Developments in SCIENCE AND TECHNOLOGY

2017
Editor’s Note

We take this opportunity to thank our readers for the appreciation they have shown for our previous editions of *Developments in Science and Technology*. The subject is an evolving one and several new discoveries and innovations take place all the time. We have done our best to select items of striking importance as well as those that have an Indian contribution. So this edition too is revised and enlarged.

Besides discussing in detail the core science and technology issues in the ‘hi-tech’ fields of *space research*, *nuclear research*, *information technology*, *earth and ocean sciences*, *energy*, and *biotechnology*, the book also covers some important topics of socio-economic nature from the point of view of S&T inputs, such as *healthcare and medicine*, *ecology* and *environment*, *agriculture*, *rural development*, and *industry*.

An effort has been made – within the constraints of space and the speed at which new developments take place – to elucidate the principles, concepts and terms associated with each topic in general besides the research developments. At the same time, when scientific endeavours are discussed, research and innovations that India has developed and whatever is relevant to India and the ‘indigenisation’ have been placed in context. The information – which is vast – has been presented in a concise and easy-to-understand way.

The section on *Recent Developments and Issues* in the Appendix, as the name suggests, presents a selection of ongoing research efforts in different fields which have given rise to new ideas, new terms, and fresh application of scientific principles and concepts in the development of new products and processes. Several products have been discussed that have been the outcome of industrial research the world over, and particularly in India. In the process, the section also
serves to update the matter in the other chapters. Certain issues of current relevance pertaining to scientific and technological developments have also been discussed.

The general reader will find the book most informative; but for the candidates of competitive examinations and job interviews that call for an advanced awareness of developments in the scientific and technological fields, this book is bound to be most useful.

Suggestions to improve the book are most welcome.

Kalpana Rajaram
August 2017
## CONTENTS

1. **Introduction**  
   - The Nature of Science and Technology  
   - S&T in India: Historical Perspective  
   - Science and Planning  
   - S&T Policies in Independent India  
   - S&T Infrastructure in India  
   - Department of Science and Technology  
   - Why India Lags Behind in Research and Innovation  

   **Box**  
   - Major Historical Scientific Achievements in India  

2. **Ecology and Environment**  
   - Concepts  
     - *Ecology*  
     - *Environment*  
   - Human Impact on Ecology and Environment  
     - Modification of Landforms  
     - Degradation of Slopes  
     - Wind Erosion  
     - Modification of Hydrological Processes  
     - Coastal Erosion and Deposition  
     - Modification of River Processes  
     - Modification due to Subsurface Human Activities  
     - Modification of Periglacial Environment  
     - Modification of the Atmosphere  
     - Simplification of Ecosystems  
     - Introduction of Alien Species
## Contents

- **Extinction of Species** 33
- **Eutrophication** 34
- **Deterioration of Natural Resources** 34

**Pollution** 34

1. **Air Pollution** 35
   - Causes and Sources 35
   - Impact 36
   - Indoor Air Pollution 37
   - Controlling Measures 39

2. **Water Pollution** 40
   - Sources 40
   - Types of Water Pollutants 40
   - Indicators of Water Pollution 41
   - Designated Best Uses of Water 42
   - Water Quality Standards in India 42
   - Controlling Water Pollution 43
   - Thermal Pollution 43
   - Effects of Water Pollution 43
   - Groundwater Pollution 44
   - Anoxic Water, Hypoxic Water, and Dead Zones in Oceans 46
   - The Problem of Oil Spills 48
   - Coral Bleaching 50

3. **Radioactive Pollution** 52

4. **Noise Pollution** 53
   - Controlling Noise Pollution 54

5. **Pesticide Pollution** 55
   - Biopesticides 57

**Management of Waste** 60

- Landfills 60
- Incineration 60
- Pyrolysis 60
- Hazardous Waste and its Management 60
- e-Waste and its Management 61

