistical science by Dr. Rao and subsequent developments.

VI. Science Education Programmes

Activities of Science Education Panel

The Science Education Panel conducts the following programmes. 1. Summer Research Fellowship Programme, 2. Focus Area Science Technology Summer Fellowship for specific geographical areas, 3. Summer Schools, 4. Refresher Courses, 5. Lecture Workshops.

Brief description of the activities for the year 2019 is given below:

Summer Research Fellowship Programme 2019

Summer Fellowships are awarded to bright students and motivated teachers to work with Fellows of Academies and Scientists suggested by them on research oriented projects for 2 months period during the calendar year. The Panel could offer over 2000 Fellowships to students and teachers.

Details about the applications received, offered and availed are provided below:

Sl. No.	Subject	Students			Teachers		
		Applications received	Offered	Availed	Applications received	Offered	Availed
1.	Life Sciences (including Agricultural Sciences)	5589	592	483	272	59	31
2.	Engineering & Technology	7649	496	295	177	44	19
3.	Chemistry	2671	343	267	156	37	22
4.	Physics	2572	244	179	129	16	9
5.	Earth & Planetary Sciences	989	106	88	20	4	3
6.	Mathematics	1316	127	88	67	3	2
	Total	**20786**	**1908**	**1400**	**821**	**163**	**86**

as on 29 October 2020

FOCUS AREA SCIENCE TECHNOLOGY SUMMER FELLOWSHIP

Sl. No.	Subject	Students			Teachers		
		Applications received	Offered	Availed	Applications received	Offered	Availed
1.	Life Sciences (including Agricultural Sciences)	166	25	16	22	03	01
2.	Engineering	529	49	28	10	01	00
3.	Chemistry	130	24	22	9	03	03
4.	Physics	102	12	11	6	01	01
5.	Earth & Planetary Sci.	15	00	00	1	00	00
6.	Mathematics	53	09	09	3	00	00
	Total	995	119	86	51	08	05

as on 29 October 2020

Summer Schools

1 Science of Materials, University of Mumbai-DAE, Mumbai, 6 May--14 June 2019

2 Mathematical Sciences, CMI, Chennai 20 May -- 21 June 2019

3 SC/ST Summer School, Indian Institute of Science, Bengaluru, 6 June -- 5 July 2019

4 Quantum Information and Quantum Technology, IISER, Kolkata, 10 June -- 20 July 2019

5 Instructional School on Stochastic Process - Level II, NISER, Bhubaneswar, 17 June-- 12 July 2019

While 30 students participated in Science of Materials, Mathematical Sciences, and Quantum Information and Quantum Technology summer schools, 90 and 50 students participated, in the SC/ST Summer School and Instructional School on Stochastic Process respectively.

Refresher Courses

Refresher Courses of 15-day duration form an important segment of the activities

of the Joint Science Education Programme. This is an all India programme primarily aimed at helping motivated teachers to improve their knowledge and teaching skills. Details of the Refresher Courses held during the report period are provided below.

Sl No.	Title	Subject	Venue	State	Duration	Director	Co-ordinator	No. of Participants
1	Statistical Physics	Physics	Sir P.T.Sarvajanik College of Science, Surat	Gujarat	10-06-2019 22-06-2019	Deepak Dhar	Pruthul Desai	45
2	Biological Sciences Botany	Life Sciences	Dayananda Science College, Latur	Maharashtra	10-06-2019 24-06-2019	Shrirang R.Yadav	R.H.Ladda	35
3	Experimental Physics - 107	Experimental Physics	Govt.Autonomous College, Rourkela	Odisha	04-06-2019 19-06-2019	R.Srinivasan	Bishwanath Parija	35
4	Experimental Physics - 106	Experimental Physics	M.R.College Vizianagaram, Vizianagaram	Andhra Pradesh	15-04-2019 01-05-2019	R. Srinivasan	D.B.R.K Murthy	45

Lecture Workshops

Lecture Workshops are of 2--3 day duration which are organized for the benefit of students and teachers in various colleges across the country. Six Lecture Workshops were held during the report period; the details of which are given below. Although, the Panel received over 70 proposals, the same could not be approved due to lack of funds.

Sl No.	Title	Subject	Venue	Duration	Sate	Convener	Co-ordinator	No. of Parici pants
1	Materials Engineering for Sustainable and Energy Environment	Physics	CSIO, Chandigarh	09-01-2020 10-01-2020	Chandigarh	Hirendranath Ghosh	Pooja	150
2	Advances in Mycology, Microbiology and Biotechnology	Life Sciences	Karnataka University, Dharwad	30-10-2019 31-10-2019	Karnataka	D.J. Bagyaraj	V. Shyam Kumar	120
3	Medicinal Chemistry and Natural Products: Approaches Towards new Drug Discovery	Chemistry	Rajiv Gandhi Unviersity, Doimukh	25-09-2019 27-09-2019	Arunachal Pradesh	Romesh Chandra Boruah	Dwipen Kakati	150
4	Nanomaterials – Applications in Biotechnology	Life Sciences	Ramaiah Institute of Technology, Bengaluru	29-07-2019 30-07-2019	Karnataka	T. Pradeep	S. Bindu	150
5	Recent advances in Stem Cell Research - Biomedical Applications	Life Sciences	Jai Hind College, Mumbai	01-06-2019 02-06-2019	M.S.	L.S. Shashidhara	Srilatha Srinivas K.	150
6	Introduction to Density Functional Theory	Chemistry	Government Arts and Science College, Melur	04-04-2019 05-04-2019	Tamil Nadu	Vijaya-mohanan	A.John Peter	120

VII. Chair Professorship

Prof. Ken Ono

Under Visiting Chair Professorship programme, Jubilee Chair Professor, Prof. Ken Ono, University of Virginia, a Japanese -- American mathematician, visited India during December. During his visit, Prof. Ono visited many national science institutions and gave lectures.

VIII. National Science Day

The Academy in association with the National College , Bengaluru (NCB) and the Academy Trust, organized a day's seminar on Women in Science on 28th February 2020 at NCB.

The programme started with a welcome speech by Prof. S.N. Nagaraja Reddy, Hon. Secretary, N.E.S of Karnataka, Bengaluru .

Dr V. Susheela Devi, Principal Research Scientist, Department of Computer Science and Automation, Indian Institute of Science, Bengaluru inaugurated the seminar and gave the key note address. She emphasized the "Role of Women' in all fields and the opportunities. She stressed on Women can do much to reform the society; more education among women means the more progress for the society. The students of final year B.Sc. and BCA presented a video on "Women in Science" which was inaugurated by mouse click by the Chief Guest. On this occasion the programme Co-ordinator, Mr Shubhankar Biswas, Executive Secretary, TaCT spoke to motivate the students towards science.

The session from 11.30 to 12.30 am was held by the speaker Dr Anasuya D.S, Department of General Medicine from St. John's Hospital, Bengaluru on "Health as well being". It was an interactive session on educating the importance's of health, food requirement and so on.

