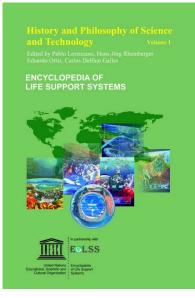
CONTENTS

HISTORY AND PHILOSOPHY OF SCIENCE AND TECHNOLOGY



History and Philosophy of Science and Technology - Volume 1 No. of Pages: 402 ISBN: 978-1-84826-323-9 (eBook) ISBN: 978-1-84826-773-2 (Print Volume)

History and Philosophy of Science and Technology - Volume 2 No. of Pages: 416 ISBN: 978-1-84826-324-6 (eBook) ISBN: 978-1-84826-774-9 (Print Volume) History and Philosophy of Science and Technology - Volume 3 No. of Pages: 394 ISBN: 978-1-84826-325-3 (eBook) ISBN: 978-1-84826-775-6 (Print Volume) History and Philosophy of Science and Technology - Volume 4 No. of Pages: 412 ISBN: 978-1-84826-326-0 (eBook) ISBN: 978-1-84826-776-3 (Print Volume)

For more information on e-book(s) and Print Volume(s) order, please **click here**

Or contact : eolssunesco@gmail.com

CONTENTS

VOLUME I

Logic and Methodology of Science: An Introduction to the Philosophy of Science 1 P. Lorenzano, National University of Quilmes (UNQ), Argentina National Council of Scientific and

Technical Research (CONICET), Argentina

- 1. Introduction: Nature and function of the Philosophy of Science
 - 1.1. The Metascientific Studies
 - 1.2. The Philosophical Theorization about Science or Philosophy of Science
 - 1.2.1. Its Nature and Relationship with Other Metascientific Disciplines
 - 1.2.2. The Distinction between General and Special Philosophy of Science
 - 1.2.3. The Distinction between Synchronic and Diachronic Philosophy of Science
 - 1.2.4. A Brief History of the Philosophy of Science
- 2. Scientific Concepts and Hypotheses
 - 2.1. The Language of Science
 - 2.2. Scientific Concepts
 - 2.2.1. Kinds of Concepts
 - 2.2.1.1. Classificatory (or Qualitative) Concepts
 - 2.2.1.2. Comparative (or Topological) Concepts
 - 2.2.1.3. Metric (or Quantitative) Concepts
 - 2.3. Scientific Statements: Hypotheses and Their Testing
 - 2.3.1. The Testing of Hypotheses
 - 2.3.2. The Elements of a Test
 - 2.3.3. Conditions for a Good Test
 - 2.3.3.1. First Condition: The Prediction is Logically Implied
 - 2.3.3.2. Second Condition: The Prediction is Improbable
 - 2.3.4. The Structure of a Test: Arguments in Favor of or Against the Hypothesis
 - 2.3.4.1. Negative Evidence (Refutation)
 - 2.3.4.2. Positive Evidence (Corroboration or Confirmation)
 - 2.3.5. Crucial Tests
 - 2.3.6. Final Remarks on Hypotheses Evaluation
- 3. Scientific Laws and Explanation
 - 3.1. The Concept of Scientific Law
 - 3.1.1. Condition of Truth
 - 3.1.2. Condition of Universality
 - 3.1.3. Condition of Unrestriction
 - 3.2. Scientific Explanation
 - 3.2.1. Explanation and Covering-Law Model
 - 3.2.1.1. Particular Deductive-Nomological Explanation (P D-N)
 - 3.2.1.2. General Deductive-Nomological Explanation (G D-N)
 - 3.2.1.3. Deductive-Statistical Explanation (D-S)
 - 3.2.1.4. Inductive-Statistical Explanation (I-S)
 - 3.2.2. The Pragmatics of Explanation
 - 3.2.3. The Causal Approach
 - 3.2.4. The Unificacion Approach
 - 3.2.5. Teleological and Functional Explanation
- 4. Scientific Theories
 - 4.1. The Classical Conception of Theories
 - 4.1.1. Calculi and Axiom Systems
 - 4.1.2. Interpretation and Rules of Correspondence
 - 4.2. The Historicist Conceptions of Theories
 - 4.2.1. Theories as Research Projects
 - 4.3. The Semantic Conceptions of Theories
 - 4.3.1. Theories as Model-Theoretical Entities