**Biodiversity** 63

- Species Richness and Distribution 63
- Importance of Biodiversity 64
- Threats to Biodiversity 65
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>How Human Activity Affects Biodiversity</td>
<td>66</td>
</tr>
<tr>
<td>Biodiversity Hotspots</td>
<td>69</td>
</tr>
<tr>
<td>Wetlands (including Mangroves and Coral Reefs)</td>
<td>73</td>
</tr>
<tr>
<td>Mangroves</td>
<td>75</td>
</tr>
<tr>
<td>Coral reefs</td>
<td>75</td>
</tr>
<tr>
<td>Forests</td>
<td>76</td>
</tr>
<tr>
<td>Wildlife</td>
<td>77</td>
</tr>
<tr>
<td>Biodiversity Treaty</td>
<td>78</td>
</tr>
<tr>
<td>International Conventions Related to Wildlife</td>
<td>79</td>
</tr>
<tr>
<td>Climate Issues</td>
<td>80</td>
</tr>
<tr>
<td>Evidence for Climate Change in the Past</td>
<td>80</td>
</tr>
<tr>
<td>History of Climate Change</td>
<td>82</td>
</tr>
<tr>
<td>Natural Causes for Climate Change</td>
<td>83</td>
</tr>
<tr>
<td>Human Causes of Climate Change</td>
<td>84</td>
</tr>
<tr>
<td>The IPCC Fourth Report on Climate Change</td>
<td>85</td>
</tr>
<tr>
<td>Fifth UNIPCC Assessment Report</td>
<td>86</td>
</tr>
<tr>
<td>Importance of The Ozone Layer</td>
<td>88</td>
</tr>
<tr>
<td>Montreal Protocol</td>
<td>90</td>
</tr>
<tr>
<td>Global Environment Facility (GEF)</td>
<td>90</td>
</tr>
<tr>
<td>Climate Change Convention</td>
<td>91</td>
</tr>
<tr>
<td>Global Warming: Evidence and Impact</td>
<td>93</td>
</tr>
<tr>
<td>Effects of Sea Level Rise</td>
<td>95</td>
</tr>
<tr>
<td>Indian Legislation, Policies and Programmes</td>
<td>96</td>
</tr>
<tr>
<td>Environmental Awareness and India</td>
<td>96</td>
</tr>
<tr>
<td>Environment Policy 2006</td>
<td>97</td>
</tr>
<tr>
<td>Government Infrastructure and Research Initiatives</td>
<td>97</td>
</tr>
<tr>
<td>Environmental Protection Act</td>
<td>98</td>
</tr>
<tr>
<td>National Green Tribunal Act</td>
<td>100</td>
</tr>
<tr>
<td>National Green Tribunal Launched</td>
<td>101</td>
</tr>
<tr>
<td>Environmental Impact Assessment</td>
<td>102</td>
</tr>
<tr>
<td>Environment Action Programme</td>
<td>102</td>
</tr>
<tr>
<td>Biodiversity Act</td>
<td>103</td>
</tr>
<tr>
<td>Tribals’ Forest Rights Act</td>
<td>104</td>
</tr>
</tbody>
</table>
Wildlife Protection Act 105
Conservation of Wild Animals 108
Biosphere Reserves 109
Conservation of Wetlands 110
Pollution and its Control 110
Integrated Coastal Zone Management 118
India’s National Plan on Climate Change 119

Boxes
Terms to Remember 26
Algal Bloom 46
Pollutants and Their Effect on the Marine Environment 47
First Genetically-Engineered Microbe to Tackle Oil Spills 49
Sources and Impacts of Selected Pollutants 56
Terms to Remember 58
Green Chemistry 62
Bio-degradable Plastics 62
India’s Hotspots 73
Environmental Impact of Various Projects 79
About the IPCC Report 88
Ozone Depleting Substances 89
Selected examples of key sectoral mitigation technologies, policies and measures 92
Protecting the Taj 115
Indian emission standards for 4-wheel vehicles 116

3. Earth Sciences 125
Weather Forecasting and Climate Research in India
Weather Research Organisations 126
S&T Application in Weather Forecasting 127
Forecasting the South-West Monsoon 129
### Contents