In the next session, at 1 pm, Dr Shilpa, Scientist, Forensic Science, spoke about various fields of Forensic Science and its application; she explained about measuring accurateness in matching techniques and pattern study.

Dr Nandini, Professor and Chairperson, Department of Environment Sciences, Bangalore University spoke about " Urbanization and Environmental Health" emphasizing the preservation of environment.

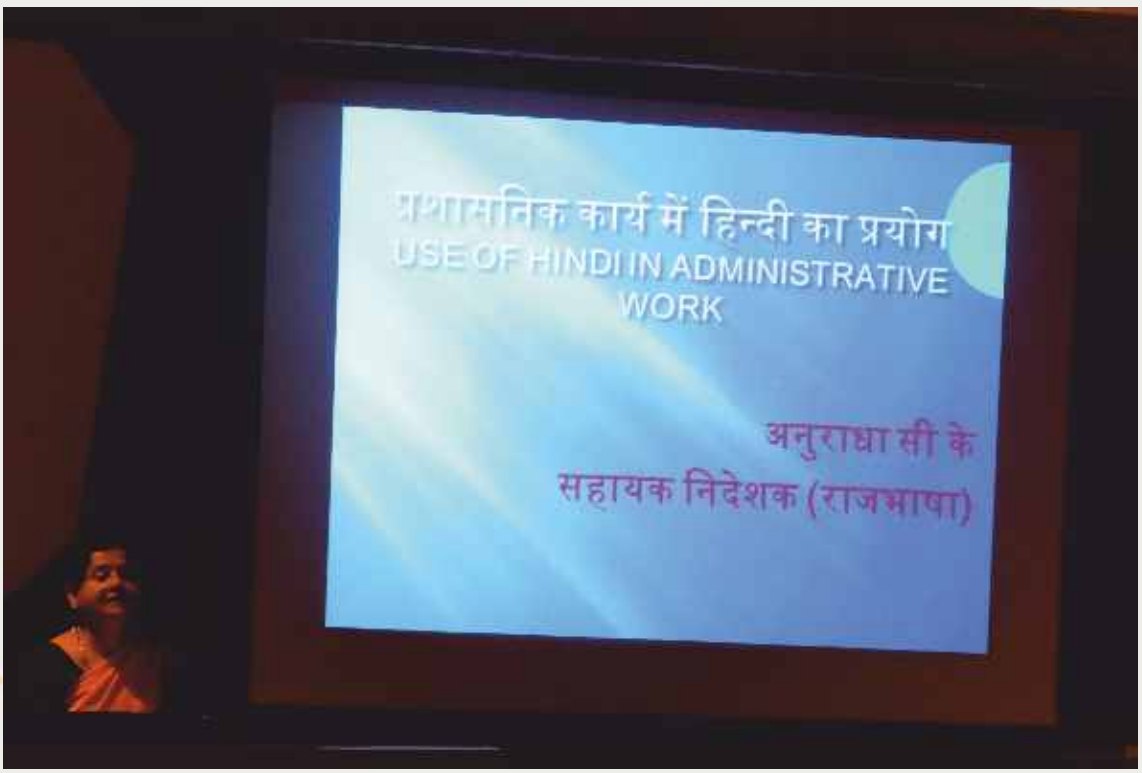
The last speaker was Dr Seetha S, Former Director, Space Science Programme Office, ISRO. She talked about the role of a Space Scientist, introduced various stages of satellite building across various branches and launching. She briefed about the various opportunities in ISRO and future of Space.

A valedictory function for honouring the Speakers was carried. The Principal Dr C.B. Annapurnamma thanked the guests, Co-ordinator and Indian Academy of Sciences for sponsoring the programme.

IX. Hindi Fortnight Celebrations

Under the Official Lang-uage Imple-mentation Policy, Raman Research Institute and Indian Academy of Sciences jointly observed Hindi Week during 20--26 September 2019. During this week, several competitions were organized for the staff of both the institutions. Hindi Day was celeb-rated on 26th September as part of this celebration, and a talk by Shri Saurabh Mandal, Scientist, CAIR, Bengaluru was organized. The celebration concluded with prize distribution to the winners of various competitions organized as part of the event.

In accordance with the directions of the Central Hindi Advisory Committee and with the aim of popularising Hindi and bringing it closer to the heart of the officials, as well as to create awareness, a short documentary film has been organized on 20.12.2019. The title of the short film was "Link Language: Hindi or Hindustani". The film was one of the episodes of Samvidhaan. A 10-part television mini series based on the making of the constitution of India, directed by Shyam Benegal. The shown episode depicts a parliamentary debate towards enabling Hindi as Rajbhasha.



04.
Social Media Outreach

http://www.ias.ac.in/Home: Our primary platform for sharing all the information. The site provides open access to all its scientific publications, which may be downloaded and used for academic and research purposes with due credit to the authors.

@IAScBng: Look out for notifications and activities of the Academy and scientific information. The page also acts as an informal platform for students and common public to interact with the academy by means of messages and clarify their doubts.

@IAScBng: We live-tweet our main events-the mid-year and annual meetings. We also tweet about upcoming events and other happenings in the Academy.

We leverage the strength of visual media to spread science and scientific awareness. The YouTube channel of the academy allow users to listen to (and watch lectures and scientific discourses by prominent researchers across the country.

05.
Pages From History

The first and the only time that C V Raman could not preside over an Academy annual meeting was at Aurangabad (1969). The last annual meeting he attended was in Bangalore (1970).

Bulletin of Materials Science, May 1979

The *Bulletin of Materials Science* launched in 1979 and the *Journal of Astronomy and Astrophysics* launched in 1980 have completed 40 years of publication in 2020.

From the Editors

Dear colleagues:

We are very happy to place before you the first issue of this new journal devoted to materials science and technology. The main objectives of this journal are to publish topical reviews, reports on R & D activities in the country and original research communications. Wherever appropriate, reports and announcements of conferences, etc. will be included. To begin with, this journal will be a quarterly with four issues in a year comprising a volume.

The need for such a journal has long been recognised. It is indeed fortunate that the Indian Academy of Sciences was able to initiate this journal with the co-operation of the Indian National Science Academy. We must acknowledge the financial support of the Advanced Centre for Materials Science of the Indian Institute of Technology, Kanpur, for the publication of this journal; this Centre has promised to continue this support in future years as well.

The success of this journal fully depends on the involvement of all those actively engaged in research and development work in materials science and technology. There are many laboratories in the country carrying out basic research related to materials. There are also a number of development activities in the area of materials being carried out in our national laboratories and other institutions with various national requirements in mind. We feel that this Bulletin will provide an appropriate medium for publication of results of all such endeavours in the country.

We solicit your co-operation, encouragement and support in making this journal a success.