The Nature and Structure of Scientific Theories

C. U. Moulines, Seminar fur Philosophie, Logik und Wissenschaftstheorie, University of Munich

1. Introduction

3

- 2. The Problem of the Meaning of Scientific Concepts
 - 2.1. The Semantic Specificity of Scientific Concepts
 - 2.2. The Definition of Scientific Concepts: Its Possibilities and Limits
 - The Axiomatic Construction of a Scientific Theory
 - 3.1. The General Idea
 - 3.2. A Simple Example of Axiomatization
- 4. The Formalist Conception of Theories
- 5. Theories as Interpreted Calculi
- 6. The Radical Empiricist View of Scientific Theories
- 7. The Two-Levels View of Empirical Theories
 - 7.1. Theoretical Concepts
 - 7.2. Correspondence Rules and the Two Conceptual Levels of a Scientific Theory
 - 7.3. The 'Eliminability' of Theoretical Concepts
 - 7.4. Some Difficulties with the Classical View of Scientific Theories
- 8. Model Building as a Bridge Between Theory and Experience
- 9. The Modelistic Determination of Empirical Theories
 - 9.1. A General Characterization of Modelistic Approaches
 - 9.2. The Set-Theoretical View of Scientific Theories
 - 9.2.1. Intended Interpretations
 - 9.2.2. Assigning Data Models to Theoretical Models
 - 9.3. The Nature of Scientific Theories According to Constructive Empiricism
 - 9.4. Metatheoretical Structuralism
- 10. Are Successful Scientific Theories True?
- 11. Conclusion

Natural Science

G. E. Allen, Department of Biology, Washington University in St. Louis, USA

- 1. Introduction
- 2. Characteristics of Science As A Rational Way of Knowing
 - 2.1. Observation, Fact and Conceptualization
 - 2.2. Types of Conceptualizations: Generalizations and Explanations
 - 2.2.1. Generalizations
 - 2.2.2. Explanations
- 3. Testing Hypotheses by Observation and Experiment
 - 3.1. Testing Hypotheses by Observation
 - 3.2. Testing Hypotheses by Experimentation
- 4. The Philosophical Bases of Modern Science: Terminology
 - 4.1. Materialism and Idealism
 - 4.2. Forms of Materialism
 - 4.2.1. Mechanistic Materialism
 - 4.2.2. Holistic and Dialectical Materialism
 - Philosophies of Science: Historical Development
 - 5.1. Empiricism and Inductivism
 - 5.2. Auguste Comte and Positivism
 - 5.3. Marxism and the Natural Sciences
 - 5.4. Karl Popper and Falsifiability in Natural Science
 - 5.5. Thomas Kuhn and Paradigm Shifts in Natural Science
 - 5.5.1. The Nature of Paradigms and Normal Science
 - 5.5.2. Anomalies
 - 5.5.3. Paradigm Shifts and Scientific Revolutions
 - 5.5.4. The Pursuit of Normal Science: Puzzle-solving, Articulation
 - 5.5.5. Kuhn and His Critics

99

- 5.6. The Social Construction of Science Movement
- 6. "Laws" in the Natural Sciences
 - 6.1. Overview
 - 6.2. "Laws" in the Physical and Biological Sciences
- 7. Science and Technology
- 8. Conclusion

Incommensurability of Knowledge: Theories and Values

Paul Hoyningen-Huene, University of Hannover, Germany Peter Schaber, University of Zurich, Switzerland