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scramble for Arctic Resources</td>
<td>155</td>
</tr>
<tr>
<td>Marine Archaeological Findings in the Gulf of Cambay</td>
<td>156</td>
</tr>
<tr>
<td>How Monuments Have Resisted Quakes</td>
<td>159</td>
</tr>
<tr>
<td>Some Earthquake-Resistant Building Techniques</td>
<td>160</td>
</tr>
<tr>
<td><strong>4. S&amp;T in Agriculture and Rural Development</strong></td>
<td>169</td>
</tr>
<tr>
<td>Basic Resources of Agriculture</td>
<td>169</td>
</tr>
<tr>
<td>Soil</td>
<td>169</td>
</tr>
<tr>
<td>Water</td>
<td>170</td>
</tr>
<tr>
<td>Seeds</td>
<td>172</td>
</tr>
<tr>
<td>Agrotechniques</td>
<td>172</td>
</tr>
<tr>
<td>1. Cropping Systems</td>
<td>172</td>
</tr>
<tr>
<td>2. Fertiliser Use</td>
<td>173</td>
</tr>
<tr>
<td>3. Crop Protection</td>
<td>176</td>
</tr>
<tr>
<td>Environment-Friendly Agriculture</td>
<td>177</td>
</tr>
<tr>
<td>Organic Farming</td>
<td>178</td>
</tr>
<tr>
<td>Organic/Natural Fertilisers</td>
<td>181</td>
</tr>
<tr>
<td>Biopesticides</td>
<td>183</td>
</tr>
<tr>
<td>Sustainable Agriculture</td>
<td>184</td>
</tr>
<tr>
<td>S&amp;T Advancements in Agricultural Produce in India</td>
<td>185</td>
</tr>
<tr>
<td>Crop Production</td>
<td>185</td>
</tr>
<tr>
<td>Horticulture</td>
<td>188</td>
</tr>
<tr>
<td>Genetically Modified Crops:</td>
<td>189</td>
</tr>
<tr>
<td>Biosafety and Regulation</td>
<td></td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>191</td>
</tr>
<tr>
<td>Cattle</td>
<td>191</td>
</tr>
<tr>
<td>Sheep and Goats</td>
<td>192</td>
</tr>
<tr>
<td>Poultry</td>
<td>193</td>
</tr>
<tr>
<td>Fisheries</td>
<td>194</td>
</tr>
<tr>
<td>Agriculture in Special Areas</td>
<td>196</td>
</tr>
<tr>
<td>Agriculture in Hot and Arid Lands</td>
<td>196</td>
</tr>
<tr>
<td>Rainfed/Dryland Farming</td>
<td>196</td>
</tr>
<tr>
<td>Hill Farming</td>
<td>197</td>
</tr>
</tbody>
</table>
## Contents

- Climate-Smart Agriculture 198  
  *Agricultural Machinery* 201  
- Research, Education, Transfer of Technology in India 201  
  *Vision 2050* 204  
  *ICAR Initiatives* 204  
  *Promoting Innovations* 205  
- S&T and Rural Development in India 205  
  *Rural Technology Park and Indigenous Technology* 206  

### Boxes
- Soil and Water Conservation Efforts 171  
- Roles of Essential Elements 174  
- Neem-Coated Urea 175  
- Mridapurikshak: Soil Test Kit 175  
- Organic Food Products 181  
- Vermiculture 182  
- Types of Biofertilisers 183  
- GM Crops 190  
- Remote Sensing Technology to Help Assess Crop Loss Data 203  

## 5. Industry 208  
- Major R&D Infrastructure in India 208  
  *Department of Scientific and Industrial Research* 208  
  *Research and Development by Industry* 208  
  *Council of Scientific and Industrial Research* 208  
- Contribution of CSIR 210  
  *CSIR 800* 215  
- Intellectual Property Rights 215  
  *National Intellectual Property Rights Policy* 215  
- Comments on the National IPR Policy 218  
  *Indian IPR Law* 220  
  *Copyrights* 221
Contents

Trademark 222
Patents 222
Historical Perspective of IPRs / Patents Law in India
Changes in Rules and Procedure 227

Boxes
CSIR Network 209
CSIR’s Achievements 210
Some Research Initiatives by CSIR 212
Nutraceuticals 214
Some Legal Cases that Indian Companies Won in the Matter of Section 3(d) 219
Swiss Claim 219
Compulsory Licensing 219
International Conventions and Indian IPR 221
Patents and Life Sciences 223
Some Laws Relevant to IPR 227

6. Energy 229
Types of Energy Resources 229
Fossil Fuels 229
Coal 229
Oil 232
Natural Gas 233
Renewable Sources and Their Development in India
Hydroelectric Systems 234
Solar Energy 235
Wind Power 241
Bioenergy 244
Energy from Urban and Industrial Wastes 246
Compressed Natural Gas 248
HCNG 248
Gasohol 248
Contents