C. N. R. Rao
Chairman, Editorial Board,
Bulletin of Materials Science

S. Ramaseshan
General Editor of Publications
Indian Academy of Sciences

Journal of Astronomy & Astrophysics
September 1980

PREFACE

Progress in astrophysics and astronomy in the last few decades has been phenolmenal and there is therefore little need for justification when a new international journal makes its debut as a rapid means of dissemination of scientific results. This heartening trend arises from major advances in both theory and observation, especially with the revolutionary technological achievements of recent years that have opened up avenues of research over the entire electromagnetic spectrum. In keeping with the general concept of the international character of astronomy, activity in almost all these fields has become a worldwide feature with numerous contributions coming in from areas of the globe that earlier had provided less effective participation. It is our hope that the new journal will provide the additional facility needed for quick publication of the results of research from members of an expanding fraternity. It is also indicative of the measure of optimism we have in the future growth of astronomical endeavour on the international scale.

We invite accounts of original contributions to any area of astronomy and astrophysics, observational and theoretical. There will be no levy of page charges. All papers are refereed and will appear with a minimum publication time-lag after acceptance. It is our wish to aim at a high quality of scientific content and there by contribute to the promotion of astronomical research.

M. K. V. BAPPU

06.
The Academy Personnel

Secretariat

Maheshchandra N.
Executive Secretary

Ravi Kumar C.S.
Assistant Executive Secretary, Coordinator, Science Academies Education Programme

Brahmananda N.N.
Administrative Assistant

Meghana B Yadav
Administrative Assistant

Nalini B.R.
Office Assistant

Rajesh P
Technical Assistant

Thirumalai N.
Senior Administrative Assistant

Venkatarathnam N.
Administrative Assistant

Editorial

Anuradha R
Copy Editor

Cicilia S.
Copy Editor

Geetha Sugumaran
Copy Editor

Geetha D.L.
Editorial Assistant

R.A. Gracy Rani
Editorial Assistant

Jai Benjamin
Editorial Assistant

Mahabaleswara T.D.
Executive Editor

Mary J Mathai
Copy Editor

Nagesh K
Copy Editor

Padmaja N
Copy Editor

Pushpavathi R
Office Assistant

Rajitha V.
Copy Editor
Shylaja K.S.
Copy Editor
Srimathi M
Executive Editor
Sudarshana Dhar
Assistant Executive Editor
Sushila Rajagopal
Copy Editor
Usha Susan Philip
Copy Editor
Venkateswari V
Office Assistant
Venugopal M.S.
Executive Editor

Science Academies' Education Programme

Chethana H
Administrative Assistant
Geetha K
Administrative Assistant
Roopashri M.S.
Office Assistant

Accounts & Finance

Shashidhar A
Accounts Officer
Asha B.S.
Accounts Assistant (Demised August 2019)
Jayakumar A
Junior Accounts Assistant
Tejaswini T.M
Administrative Assistant

Journals'Circulation

Chikkahanumanthappa L
Office Assistant

Computer & IT Support

Sumesh K.S.
IT Support Engineer

Supporting Staff

Channaiah, H.
Literate Attender

Govindaswamy J
Literate Attender

Rathnamma N
Literate Attender

Vijaya Kumar R.P.
Literate Attender

Gangadharaiah H
Guest House Attender

Manjunath N
Guest House Attender

Ravindra M
Guest House Attender

Current Science Association

Madhavan G
Executive Secretary (currsci@ias.ac.in)

The Academy Trust

General Ph. No. +91 80 22661225
Website: http//www.ias.ac.in/trust

Subhankar Biswas
Executive Secretary | 22661225 | 9886242342 | trust@ias.ac.in

07.
Statement Of Finances

G.R. VENKATANARAYANA
CHARTERED ACCOUNTANTS
No. 618, 75th Cross, 6th Block, Rajajinagar, Bangalore-560 010.
Ph: 23404921 Email: grvauditor@gmail.com/ 1grvenkat@gmail.com

Partners :
CA. G.R. Venkatanarayana, B.Com., F.C.A.,
CA. G.S. Umesh, B.Com., F.C.A.,
CA. Venugopal N. Hegde, B.Com., F.C.A.,

AUDITOR'S REPORT TO THE MEMBERS OF THE GOVERNING BODY OF INDIAN ACADEMY OF SCIENCES, BANGALORE

We have audited the attached Balance Sheet of **INDIAN ACADEAMY OF SCIENCES,** C V Raman Avenue, Sadashivanagar, Bangalore - 560080 as at March 31, 2020, the Income & Expenditure Account for the year ended on that date and the Receipts and Payment account for the year ended on that date annexed thereto. These financial statements are the responsibility of the management of Indian Academy of Sciences. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with auditing, standards generally accepted in India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An Audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by Management as well as evaluating the overall financial statements presentation. We believe that our audit provides reasonable basis for our opinion.

We report that:

1. We have obtained all the information and explanations, which to the best of our knowledge and belief were necessary for the purpose of our audit.

2. In our opinion proper books of accounts as required by law have been kept by the Indian Academy of Sciences so for as it appears from our examination of those books.

3. The Balance Sheet, Income and Expenditure Account and Receipts and Payment account dealt with by this report are in agreement with the books of account.

4. The Balance Sheet and Income and Expenditure Account dealt with by this report are prepared in accordance with the Accounting Standards issued by the Institute of Chartered Accountants of India subject to the following observation:

- Non-Provisions of accrued liability in respect of leave encashment and gratuity which is not in conformity with the Accounting, Standard 15 [Accounting for retirement benefits in the financial statements of Employers] issued by the Institute of Chartered Accountants of India. [Refer Note No. 10 (b) of Schedule 24 and Note No. 03 of Schedule No.25]

.....2

G.R. VENKATANARAYANA Chartered Accountants BANGALORE

5. In our opinion and to the best of our information and according to the explanations given to us and subject to notes on accounts and our qualification in para 4 above, the said accounts give a true and fair view in conformity with the accounting principles generally accepted in India:

a) in the case of Balance Sheet, of the state of affairs of the Indian Academy of Sciences as at March 31, 2020; and

b) in the case of Income and Expenditure Account, of the excess of Income over Expenditure for the year ended on that date.