- 1. Introduction
- 2. Incommensurability of Theories
 - 2.1. What Does the Incommensurability of Theories Concern?
 - 2.2. Semantic Incommensurability
 - 2.3. Methodological Incommensurability
- 3. Incommensurability of Values
 - 3.1. Incommensurability of Values: the Different Meanings
 - 3.2. Arguments in Favor of Rough Equality and Incomparability
 - 3.3. Objections
 - 3.4. Theoretical and Practical Incomparability
 - 3.5. Practical Consequences

Science and Religion

E. Agazzi, Department of Philosophy, University of Genoa, Italy

- 1. Introduction
- 2. What Do We Mean by Science?
- 3. What Do We Mean by Religion?
- 4. Relations Between Science and Religion in History
- 5. The "Scientific Revolution" of the Renaissance
- 5.1. The Fundamental Traits of the Galilean Revolution
 - 5.2. Galileo's Trial and Sentence
- 6. The Partition between Matter and Spirit and the Cartesian Compromise
- 7. From the Ontological to the Epistemological Dualism: Kant
- 8. Evolutionism and Religion
- 9. Knowledge, Belief, Faith and Rationality
- 10. The Point of View of "the Whole"
- 11. The Point of View of the Whole and the "Problem of Life"
- 12. Science and the Question of the Whole
- 13. Conclusions

Scientific Knowledge And Religious Knowledge - Significant Epistemological Reference Points

185

Adrian Lemeni, University of Bucharest, Romania

- 1. The Constitutive Principles of Modernity
 - 1.1. The Premises of Modernity
 - 1.2. The Relationship between the Reformation and Modernity
 - 1.3. Scientific knowledge in the Traditional and Modern Paradigm
- 2. The Enlightenment The Religious Consciousness as Illusion
- 3. Epistemological Mutations in the Paradigm of Contemporary Science
 - 3.1. The Epistemological Implications of Quantum Physics
 - 3.1.1. The Uncertainty Principle and its Consequences
 - 3.2. Discontinuity as the Principle of Quantum Physics

134

3.3. Methodological Limits of Science Evidenced by Quantum Physics

Episodes of XX Century Cosmology: A Historical Approach201V. R. Rodríguez, Faculty of Philosophy and Humanities, National University of Cordoba, Argentina

- 1. Introduction
- 2. Cosmological Lessons from Earlier Centuries
- 3. From Nebulae to Galaxies
- 4. The Emergence of the Idea of Expansion
- 5. The Principal Cosmological Models of the First Half of the Century
- 6. The Discovery of Cosmic Background Radiation and Some Implications
- 7. The COBE Results and the Analysis of the Fluctuations
- 8. Changes in the Epistemological Status of Cosmological Research Programmes
- 9. A Brief Panorama of Contemporary Cosmology

A Concise History of Biotechnology - Some Key Determinants

John E. Smith, Institute of Pharmacy and Biomedical Sciences, University of Strathclyde, Glasgow, Scotland

- 1. Introduction
 - 1.1. Biotechnology What's in a Name?
 - 1.2. Biotechnology A Three Component Central Core
- 2. Biotechnology of Traditional Fermented Foods and Beverages
- 2.1. Food Fermentations
 - 2.1.1. People and Environment
 - 2.1.2. Substrate
 - 2.1.3. Microorganisms
 - 2.1.4. Cultured Dairy Products
 - 2.2. Beverage Fermentations
- 3. Biotechnological Production of Biomass, Organic Acids, Solvents and Waste Treatment Processes under Non-Sterile Conditions
 - 3.1. Biomass Inocula
 - 3.2. Organic acids
 - 3.3. Waste Treatments and Water Purification
 - Biotechnological Processes Produced Under Conditions of Sterility
 - 4.1. Introduction

4.