Hydrogen 248
Chemical Energy: Fuel Cells 249
Battery Operated Vehicles 249
Ocean Energy 249
Geothermal Energy 250
Magneto Hydrodynamics (MHD) 250

Boxes
Emission Control In Fossil Fuels 231
CNG, LNG, LPG AND PNG 233
Advantages and Disadvantages of
Solar Energy Systems
Solar Pond 238
Solar Thermal vs SPV 240

7. Nuclear Science 252
Radioactivity 252
Radiation 252
Uses of Radiation 254
Measurement of and Protection against Radiation 254
Radioisotopes 255
Radioactive Decay 255
Radioactive (or radiometric) Dating 256
Nuclear Power 257
Nuclear Fission 258
Nuclear Reactor 258
Nuclear Fusion 259
Impact of Nuclear Power Plants 260
Applications of Nuclear S&T 261
Commercial and Industrial Uses 261
Research 262
Food Irradiation 262
Medical Field 264
Nuclear Energy in Space 265
Safety Issues 265
Waste and its Disposal 266
Nuclear Waste Disposal in India 268
Contents

Nuclear Weapons 269
   Effects 269
India's Nuclear Science Programme 270
   Organisation 270
   Power Production 271
   Fuel Fabrication 275
   R&D Units 276
Particle Physics 283
   Higgs Boson 283
   Concepts and Terms Relating to Higgs’ Boson 285
      Chi-b(3P) 286
      Antimatter Trapped 287
      The OPERA Experiment 288
      Solar Neutrinos: Strange Neutrinos from the Sun Detected for the First Time 289
      What are Neutrinos? 290
      IceCube Particle Detector 292
      India-Based Neutrino Observatory (INO) Project 292
Boxes Detecting and Measuring Radiation 254
ITER 260
Nuclear Winter 270
The Kudankulam Nuclear Power Plant 273
Standard Model 284
The Large Hadron Collider 286
Nobel Prize in Physics, 2015 291

8. Information Technology 294
   Electronics 294
      Basic Facts 294
      Development 295
      Role of Electronics 296
   Computers 297
      Development of Computers 297
Contents

How Computers Calculate 298
Parts of a Computer 299
Computer Language 300
Operating Systems 301
Types of Computers 301
Uses of Computers 305
Networking 306
Data Transmission 306
The Internet 307
Internet Uses 308
Computer Security 311
Telecommunication 317
Mobile Telephony 317
2G, 3G, 4G and such Terms 319
Use of Broadband 321
Smart Phone 322
Satellite Phone 322
Direct to Home (DTH) Television 324
India and Info-Tech 326
Major Initiatives in IT 328
Artificial Intelligence 330
Robots and Robotics 331
What is a Robot 331
Working 333
Applications 335
Robotics in India 336
Fibre Optics 337
History of Development of 337
Optical Fibres 338
Basic Principles 338
Advantages 339
Indian Scene 339
Computer- and IT-Related Terms and Products 341
Boxes 295
Semiconductors 295
Web Vocabulary 308
Contents

Nerdic Vocabulary 309
Some Nerdic Words 309
Social Media 310
Blackworm Attack 313
Smart Card 315
RFID 315
OFDMA 320
CDMA 320
Wi-Fi 320
WiMAX 320
Mesh Networks 323
Set-Top Box 325
Fuzzy Logic 331
Diverse Dimensions of Artificial Intelligence 332
Drones: Many Uses 334
Some Acronyms related to IT 340
Green Computing 349
Malware and Spyware 352
Plasma, LCD, LED and OLED 353
The USB and the Indian Connection 361
3D Printing 363
Copyright Issues and 3D Printing 363

9. Lasers 368
Principles and Types 368
Applications 369
  Basic Science 369
  Industry 369
  Defence 369
  Nuclear Energy 370
  Health and Medical Care 370
Laser Technology in India 372

Box 371
Holography 371
### Contents

10. **Superconductivity** 374  
   - What is Superconductivity 374  
   - Uses and Applications 374  
   - Research in India 376  