For M/s G R Venkatanarayana
Chartered Accountants
Firm Regn. No. 004616S

(G R Venkatanarayana)
Partner
Membership No. 018067
UDIN: 20018067AAAADW965

M/s. G.R. VENKATANARAYANA
Chartered Accountants
618, 75th Cross, 6th Block,
Rajajinagar, BANGALORE-560 010

Place: Bangalore
Date: 17.06.2020

INDIAN ACADEMY OF SCIENCES

C.V.RAMAN AVENUE BENGALURU-560 080

BALANCE SHEET AS AT 31ST MARCH 2020

(Amount in Rupees)

I CORPUS/CAPITAL FUND AND LIABILITIES	SCH	As at 31.3.2020	As at 31.3.2019
Corpus/Capital fund	1	24,62,87,690	22,99,02,797
Reserves and surplus	2		
Earmarked/endowment funds	3	25,34,45,904	22,91,84,506
Secured loans and borrowings	4		
Unsecured loans and borrowings	5		
Deferred credit liabilities	6		
Current liabilities and provisions	7	2,35,08,534	1,73,31,929
TOTAL		52,32,42,128	47,64,19,232
II ASSETS/APPLICATION OF FUNDS			
Fixed assets	8	9,73,92,012	9,80,34,753
Investments - from earmarked/endowment funds	9	18,64,78,982	17,67,36,212
Investments - others	10	9,27,20,947	7,99,03,525
Current assets, loans, advances etc.	11	14,64,96,187	12,15,64,742
Miscellaneous expenditure (to the extent not written off or adjusted)		1,54,000	1,80,000
TOTAL		52,32,42,128	47,64,19,232
Significant accounting policies	24		
Contingent liabilities and notes on accounts	25		

Place: Bengaluru
Date: 17.06.2020

As per our Report of even date
(for M/s. G.R. Venkatanarayana)
Chartered Accountants
Firm Regn. No. 004616S

(V A Raghunathan)
Treasurer

(N Maheshchandra)
Executive Secretary

(A Shashidhar)
Accounts Officer

(G.R.Venkatanarayana)
Partner
M. No. 018067

M/s. G.R. VENKATANARAYANA
Chartered Accountants
618, 75th Cross, 6th Block,
Rajajinagar, BANGALORE-560 010

INDIAN ACADEMY OF SCIENCES

C.V.RAMAN AVENUE BENGALURU-560 080

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2020

(Amount in Rupees)

A. INCOME	Sch	2019-20 Recurring grant DST	2019-20 Internally generated revenue/ Expenditure	2018-19 Recurring grant DST	2018-19 Internally generated revenue/ Expenditure
Income from sales/services	12	-	-	-	-
Grants/subsidies	13	12,34,75,979		15,24,94,451	-
Fees/subscriptions	14		1,27,89,362		1,49,06,096
Income from investments (income on investments from earmarked /endowment funds transferred to funds)	15		3,83,39,796	-	50,39,106
Income from royalty, publications etc.	16		3,36,63,491	-	2,91,79,620
Interest earned	17		13,46,592	-	11,56,407
Other income	18		27,66,168	-	23,85,146
Increase/Decrease in stock of finished goods and works-in-progress	19	-	-	-	-
TOTAL (A)		12,34,75,979	8,89,05,409	15,24,94,451	5,26,66,375
B. EXPENDITURE					
Establishment expenses	20	3,16,45,700	48,42,130	2,89,96,336	52,46,845
Other administrative expenses etc.	21	8,15,55,709	1,24,84,488	12,97,38,136	1,34,31,227
Expenditure on grants, subsidies etc.	22	-	-	-	-
Interest	23	-	-	-	-
Depreciation (Corresponding to Schedule 8)		54,12,105	-	57,40,452	-
TOTAL (B)		11,32,01,409	1,73,26,618	15,87,34,472	1,86,78,072
C. Surplus for the year (A-B)		1,02,74,570	7,15,78,791	(62,40,021)	3,39,88,303
D. Transfer to:					
a. Journal Archives,Science Education & Publication Fund		-	3,32,38,995	-	2,89,49,197
b. Raman Chair		-		-	-
TOTAL (D)		-	3,32,38,995	-	2,89,49,197
E. Transfer to Earmarked funds: (Being interest on investments)		-	2,28,03,419	-	64,57,940
TOTAL (E)		-	2,28,03,419	-	64,57,940
F. Balance Surplus transferred to Capital Fund 1/ Carried forward to next financial year (C-D-E)		1,02,74,570	1,55,36,377	(62,40,021)	(14,18,834)
Significant accounting policies	24				
Contingent liabilities and notes on accounts	25				

Place: Bengaluru
Date: 17.06.2020

(V A Raghunathan)
Treasurer

(N Maheshchandra)
Executive Secretary

(A Shashidhar)
Accounts Officer

As per our Report of even date
(for M/s. G.R. Venkatanarayana)
Chartered Accountants
Firm Regn. No. 004616S

(G.R.Venkatanarayana)
Partner
M. No. 018067

M/s. G.R. VENKATANARAYANA
Chartered Accountants
618, 75th Cross, 6th Block,
Rajajinagar, BANGALORE-560 010

INDIAN ACADEMY OF SCIENCES

C.V.RAMAN AVENUE, BENGALURU-560 080

RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDED 31ST MARCH 2020

(Amount in Rupees)

	Receipts	2019-20	2018-19		Payments	2019-20	2018-19
I	**Opening balance**			I	**Expenses**		
	a)Cash in hand	36,142	40,219		a) Establishment expenses (corresponding to Schedule 20)	3,85,07,343	3,41,00,910
	b)Bank balances	4,95,79,499	6,33,20,625		b) Administrative expenses (corresponding to Schedule 21)	8,43,11,180	13,24,10,327
II	**Grants received**						
	a) From Govt of India	13,67,46,000	13,15,87,000	II	**Payments made against funds for various projects**		
	b) From other sources						
III	**Income on investment**			III	**Investments and deposits made**	9,76,39,880	3,76,83,890
	a) Earmarked endowment funds	97,62,145	54,66,568				
	b) Own funds						
IV	**Interest received**			IV	**Expenditure on**		
	a) On bank deposits	71,46,198	61,03,330		a)Fixed assets	15,67,218	45,75,473
	b) Loans & advances etc				b)Capital work in progress	32,02,145	2,46,915
					c)Land		
V	**Other income / Receipts**	5,80,84,236	4,07,55,775				
				V	**Refund of surplus money/loans**		
VI	**Amount borrowed**						
				VI	**Finance charges (interest)**		
VII	**Any other receipts**						
				VII	**Other payments**	3,62,00,622	93,64,574
	a)Contribution to Scientific Research	20,000	30,000				
	b) Fellowship fees	83,200	59,800	VIII	**Closing balances**		
					a)Cash in hand	11,945	36,142
VIII	**Investments matured**	7,50,79,688	2,06,34,413		b)Bank balances	7,50,96,775	4,95,79,499
	TOTAL	**33,65,37,108**	**26,79,97,730**		**TOTAL**	**33,65,37,108**	**26,79,97,730**

Place: Bengaluru
Date 17.06.2020

(V A Raghunathan)
Treasurer

(N Maheshchandra)
Executive Secretary

(A Shashidhar)
Accounts Officer

As per our Report of even date
(for M/s. G.R. Venkatanarayana)
Chartered Accountants
Firm Regn. No. 004616S

(G.R.Venkatanarayana)
Partner
M. No. 018067

INDIAN ACADEMY OF SCIENCES

C.V.RAMAN AVENUE BENGALURU-560 080

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31.03.2020

(Amount in Rupees)