- 4.2. The Penicillin Story
- 4.3. Microbial Enzyme Production
- 4.4. The Bioreactor
- 5. Downstream Processing
- 6. Applied Genetics and Genetic Engineering Their Influence on Biotechnology
 - 6.1. Improvement of Industrial Microorganisms
 - 6.2. The Impact of Genetic Engineering on Biotechnology 6.2.1. Cutting and Forming DNA Molecules
 - 6.2.2. Joining DNA Molecules
 - 6.3. Polymerase Chain Reactions (PCR)
 - 6.4. Genomic Library
 - 6.5. Gene Cloning in Plant Cells
 - 6.6. Gene Cloning in Animal Cells
 - 6.7. Monoclonal Antibodies
 - 6.8. The Potential Biohazards of Biotechnology the Asilomar Conferences
- Public Perceptions of Biotechnology
 - 7.1. What are the Main Areas of GM Technology that Appear to Create the Greatest Level of Public Concern?
 - 7.1.1. Antibiotic-Resistance Genes
 - 7.1.2. Transfer of Allergens

- 7.1.3. Release of Genetically-Manipulated Organisms into the Environment
- 7.1.4. Safety of Genetical Engineered Foods
- 7.1.5. Applications of Human Genetic Research
- 8. Conclusions

History and Philosophy of the Systems Sciences: The Road Toward Uncertainty

Charles Oscar Francois, GESI, Grupo de Estudio de Sistemas, Argentina

270

- 1. Introduction
- 2. Medieval Universals
- 3. The Snake of Rational Curiosity alive in Medieval Garden
- 4. The Slow Dawn of Technology in Medieval Europe
- 5. Descartes, the not very Systemic Systemist
- 6. The Expansion of the Universe of Knowledge
- 7. The Twilight of Scientific Simplicity: A Can of Conceptual Worms in 20th Century Science
- 8. In Search of a New Coherence
 - 8.1. Overview
 - 8.2. Bertalanffy, the Stitcher
 - 8.3. Energy Rules
 - 8.4. Cybernetics in its Prime
 - 8.5. New Views on Organization
 - 8.6. Cybernetics Observed
 - 8.7. The Nature of Autonomy
 - 8.8. New Views on Order and Disorder
 - 8.9. Structure and Function in a New Light
 - 8.10. Models for Autogenesis, Self Construction and Autopoiesis
 - 8.11. Thermodynamics Reconsidered
 - 8.12. Networks and Networkers: Natural and Artificial
 - 8.13. Societies as Systems
 - 8.14. New Concepts, Models and Methodologies
 - 8.15. Practical Systemists
- 9. Conclusion

The Structure Of The Darwinian Argument In The Origin Of Species

Anna Carolina K. P. Regner, Graduate Program in Philosophy, Universidade do Vale do Rio dos Sinos, Brazil

- 1. Introduction: The Hypothetical-Deductive Reconstruction
- 2. Analyzing The Hypothetical-Deductive Reconstructions
 - 2.1. A Referential Case
 - 2.2. The Logical Structure
 - 2.3. The Empirical Support
 - 2.4. The Tautology Problem
- 3. The Historical Reconstructions
- 4. Bringing Together History and Philosophy of Science
- 5. Towards a New Analysis

Index

About EOLSS

335

329

VOLUME II

A Short History Of Molecular Biology

Hans-Jörg Rheinberger, Max Planck Institute for the History of Science, Berlin

- 1. Methodological Introduction
- 2. Some Important Lines of Development between 1930 and 1950
 - 2.1. From Colloid Chemistry to the Macromolecule: Ultracentrifugation
 - 2.2. X-Ray Structure Analysis
 - 2.3. UV Spectroscopy
 - 2.4. Biochemical Genetics: Neurospora
 - 2.5. Tobacco Mosaic Virus (TMV)
 - 2.6. Electron Microscopy
 - 2.7. Bacteriophages
 - 2.8. The Transformation of Pneumococci
 - 2.9. The Genetics of Bacteria
 - 2.10. Nucleic Acid-Paper Chromatography
 - 2.11. The Construction of Protein Models
 - 2.12. Radioactive Tracing and Protein Synthesis
 - 2.13. Summary: A New "Technological Landscape"
- 3. The Structure of DNA and the Establishment of a New Paradigm (1950-1965)
 - 3.1. The DNA Double Helix: X-Ray Structure Analysis and the Building of Models
 - 3.2. The "Central Dogma" of Molecular Biology
 - 3.3. In vitro Protein Synthesis and Transfer RNA
 - 3.4. From Enzymatic Adaptation to Gene Regulation: Messenger RNA
 - 3.5. An in vitro System for Deciphering the Genetic Code
 - 3.6. Summary: The New Keywords
- 4. Molecular Biology and the Origins of Gene Technology
 - 4.1. Recombinant DNA
 - 4.2. Genome Analysis
- 5. Molecular Biology and Evolution