11. **Nanotechnology** 378  
   - Understanding Nanotechnology 378  
     - Approaches in Nanotechnology 379  
   - Applications 380  
     - Nanomedicine 381  
   - Implications and Various Concerns 382  
   - Nanotechnology in India 383  
     - Nano Mission 384  

**Box**  
Some Terms Associated with 380  
Nanotechnology  

12. **Astronomy and Space** 335  
   **Research**  
   - Astronomy and its Importance 385  
     - The Usefulness of Astronomy 385  
   - The Origin and Development of the Universe 386  
   - Accelerating Expansion of the Universe 388  
   - The Objects in the Universe 390  
     - The Stars 390  
     - Galaxies 393  
     - The Sun 395  
     - The Solar System 395  
   - Observing the Universe 399  
     - Some Famous Observatories/Telescopes 400  
   - Space Exploration 407  
     - What is Space Exploration 407  
     - Relevance of Interplanetary and Stellar Explorations 407  
     - Some Firsts in Space Exploration 411  
   - Elements of Space Research and
## Technology

*Artificial Satellites* 412  
*Space Probes* 413  
*Orbits* 414  
*Launch Vehicles* 416  
*Escaping Earth’s Gravity* 418  
*Reaching the Stars* 420  

### Major Space Probes

- **Mercury** 420  
- **Venus** 421  
- **Mars** 423  
- **Jupiter** 425  
- **Saturn** 427  
- **Uranus** 427  
- **Neptune** 427  
- **Pluto** 427  
- **Earth** 428  
- **Moon** 430  

* Asteroids and Comets 433  

### India’s Space Programme 435  

* Organisation and Objectives 435  
* Space Centres and Units 435  

### India’s Space Ventures 439  

* Experimental and Small Satellites 439  
* Geostationary Satellite System: 441  
* INSAT (including GSAT) System 441  
* Earth Observation System 446  
* Navigation Satellites 452  
* Space Missions 453  
* Launch Vehicle Technology 457  
* Cryogenic Engine 461  

### Space Applications 464  

* Satellite Communication 464  
* Earth Observations 465  
* Disaster Management 467  

### Milestones in India’s Space Ventures 467  

(as of 2015)
Contents

Arjun—India’s MBT 485
LCA (Tejas) Project 485
Advanced Light Helicopter 486
Lakshya 486
Nishant 486
Netra 486
Spin-off Technologies for Civilian Use 487

14. Health and Medicine 488
Disease-Causing Agents 488
Types of Disease 488
Congenital Diseases 488
Acquired Diseases 488
Infectious Diseases 489
Modes of Spread 489
Viral Diseases 489
Bacterial Diseases 502
Protozoal Diseases 506
Diseases Caused by Fungi 507
Diseases Caused by Parasitic Worms 507
Non-Infectious or Degenerative 508
Diseases
Red Blood Cell Diseases 508
White Blood Cell Diseases 509
Heart and Blood Vessels 509
Diseases Affecting Joints 510
Disorders of the Brain and Nervous System 510
Genetic Disorders 511
Endocrine Disabilities 512
Deficiency Diseases 515
Allergies 515
Cancer 516
Recent Life Style Concerns 518
Tobacco and Its Effect on Health 518
Trans Fat Can Cause Harm 520
Understanding Cholesterol: Nature, Effects and Ways of Control 522
Health Policies and Programmes in India

National Health Policy 524
National Health Mission 524
Immunisation Programme 526
Programmes to Communicable Control Diseases and Polio
Controlling Other Diseases 530

Indian Systems of Medicine and Homoeopathy

Boxes

Immunisation 492
Thiomersal in Vaccines 492
Vaccine-Derived Polio 492
Bird Flu 494
Swine Flu or Novel Influenza 495
Chikungunya 495
Dengue and DHF 496
Why Vaccine for HIV is Difficult to Develop 501
Fibrocalculous Pancreatic Diabetes 513
FLUOROSIS 514
E-Cigarettes: Not a Safe Alternative 519
Nicotine Patches: Of More Harm than Good? 519
National Health Goals for Communicable Diseases 529
Twelfth Plan Interventions to Combat Non-Communicable Diseases (NCDs) 530
Sowa-Rigpa becomes part of Indian Medical System 532