SCHEDULE 1: CORPUS/CAPITAL FUND	As at 31.3.2020		As at 31.3.2019	
a. Capital Fund 1 Account				
Balance as at the beginning of the year	10,49,39,030		10,71,06,507	
Add: Surplus under Internal Resource	1,55,36,377		(14,18,834)	
	12,04,75,407		10,56,87,673	
Deduct Deficit: Recurring Grant				
Deficit: under Internal Resource				
Expenditure met out of capital fund	7,69,379		7,48,643	
		11,97,06,028		10,49,39,030
b. Capital Grant balances				
As per previous balance sheet	1,66,39,352		1,55,42,740	
Add: Grant received from DST - Non Recurring Capital	70,30,000		59,19,000	
Interest on Capital during the year			-	
Less: Capital expenditure during the year	(47,69,363)		(48,22,388)	
Less: Transfer to Capital fund representing creation of assets		1,88,99,989	-	1,66,39,352
c. Capital Fund representing creation of Assets				
Opening balance	10,83,24,415		10,92,42,479	
Add: Additions during the year	47,69,363		48,22,388	
Less: Depreciation	(54,12,105)		(57,40,452)	
		10,76,81,673		10,83,24,415
BALANCE AS AT YEAR END		24,62,87,690		22,99,02,797

SCHEDULE 2: RESERVES AND SURPLUS	As at 31.3.2020	As at 31.3.2019
1.Capital Reserve:	-	-
As on 31 March 2019		
Addition during the year		
Less: Deductions during the year		
2.Revaluation Reserve:	-	-
As on 31 March 2019		
Addition during the year		
Less: Deductions during the year		
3.Special Reserves:	-	-
As on 31 March 2019		
Addition during the year		
Less: Deductions during the year		
4.General Reserve		
As on 31 March 2019		
Surplus during the year		
Less: Deductions during the year		
BALANCE AS AT YEAR END	-	-

(Amount in Rupees)

SCHEDULE 3: EARMARKED / ENDOWMENT FUNDS	FUND-WISE BREAKUP					TOTAL	
	LCF	RC	JC	RF	JASP	2019-20	2018-19
a) Opening balance of the funds	10,17,094	1,10,85,746	59,44,262	6,28,279	21,05,09,125	22,91,84,506	20,23,51,585
b) Additions to the funds:						-	
i.Donations /Grants				20,000		20,000	30,000
ii.Income from investments made on account of funds		6,16,842	2,73,281		88,82,689	97,72,812	54,66,568
iii. Accrued income from investments	73,250	1,12,456	81,845	34,738	68,30,737	71,33,026	9,20,830
iv.Other additions (Transfers)					3,32,38,995	3,32,38,995	2,89,71,654
v.Entrance Fee collected from Fellows	83,200					83,200	59,800
TOTAL (a+b)	11,73,544	1,18,15,044	62,99,388	6,83,017	25,94,61,546	27,94,32,539	23,78,00,437
c) Utilisations/expenditure towards objectives of funds					-	-	
i.Donations /Grants	-	-	-	-	-	-	-
Fixed assets						-	
						-	
ii.Revenue Expenditure	-	-	-	-	-	-	-
Salaries, wages and allowances, etc.	-	-	-	-	-	-	-
Rent	-	-	-	-	-	-	-
Others	-	-	-	-		-	69,61,638
Expenses on Raman Chair, Jubilee Chair & JASP	-	3,02,809	3,80,661	-	2,53,03,165	2,59,86,635	16,54,293
TOTAL (c)	-	3,02,809	3,80,661	-	2,53,03,165	2,59,86,635	86,15,931
NET BALANCE AT THE YEAR-END (a+b)-(c)	11,73,544	1,15,12,235	59,18,727	6,83,017	23,41,58,381	25,34,45,904	22,91,84,506

Note: LCF - Life Composition Fee; RC - Raman Chair; JC - Jubilee Chair; RF- Research Fund; JASP - Journal Archives, Science Education & Publication Fund

SCHEDULE 4: SECURED LOANS AND BORROWINGS:	As at 31.3.2020	As at 31.3.2019
1.Central Government		
2.State Government		
3.Financial Institutions		
a) Term loans		
b) Interest accrued and due		
4.Banks:		
a) Terms loans	-	-
Interest accrued and due		
b) Other loans		
Interest accrued and due		
5.Other institutions and agencies		
6.Debentures and bonds		
7.Others		
TOTAL	-	-

Note: Amounts due within one year

SCHEDULE 5: UNSECURED LOANS AND BORROWINGS	As at 31.3.2020	As at 31.3.2019
1.Central Government		
2.State Government		
3.Financial Institutions		
4.Banks:		
a) Terms loans		
Interest accrued and due	-	-
b) Other loans		
5.Other institutions and agencies		
6.Debentures and bonds		
7.Fixed deposits		
8.Others		
TOTAL		

Note: Amounts due within one year

SCHEDULE 6: DEFERRED CREDIT LIABILITIES	As at 31.3.2020	As at 31.3.2019
a) Acceptances secured by hypothication of capital equipment and other assets	-	-
b) Others		
TOTAL		

Note: Amounts due within one year

SCHEDULE 7: CURRENT LIABILITIES AND PROVISIONS	As at 31.3.2020	As at 31.3.2019
A.CURRENT LIABILITIES		
1.Acceptances		-
2.Sundry creditors:		
a) For Goods/Printing expenses	-	-
b) Others/Security deposit	3,69,000	1,52,666
c) Earnest Money deposit	2,82,500	3,54,250
d) Science Education Programme	77,729	24,22,184
e) Staff - Medical expenses & Others	1,08,786	83,654
f) Due to parties/fellows	54,87,937	52,87,045
3.Advances received (Subscriptions)	29,48,334	1,06,75,107
4.Interest accrued but not due on:		
a) Secured loans/borrowings		-
b) Unsecured loans/borrowings		-
5.Statutory liabilities:		
a) TDS- Vendors	75,905	54,379
b) TDS : Rent	852	2,289
c) TDS : Professional fees	90,700	29,175
d) GST	6,840	
6.Other current liabilities:		
a) Due to DST	4,25,478	17,61,091
b) Recurring grants pending Utilisation	1,02,74,570	(62,40,021)
c) Professional Tax		-
d) Interest on DST grant-To remit to Consolidated Fund of India	30,33,438	25,61,777
TOTAL (A)	2,31,82,069	1,71,43,596
B.PROVISIONS:		
1.For taxation	-	-
2.Gratuity	-	-
3.Superannuation / pension	-	-
4.Accumulated leave/encashment	-	-
5.Trade warranties/claims	-	-
6.DA Arrears payable to staff	-	1,70,131
7.NSDL-Tier 1 Remitence	3,26,465	18,202
8.Others		-
TOTAL (B)	3,26,465	1,88,333
TOTAL (A+B)	2,35,08,534	1,73,31,929

SCHEDULE 8:- FIXED ASSETS

(Amount in Rupees)