A History of Conservation

Martin Holdgate, Cambridge, UK

- 1. The Origins of Conservation
 - 1.1. Conservation and Development
 - 1.2. The Roots of Conservation
 - 1.3. The Roots of Conservation
- 2. The Rise of Conservation
 - 2.1. The Creation of National Parks and Nature Reserves
 - 2.2. The Foundation of National Societies
 - 2.3. American Conservation under Roosevelt
- 3. International Action for Conservation
 - 3.1. The Beginnings of International Action
 - 3.2. The First Steps Towards a Global Organization
 - 3.3. The Creation of the International Union for the Protection of Nature
 - 3.4. The Early Years of International Conservation
 - 3.5. Science and Conservation
 - 3.6. The World Wildlife Fund-the First Global Campaigner
- 4. The Environmental Revolution
 - 4.1. The Rise of the "New Environmentalism"
 - 4.2. The United Nations Conference on the Human Environment
- 5. Strategies for Conservation and Sustainable Development
- 6. The New Conservation Scene
 - 6.1. Expanding Action

32

- 6.2. Conservation with a Human Face
- 6.3. The 1992 "Earth Summit"
- 6.4. A Regionalized Conservation Network
- 7. Perspective

History of Biodiversity Conservation, Protected Areas and The Conservation Movement 55

Naill E. Doran, Department of Primary Industries, Water and Environment, Tasmania, Australia Alastair M.M. Richardson, University of Tasmania, Australia

- 1. Global Overview
- 2. History of Biodiversity Conservation and Protected Areas
 - 2.1. Biodiversity Conservation
 - 2.1.1. Biodiversity
 - 2.1.2. Biodiversity Problems
 - 2.1.3. Biodiversity Conservation
 - 2.2. Protected Areas
 - 2.2.1. Origins of Protected Areas
 - 2.2.2. Time Scales
 - 2.3. Priorities
 - 2.3.1. Biodiversity
 - 2.3.2. Geodiversity
 - 2.3.3. Marine Protected Areas
- 3. A Global Approach
 - 3.1. Preservation versus Collaborative Management
- 4. Putting a Financial Value on Conservation
- 5. History of the Conservation Movement
 - 5.1. Early History
 - 5.2. Wise Use versus Protectionism
 - 5.3. Postwar Developments
 - 5.4. Animal Welfare
 - 5.5. Zero Population Growth
 - 5.6. Green Political Parties
 - 5.7. Professional Scientists and Environmentalism
 - 5.8. Tactics
 - 5.9. Nongovernment Organizations
- 6. The Future

Biogeography

Michael E. Meadows, University of Cape Town, South Africa

- 1. Introduction: defining the indefinable
- 2. History of biogeography
 - 2.1. Development of the spatial tradition
 - 2.2. Ecological biogeography
- 3. The major approaches to biogeography
 - 3.1. The spatial tradition: phytogeography and zoogeography
 - 3.2. The spatial tradition: historical biogeography
 - 3.3. The spatial tradition: vicariance and dispersal
 - 3.4. The ecological tradition: ecosystems
 - 3.5. The ecological tradition: palaeoecology
 - 3.6. The ecological tradition: island biogeography
- 4. Towards an applied biogeography
 - 4.1. Conservation biology
 - 4.2. Global change studies
 - 4.3. Ecosystem management