15. Genetics and Biotechnology 534

What is Genetics 534
Genes 535
Physical Basis of Heredity 535
How Traits are Inherited 535
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>How Sex is Determined</td>
<td>536</td>
</tr>
<tr>
<td>Patterns of Heredity</td>
<td>536</td>
</tr>
<tr>
<td>Chemical Basis of Heredity</td>
<td>538</td>
</tr>
<tr>
<td>Mutations</td>
<td>539</td>
</tr>
<tr>
<td>Gene Mapping</td>
<td>539</td>
</tr>
<tr>
<td>Milestones in Gene mapping Research</td>
<td>539</td>
</tr>
<tr>
<td>Genome Analysis and Human Genomics</td>
<td>540</td>
</tr>
<tr>
<td>Genetics</td>
<td></td>
</tr>
<tr>
<td>Benefits of Genome Research</td>
<td>541</td>
</tr>
<tr>
<td>Health and Molecular Medicine</td>
<td>541</td>
</tr>
<tr>
<td>What is Biotechnology</td>
<td>542</td>
</tr>
<tr>
<td>Biotechnology Techniques</td>
<td>542</td>
</tr>
<tr>
<td>Bioreactors</td>
<td>542</td>
</tr>
<tr>
<td>Cell Fusion</td>
<td>542</td>
</tr>
<tr>
<td>Use of Liposomes</td>
<td>543</td>
</tr>
<tr>
<td>Cell Tissue Culture</td>
<td>543</td>
</tr>
<tr>
<td>Genetic Engineering</td>
<td>543</td>
</tr>
<tr>
<td>DNA Fingerprinting</td>
<td>544</td>
</tr>
<tr>
<td>Cloning</td>
<td>545</td>
</tr>
<tr>
<td>Artificial Insemination and Embryo Transfer Technology</td>
<td>546</td>
</tr>
<tr>
<td>Stem Cell Technology</td>
<td>546</td>
</tr>
<tr>
<td>What is Stem Cell?</td>
<td>546</td>
</tr>
<tr>
<td>Use of Stem Cells</td>
<td>548</td>
</tr>
<tr>
<td>Applications of Biotechnology</td>
<td>550</td>
</tr>
<tr>
<td>Medicine</td>
<td>550</td>
</tr>
<tr>
<td>Agriculture</td>
<td>550</td>
</tr>
<tr>
<td>Food Biotechnology</td>
<td>551</td>
</tr>
<tr>
<td>Fuel and Fodder</td>
<td>552</td>
</tr>
<tr>
<td>Environment</td>
<td>552</td>
</tr>
<tr>
<td>Development of Biosensors</td>
<td>552</td>
</tr>
<tr>
<td>Animal Husbandry</td>
<td>554</td>
</tr>
<tr>
<td>Biocatalysts</td>
<td>554</td>
</tr>
<tr>
<td>Biotech Research in India</td>
<td>555</td>
</tr>
<tr>
<td>National Biotechnology Development</td>
<td>555</td>
</tr>
<tr>
<td>Strategy 2015-2020</td>
<td>555</td>
</tr>
<tr>
<td>Organisations</td>
<td>555</td>
</tr>
<tr>
<td>Biotechnology Information System</td>
<td>556</td>
</tr>
</tbody>
</table>
## Contents

*Applications and Research Efforts*  
*Biosafety Regulations*  
Patents and Biotechnology  
*Evergreening Patents*  
Patents and Biotechnology:  
Terminology

### Boxes
- Albinism  
- The Code of Life  
- Terminator Gene Technology  
- Golden Rice  
- Controversy Over GM Technology  
- Indian Seeds Deposited in Seed Vault  
- Apomictic Hybrid  
- Sui Generis

### APPENDICES

1. **Some Indian Scientists**  
2. **Select Terminology**  
3. **Recent Developments and Issues**

### Environment and Earth Science
- **Factors Affecting Indian Monsoon**  
- **Impact of El Nino on Coral Bleaching**  
- **Great Barrier Reef hit by Mass Bleaching**  
- **White Heat: The Third Coral Bleaching**  
- **About Weather Forecasts and Normal Monsoons**  
- **Aerosols Weakening Indian Monsoon**  
- **Heat Waves and Climate Change**  
- **WHO Report on Need to Reduce Climate Pollutants**  
- **Air Pollution: Particulate Matter Higher than WHO Limit in Indian Cities**  
- **Light Pollution: A Reason to Put Off the Switch**  
- **First Dark-Sky Reserve in Tibet to Limit Light Pollution**
Contents