DESCRIPTION	GROSS BLOCK			DEPRECIATION				NET BLOCK	
	Cost as at beginning of the year	Additions\(Deletions) during the year	Cost at the year end	As at beginning of the year	Rate of Depreciation	Additions\ (Deletions) during the	Total up to the year end	As at the current year end	As at the previous year end
A. FIXED ASSETS:									
1. Land:									
a) Freehold	1,58,87,217		1,58,87,217				-	1,58,87,217	1,58,87,217
b) Leasehold							-	-	
2. Buildings	-						-	-	
a) On freehold land	8,98,09,472		8,98,09,472	2,27,42,558	2.5%	22,48,584	2,49,91,142	6,48,18,330	6,70,66,914
b) On leasehold land							-	-	
c) Ownership flats/premises							-	-	
d) Superstructures on land not belonging to the entity	-						-	-	
3. Plant, machinery and equipment	-						-	-	
4. Vehicles	-						-	-	
5. Furniture, fixtures, equipment & Computer/peripherals	5,07,52,944	11,98,474	5,19,51,418 -	3,70,93,657	10%	27,06,903	3,98,00,560 -	1,21,50,858 -	1,36,59,287
6. Electric installations	-		-				-	-	
7. Library books	14,76,868	-	14,76,868 -	13,96,709	10%	37,554	14,34,263 -	42,605 -	80,158
8. Tube wells & water supply							-	-	
9. Other fixed assets									
Rainwater harvesting	18,42,110		18,42,110	17,71,780	10%	23,443	17,95,223	46,887	70,330
10. Software		3,68,744	3,68,744		100%	3,68,744	3,68,744	-	
11. Civil Works	10,75,055		10,75,055 -	51,123	2.5%	26,877	78,000 -	9,97,055 -	1023932
TOTAL (A)	16,08,43,666	15,67,218	16,24,10,884	6,30,55,827		54,12,105	6,84,67,932	9,39,42,952	9,77,87,838
B. CAPITAL WORK IN PROGRESS									
1. Civil & interior works-1st & 2nd Floor	2,46,915	32,02,145	34,49,060					34,49,060	2,46,915
TOTAL (B)									
GRAND TOTAL	16,10,90,581	47,69,363	16,58,59,944	6,30,55,827		54,12,105	6,84,67,932	9,73,92,012	9,80,34,753

SCHEDULE 9: INVESTMENTS EARMARKED/ENDOWMENT FUNDS	As at 31.3.2020	As at 31.3.2019
1.In Government securities	-	-
2.Other approved securities	-	-
3.Shares	-	-
4.Debentures and bonds	-	-
5.Subsidiaries and joint ventures	-	-
6.Fixed deposits in Banks	15,50,65,423	11,29,32,756
7.Investments in UTI Schemes	3,14,13,559	6,38,03,456
TOTAL	18,64,78,982	17,67,36,212

SCHEDULE 10: INVESTMENTS - OTHERS	As at 31.3.2020	As at 31.3.2019
1.In Government securities	-	-
2.Other approved securities	-	-
3.Shares	-	-
4.Debentures and bonds		-
5.Subsidiaries and joint ventures		-
6.Fixed deposits in Banks	5,63,42,947	6,34,03,525
7.Investments in UTI Schemes	3,63,78,000	1,65,00,000
TOTAL	9,27,20,947	7,99,03,525

SCHEDULE 11: CURRENT ASSETS, LOANS AND ADVANCES	As at 31.3.2020		As at 31.3.2019	
A. CURRENT ASSETS:				
1.Inventories:				
a) Stores and spares				
b) Loose tools				
c) Stock-in-trade				
d) Stock on stamps, stationery and paper		1,25,187		10,96,063
2.Sundry debtors				
a) Debts outstanding for less than six months	3,07,03,735		2,72,24,910	
b) Debts outstanding for more than six months	85,702	3,07,89,437	85,702	2,73,10,612
3. TDS Receivable				
a) Less than six months	34,85,957		29,36,066	
b) More than six months	75,80,531	1,10,66,488	99,03,066	1,28,39,132
4.Cash balances in hand		11,945		36,142
(including cheques/drafts and imprest)				
5.Bank balances:				
a) With scheduled banks:				
On current accounts				
On savings bank accounts				
i) SBI, Sadashivnagar a/c no 10356553343	2,15,112		55,27,742	
ii) SBI, Sadashivnagar a/c no 30712324923	1,24,402		1,47,734	
iii) SBI, Sadashivnagar a/c no 33251454227	14,61,646		2,96,128	
iv) SBI, Sadashivnagar a/c no 33251455185	6,57,652		7,06,855	
v) Union Bank of India a/c no 392002010008130	11,37,963		14,01,040	
On deposit accounts with UBI (includes margin money)	7,15,00,000	7,50,96,775	4,15,00,000	4,95,79,499
On savings accounts				
b) With non-scheduled banks:				
On current accounts				
On deposit accounts				
On savings accounts				
6. Post Office-savings accounts				-
SUB TOTAL (A)		11,70,89,832		9,08,61,448

SCHEDULE 11: CURRENT ASSETS, LOANS, ADVANCES ETC.	As at 31.3.2020		As at 31.3.2019	
B. LOANS, ADVANCES AND OTHER ASSETS				
1.Loans:				
a) Staff	2,95,002		80,300	
b) Other entities engaged in activities/objectives similar to that of the entity	20,28,425		1,06,25,869	
c) Others		23,23,427	-	1,07,06,169
2. Advances and other amounts recoverable in cash or in kind or for value to be received:				
a) On capital account			-	
b) Prepayments	1,93,259		3,36,168	
c) Others	8,07,210		25,82,460	
		10,00,469		29,18,628
3.Income Accrued:				
a) On investments from earmarked/endowment funds	1,67,81,848		96,81,835	
b) On investments-others	93,00,611		73,96,662	
c) On loans and advances		2,60,82,459		1,70,78,497
d) Others				
SUB TOTAL (B)		2,94,06,355		3,07,03,294
TOTAL (A+B)		14,64,96,187		12,15,64,742

INDIAN ACADEMY OF SCIENCES

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(Amount in Rupees)

SCHEDULE 12: INCOME FROM SALES/SERVICES	2019-20	2018-19
1.Income from sales		
a) Sale of finished goods		
b) Sale of raw materials		
c) Sale of scrap		
2.Income from Services		
a) Labour and processing charges		
b) Professional/consultancy services		
c) Agency commission and brokerage		
d) Maintenance services (equipment/property)		
e) Others		
TOTAL		

SCHEDULE 13: GRANTS/SUBSIDIES	2019-20	2018-19
(Irrevocable grants & subsidies received)		
1.Central Government		
Plan - DST (including carry forward of 2018-19)	12,34,75,979	15,42,03,081
Special Component Plan for Scheduled Caste		(17,08,630)
INSA, New Delhi		
NASI, Allahabad		
Grant - Inspire		
TOTAL	12,34,75,979	15,24,94,451

SCHEDULE 14: FEES/SUBSCRIPTIONS	2019-20	2018-19
1.Entrance fees		
2.Annual fees/subscriptions	1,27,89,362	1,49,06,096
3.Seminar/Programme fees		
4.Consultancy fees		
5.Others		
TOTAL	1,27,89,362	1,49,06,096

SCHEDULE 15: INCOME FROM INVESTMENTS	Investment - Earmarked funds		Investment others	
	2019-20	2018-19	2019-20	2018-19
1.Interest				
a) On Govt. securities				
b) Other bonds/debentures				
c) Banks and Financial Institutions	2,28,03,419	64,57,940	1,55,36,377	(14,18,834)
2.Dividends:				
a) On shares				
b) On mutual fund securities				
3.Rents				
4.Others				
TOTAL	2,28,03,419	64,57,940	1,55,36,377	(14,18,834)

SCHEDULE 16: INCOME FROM ROYALTY, PUBLICATIONS ETC.	2019-20	2018-19
1.Income from royalty (Springer)	3,32,38,995	2,89,49,197
2.Other royalty	8,789	3,666
3.Income from publications		
i.Special publications	2,53,825	1,53,970
ii.Off-prints		-
iii.Back volumes/Previous year publication	1,61,882	72,787
TOTAL	3,36,63,491	2,91,79,620

SCHEDULE 17: INTEREST EARNED	2019-20	2018-19
1.On term deposits:		
a) With scheduled banks		
b) With non-scheduled banks		
c) With institutions		
d) Others		
2.On Savings accounts:		
a) With scheduled banks-Non-Plan	5,24,956	11,53,532
b) With scheduled banks-Plan		-
c) With non-scheduled banks		
d) Post office savings accounts		
e) Others		
3.On Loans:		
a) Employees	5,400	2,875
b) Others		
4. Interest on IT Refund	8,16,236	
5.Interest on debtors and other receivables		
TOTAL	13,46,592	11,56,407

SCHEDULE 18: OTHER INCOME	2019-20	2018-19
1.Profit on sale/disposal assets:		
a) Owned assets		
b) Assets acquired out of grants, or received free of cost		
2.Export incentives realized		
3.Fees for miscellaneous services		-
4.Licence fee receipts		864
5. Rent for Guest House/Council Room/Auditorium (User Charges)	22,12,084	20,75,822
6. Electricity charges		-
7.Miscellaneous income	13,000	27,593
8.Tender Fees	14,000	53,000
9.Administrative charges from CSA	5,27,084	2,27,867
TOTAL	27,66,168	23,85,146

SCHEDULE 19: INCREASE/(DECREASE) IN STOCK OF FINISHED GOODS & WORK IN PROGRESS	2019-20	2018-19
A) Closing Stock		
Finished goods		
Work-in-progress	-	-
B) Less: Opening Stock		
Finished goods		
Work-in-progress		
NET INCREASE/(DECREASE) [A-B]	-	-

SCHEDULE 20: ESTABLISHMENT EXPENSES	2019-20		2018-19	
	Recurring Grant	Expenditure met out of Internal	Recurring Grant	Expenditure met out of Internal
a) Salaries and wages	3,16,45,700	18,77,238	2,89,96,336	37,22,837
b) Special component expenditure for schedule caste			-	
c) Allowances and bonus				-
d) Staff welfare expenses		12,26,664		4,14,375
e) Expenses on employees' retirement and terminal benefits	18,75,778		-	
f) Medical expenses		17,38,208		11,09,633
TOTAL	3,35,21,478	48,42,130	2,89,96,336	52,46,845

SCHEDULE 21: OTHER ADMINISTRATIVE EXPENSES ETC.	2019-20		2018-19	
A. Recurring Grant				
a) Annual/mid year/Editorial/Council/Sectional committee meetings/C R Rao Conference	1,31,04,168		1,42,65,942	
b) Discussion meetings	8,71,885	1,39,76,053	13,09,987	
c) Science education programme				1,55,75,929
i) Summer research fellowships	4,88,56,408		3,80,17,228	
ii) Lecture workshops	39,52,803		2,12,36,921	
iii) Refresher courses	85,76,419		2,85,83,934	
iv) SRF selection committee expenses	6,42,431	6,20,28,061	7,66,168	8,86,04,251
d) Upgradation of internet link			3,53,988	
e) Property tax	2,76,209		2,73,524	
f) Publication of journals	2,63,40,842		2,26,41,893	
g) Advertisement expenses	1,26,972		1,68,731	
h) Panel on women in science			-	
i) Expenditure on social media management	35,997		3,33,650	
j) Public lecture expenses	1,28,282		1,50,819	
k) Expenditure on official language implementation	92,698		2,35,427	
l) Installation of LED lights	-		1,32,052	
m) Expenditure on Fellows repository	22,367		2,84,486	
n) Time Share in Orange County Written off	26,000		26,000	
o) National Science Day	54,169		16,975	
p) Cloud Service	2,21,953		-	
q) Horticulture/Gardening expenses			53,532	
r) Education policy meeting			11,828	
s) Ethics Committee meeting	22,236		42,161	
t) TA/DA			54,090	
u) Expenditure on software maintenance	7,08,000		7,78,800	
		2,80,55,725		2,55,57,956
TOTAL (A)		10,40,59,839		12,97,38,136
Total expenditure incurred		10,59,35,617		12,97,38,136
Less : Expenditure met out of JASP fund		2,43,79,908		-
Net Expenditure Incurred General Component		8,15,55,709		12,97,38,136

SCHEDULE 21 : Continued	2019-20		2018-19	
B.Expenditure met out of Internal Resource				
a) Telephones	3,20,505		2,57,527	
b) AMC expenses	8,38,257		9,92,941	
c) Stationery	2,58,473		4,50,852	
d) Traveling/conveyance	5,28,891		4,79,484	
e) Audit fee	35,400		35,400	
f) Packing and forwarding	1,05,016		8,07,161	
g) Bank charges	18,969		32,747	
h) Miscellaneous expenses	3,11,581		4,37,406	
i) Newspaper and books	37,548		47,305	
j) Postage	25,91,017		29,91,982	
k) Upkeep of building	23,22,912		21,01,094	
l) Upkeep of equipment	3,57,130		2,92,603	
m) Maintenance of guest house- Jalahalli	44,10,891		42,09,136	
n) Diary/Calendar	89,090		81,943	
o) IT Services			35,400	
p) NSDL Quarterly maintenance charges	5,936		3,429	
q) Quarterly filing charges of 24Q & 26Q	28,115		22,412	
r) Special Publication	7,500		-	
s) Legal fees	25,000		45,000	
t) GST/Income Tax Consultancy charges	72,740		23,600	
u) Wi-fi charges	1,14,517		83,805	
v) Indian Science Congress Meeting	5,000		-	
TOTAL (B)		1,24,84,488		1,34,31,227
TOTAL (A+B)		11,65,44,327		14,31,69,363

SCHEDULE 22: EXPENDITURE ON GRANTS, SUBSIDIES ETC.	2019-20	2018-19
a) Grants given to institutions/organizations		
b) Subsidies given to institutions/organizations	-	-
TOTAL		

Note:- Name of the entities, their activities along with the amount of grants/subsidies are to be disclosed.