Making People Aware of Pollution 605

BS IV Emission Norms Implemented 608

Across Country

Phasing out HFCs 608

Namami Gange 611

Impact of Pharmaceuticals on Environment 612

Bioplastics: An Alternative to Plastics? 615

Global Forest Data 616

India State of the Forest Report 2015 617

E-Green Watch 618

Rapidly Melting Ice of the Earth’s 618

Polar Caps

Emergence of Ice-free Islands in Antarctica 619

South Pole Ozone Layer Healing 619

Rising Sea Levels Threat to Small Islands 619

Over 12 per cent of Landmass 620

Susceptible to Landslides in India

Anthropocene: A New Geological Epoch 620

Zealandia—the Hidden Continent 620

A Brexit that Happened 450,000 Years Ago 621

Jet Stream Detected in Earth’s Core 622

Survey of India to Re-measure the Height 622

of Mount Everest

Himansh—India’s High altitude Station 623

Agriculture 623

Year of the Pulses 2016 623

Aeroponics 627

Information Technology 627

National Supercomputing Mission 627

Make in India Supercomputer under 628

the NSM

Top500: the Fastest Computers in 628

the World

White Space and White Fi 630

All About Spectrum Allocation 631

Mesh Networks 632

Identity Theft 632
<table>
<thead>
<tr>
<th>Contents</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Cybersecurity held to Ransom</td>
<td>633</td>
</tr>
<tr>
<td>Need to Evolve Digital Security</td>
<td>634</td>
</tr>
<tr>
<td>DNA Computer</td>
<td>635</td>
</tr>
<tr>
<td>Quantum Computer</td>
<td>635</td>
</tr>
<tr>
<td>SARAT App</td>
<td>636</td>
</tr>
<tr>
<td>India’s First Industrial Robot</td>
<td>636</td>
</tr>
<tr>
<td><strong>Astronomy and Space Exploration</strong></td>
<td>637</td>
</tr>
<tr>
<td>Detection of Gravitational Waves:</td>
<td></td>
</tr>
<tr>
<td>The LIGO Story</td>
<td></td>
</tr>
<tr>
<td>IndIGO</td>
<td>644</td>
</tr>
<tr>
<td>LIGO Detects Third Gravitational Wave Merger</td>
<td>646</td>
</tr>
<tr>
<td>Astronomical Discoveries</td>
<td>646</td>
</tr>
<tr>
<td>Space Exploration</td>
<td>650</td>
</tr>
<tr>
<td>India’s Space Ventures in 2015</td>
<td>657</td>
</tr>
<tr>
<td>India’s Space Ventures in 2016</td>
<td>660</td>
</tr>
<tr>
<td>Reusable Launch Vehicle</td>
<td>662</td>
</tr>
<tr>
<td>India’s Space Ventures in 2017</td>
<td>662</td>
</tr>
<tr>
<td>Aditya-L1: Indian Mission to the Sun</td>
<td>671</td>
</tr>
<tr>
<td>GIRI Radar System Set up</td>
<td>671</td>
</tr>
<tr>
<td>Project Sudoor Drishti</td>
<td>672</td>
</tr>
<tr>
<td><strong>Defence Research</strong></td>
<td>672</td>
</tr>
<tr>
<td>DRDO Extends its Patented Technology for Commercial Exploitation</td>
<td></td>
</tr>
<tr>
<td>‘Floating Test Range Ship’ for Missile</td>
<td></td>
</tr>
<tr>
<td>Defence Systems</td>
<td></td>
</tr>
<tr>
<td><strong>Particle Physics</strong></td>
<td>673</td>
</tr>
<tr>
<td>LUX Fails to Find Dark Matter</td>
<td>673</td>
</tr>
<tr>
<td>New Boson Discovered</td>
<td>673</td>
</tr>
<tr>
<td>Belle-II Particle Detector Project</td>
<td>673</td>
</tr>
<tr>
<td>The Angel Particle</td>
<td>674</td>
</tr>
<tr>
<td>India-based Neutrino Observatory</td>
<td>674</td>
</tr>
<tr>
<td>Project Delayed</td>
<td></td>