SCHEDULE 23: INTEREST	2019-20	2018-19
a) On fixed loans		
b) On other loans (including bank charges)	-	-
c) Others		
TOTAL		

INDIAN ACADEMY OF SCIENCES

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STATEMENT SHOWING DEFICIT/SURPLUS UNDER RECURRING & NON-RECURRING GRANT FOR THE YEAR ENDED 31ST MARCH 2020

(Rs. in lakhs)

Sl.No	Grants	Opening balance	Grant-in-aid received during the year	Total grant available	Actual expenditure	(Deficit) or Surplus
1	Non-Recurring Capital Component	166.39	70.30	236.69	47.69	189.00
2	Recurring General Component	(241.97)	1076.93	834.96	815.56	19.40
3	Recurring Salaries Component	179.57	220.23	399.80	316.46	83.34
Total		103.99	1367.46	1471.45	1179.71	291.74
Less: Surplus under Capital						189.00
Surplus as per income and expenditure account						102.74

Place: Bengaluru
Date: 17.06.2020

As per our Report of even date
(for M/s. G.R. Venkatanarayana)
Chartered Accountants
Firm Regn. No. 004616S

(V A Raghunathan)
Treasurer

(N Maheshchandra)
Executive Secretary

(A Shashidhar)
Accounts Officer

(G.R.Venkatanarayana)
Partner
M. No. 018067

M/s. G.R. VENKATANARAYANA
Chartered Accountants
618, 75th Cross, 6th Block,
Rajajinagar, BANGALORE-560 010

INDIAN ACADEMY OF SCIENCES, BENGALURU

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020

SIGNIFICANT ACCOUNTING POLICIES AND NOTES ON ACCOUNTS:

OVERVIEW:

The Indian Academy of Sciences (IAS) is registered as a society under the Karnataka Societies Registration Act, 1960, dated 24th April 1934 and also registered under Section 12A of the Income Tax Act, 1961. It is an autonomous institution recognized and substantially funded by the Department of Science and Technology, Government of India.

The main objects of the Academy, inter-alia, are to promote research in pure and applied branches of science, publish work relating to scientific research initiated by the Academy, conduct/ organize seminars, lecture meetings for dissemination of knowledge on pure sciences.

SCHEDULE 24: SIGNIFICANT ACCOUNTING POLICIES:

Basis of Preparation of Financial Statements:

1. Accounting Conventions:

a) The financial statements are drawn up in accordance with the historical accounting convention and on the going concern concept. Accrual system of accounting is followed to record Income and Expenditure for the year, except in case of Income from Investments in Mutual Fund, which is accounted on cash basis.

b) The guidelines as per the Uniform Format of Accounts for Central Autonomous Institutions, as applicable and to the extent practicable, are followed in the presentation of the financial statements of the Academy.

2. Revenue Recognition:

a) Entrance Fee Collected from Fellows is credited to Life Composition Fee. This practice has been consistently followed by the Academy.

b) Annual Fees/Subscription is recognized as income on accrual basis.

c) Income from Publications is recognized as income as and when the publications are sold.

3. Allocation/Transfers to Earmarked Funds:

The Academy has a policy to transfer interest to Earmarked Funds to recognize the interest attributable to those Funds. Specific expenses related to such Funds are appropriated in the respective earmarked fund as has been consistently followed.

4. Fixed assets:

Fixed assets are stated at Cost less Depreciation. Fixed assets are accounted at cost of acquisition, inclusive of inward freight, duties, taxes and incidental expenses related to acquisition.

5. Investments:

Investments are stated at cost. Interest on Bank Fixed Deposits is accounted on accrual basis and Income from Mutual Funds is accounted on receipt basis.

6. Government Grants:

a) The Grants received from the DST are accounted on realization basis and the same are accounted and separately shown under Recurring Grant and Internal Resource in Annual Accounts of the Academy.

b) The Grants received from the DST for meeting recurring expenditure like Salaries and Other Administrative expenses are credited to the Income and Expenditure account and Grants received for the purpose of meeting capital expenditure is credited to the Capital Fund -2 Account.

c) The unutilized Grant is recognized as a liability and shown under "Current Liabilities".

7. Prior Period Items:

Prior period items, which has arisen in the current period are recognized as and when they arise and are shown separately.

8. Depreciation:

Depreciation is provided on Straight Line Method at rates as stated in Fixed Assets Schedule. Depreciation is charged at 100% on fixed assets costing less than Rs.10,000/- each during the year. Depreciation on additions is charged for the full year irrespective of the date of addition during the year.

9. Foreign Exchange Transactions:

Subscriptions received in foreign currency during the year are accounted on realization, at the rates prevailing on the date of realization.

10. Retirement Benefits:

a) Provident Fund contributions are recovered and remitted as per the General Provident Fund Rules as applicable to the Govt. employees.

b) No provision has been made in respect of the Leave Encashment and Gratuity liability in the accounts as required by AS 15. However, the same is accounted on cash basis as and when the liability is discharged.

11. Income Tax:

The Academy is registered under Section 12A of the Income Tax Act, 1961 and is eligible for exemption from income tax and hence no provision has been made towards Income tax.

As per our report of even date,
For M/s G R Venkatanarayana
Chartered Accountants
Firm Regn. No. 004616S

(V A Raghunathan)	(N Maheshchandra)	(A Shashidhar)	(G R Venkatanarayana)
Treasurer	Executive Secretary	Accounts Officer	Partner
			M. No. 018067

M/s. G.R. VENKATANARAYANA
Chartered Accountants
618, 75th Cross, 6th Block,
Rajajinagar, BANGALORE-560 010

Place: Bengaluru
Date: 17.06.2020

INDIAN ACADEMY OF SCIENCES, BENGALURU

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020

SCHEDULE 25: NOTES ON ACCOUNTS:

1. Contingent Liabilities: Rs. Nil (Previous Year: Rs. Nil)

2. Claims against the Academy not acknowledged as debts: Rs. Nil (Previous Year: Rs. Nil)

3. In respect of the retirement benefits (Gratuity, leave encashment) to the employees, the Academy is awaiting approval from DST for creation of separate funds for meeting the future liability. However, the same is accounted on cash basis as and when the payments are made on retirement of employees.

4. Figures are rounded off to the nearest rupee and figures of previous year have been regrouped and reclassified to conform to that of the current year.

5. Schedules 1 to 25 are annexed to and form an integral part of the Balance Sheet as at 31st March 2020 and the Income and Expenditure Account for the year ended on that date.

As per our report of even date,
For M/s G R Venkatanarayana
Chartered Accountants
Firm Regn. No. 004616S

(V A Raghunathan)
Treasurer

(N Maheshchandra)
Executive Secretary

(A Shashidhar)
Accounts Officer

(G R Venkatanarayana)
Partner
M. No. 018067

M/s. G.R. VENKATANARAYANA
Chartered Accountants
618, 75th Cross, 6th Block,
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Place: Bengaluru
Date: 17.06.2020