</tr>
<tr>
<td><strong>Health and Medicine</strong></td>
<td>675</td>
</tr>
<tr>
<td>National Health Policy 2017</td>
<td>675</td>
</tr>
<tr>
<td>WHO Report on Anti-Microbial Resistance</td>
<td>676</td>
</tr>
<tr>
<td>Contents</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>National Action Plan to Combat</td>
<td>678</td>
</tr>
<tr>
<td>Anti-Microbial Resistance</td>
<td></td>
</tr>
<tr>
<td>Bioequivalence Studies Made Mandatroy for Generic Medicines</td>
<td>678</td>
</tr>
<tr>
<td>Digital Technology in Healthcare</td>
<td>679</td>
</tr>
<tr>
<td>WHO Protocol or Antibiotics Revised</td>
<td>680</td>
</tr>
<tr>
<td>WHO’s Global Plan to Tackle Drug Resistance</td>
<td>680</td>
</tr>
<tr>
<td>Growth–Promoting Antibiotics</td>
<td>680</td>
</tr>
<tr>
<td>Indians taking Unsafe Fixed Dose Combination Drugs</td>
<td>682</td>
</tr>
<tr>
<td>How Malaria Parasites Multiply</td>
<td>682</td>
</tr>
<tr>
<td>Sanitising Cattle-sheds can Prevent Malaria</td>
<td>682</td>
</tr>
<tr>
<td>Malaria Vaccine Gets Green Signal</td>
<td>683</td>
</tr>
<tr>
<td>Protein that Triggers the Malarial Parasite identified</td>
<td>683</td>
</tr>
<tr>
<td>Drug Resistance to TB: The Growing Threat</td>
<td>683</td>
</tr>
<tr>
<td>India Lags behind in the TB Fight</td>
<td>685</td>
</tr>
<tr>
<td>Blood Test Diagnosis for TB</td>
<td>685</td>
</tr>
<tr>
<td>Nix-TB—A Breakthrough Treatment for Drug-resistant TB</td>
<td>686</td>
</tr>
<tr>
<td>TB Treatment with urcumin Nanoparticles</td>
<td>686</td>
</tr>
<tr>
<td>Molecules to Fight TB</td>
<td>687</td>
</tr>
<tr>
<td>Zika, the New Virus</td>
<td>687</td>
</tr>
<tr>
<td>Middle East Respiratory Syndrome</td>
<td>691</td>
</tr>
<tr>
<td>Vaccine for Ebola</td>
<td>691</td>
</tr>
<tr>
<td>Prevalence of Diabetes in India: Cause of Caution</td>
<td>693</td>
</tr>
<tr>
<td>Indigenously Developed Rotavirus Vaccine Trial Successful</td>
<td>693</td>
</tr>
<tr>
<td>Open Source Drug Discovery: A Collaborative Research Platform for Drug Discovery</td>
<td>693</td>
</tr>
<tr>
<td>fears of Drug Resistance to H1N1 Medicines</td>
<td>694</td>
</tr>
<tr>
<td>eVIN Project of India Becomes</td>
<td>694</td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>GAGAN</td>
<td>658</td>
</tr>
<tr>
<td>The Sprites</td>
<td>666</td>
</tr>
<tr>
<td>ISRO to Share Technology of Lithium-ion Battery for Mass Production</td>
<td>668</td>
</tr>
<tr>
<td>India becomes an Associate Member of CERN</td>
<td>674</td>
</tr>
<tr>
<td>Antibiotic Resistance in India</td>
<td>677</td>
</tr>
<tr>
<td>Antibiotic Resistance makes Gonorrhoea Difficult to Treat</td>
<td>677</td>
</tr>
<tr>
<td>Drug Resistance May Increase in India due to TB Treatment Programme</td>
<td>684</td>
</tr>
<tr>
<td>TB</td>
<td>685</td>
</tr>
<tr>
<td>About Zika Disease</td>
<td>688</td>
</tr>
<tr>
<td>International Health Regulations</td>
<td>688</td>
</tr>
<tr>
<td>Procedures Concerning International Public Health Emergencies</td>
<td>688</td>
</tr>
<tr>
<td>What is Microcephaly?</td>
<td>689</td>
</tr>
<tr>
<td>Chinese Scientists Edit Genes of Human Embryos</td>
<td>700</td>
</tr>
</tbody>
</table>