Theory and Methods in Geography

Maria Sala, University of Barcelona, Spain

- 1. Theories
 - 1.1. Introduction
 - 1.2. The Basic Scientific Principles
 - 1.3. The Main Conceptions in Human Geography
 - 1.4. The Regional Approach
 - 1.5. Systematic Studies
 - 1.6. The Coexistence of Naturalism and Historicism
- 2. Methods
 - 2.1. Methods Related to Scale
 - 2.2. About Fieldwork
 - 2.3. The structure of field research
 - 2.4. Field Sampling
 - 2.5. Examples of Geographical Field Research
 - 2.6. Teaching Based on Direct Observation
 - 2.7. Display and Analysis of Data

The History of Archaeology

Stephen E. Nash, Department of Anthropology, The Field Museum, USA

- 1. The Nature of Archaeology
 - 1.1. Distinctions Between Old World and New World Archaeology
 - 1.2. The Multidisciplinary Nature (and Strength) of Modern Archaeology
- 2. Writing the History of Archaeology
 - 2.1. Chronicle: Scholars and Their Discoveries
 - 2.2. Chronicle: Development of Archaeological Method and Theory
 - 2.3. Biography
 - 2.4. Autobiography
 - 2.5. Issues of Professionalization, Confirmation, And Verification
- 3. The Fragmentary Nature of the Archaeological Record
 - 3.1. Differential Preservation
 - 3.2. Breakage
 - 3.3. Changes in Archaeological Fieldwork and Collecting Criteria
 - 3.4. Improvements in Analytical Techniques
- 4. Foundations of Archaeological Inquiry
 - 4.1. The Enlightenment
 - 4.1.1. The Scientific Revolution
 - 4.1.2. The Industrial Revolution
 - 4.2. The Age Of The Earth
 - 4.2.1. Uniformitarianism and Catastrophism
 - 4.2.2. Stratigraphy and The Law Of Superposition
 - 4.3. The Antiquity of Man 4.3.1. Fossil Human Ancestors
 - 4.3.2. The Three-Age System
 - 4.4. Evolution by Natural Selection
 - 4.5. The Concept of Culture
 - 4.6. Evolutionism

5

- Foundations of Archaeology in The New World
- 5.1. The Myth of the Mound Builders
 - 5.2. Historical Particularism and Cultural Relativism
 - 5.3. Archaeology, Museums, and the Reason for Collections
 - 5.4. Culture Areas and Culture History
- 6. Archaeological Dating
 - 6.1. Seriation
 - 6.2. Dendrochronology

- 6.3. The Implications of Paleoindian Occupation of the New World
- 6.4. Radiocarbon Dating
 - 6.4.1. Calibration Of The Radiocarbon Timescale
- 6.5. Other dating techniques
- 7. The New Archaeology
- 8. Post-Processual Archaeology
- 9. Conclusion

A Brief History of Soil Science

160

Eric C. Brevik, Departments of Natural Sciences and Agriculture and Technical Studies, Dickinson State University, Dickinson, ND, USA

- 1. Introduction
- 2. Soil Science/Agriculture In Ancient Times And Early History (Up To 4th Century AD)
 - 2.1. Mesopotamia
 - 2.2. Greeks And Romans
 - 2.3. Other Mediterranean Civilizations
 - 2.4. Northern Europe
 - 2.5. Asia
 - 2.6. Americas
 - 2.7. Ancient Times And Early History Summary
- 3. Soil Science In The Middle Ages (5th To 14th Centuries AD)
 - 3.1. Byzantium And Europe
 - 3.2. Arabia And The Middle East
 - 3.3. Southeast Asia
- 4. Soil Science In The Renaissance Period (15th To 17th Centuries)
 - 4.1. Studies In Soils And Plant Nutrition
 - 4.2. Soils And Government
 - 4.3. Soils Recognized By Geologists
 - 4.4. Drainage Of Wet Soils
- 5. Soil Science In The Age Of Enlightenment (18th Century)
 - 5.1. The "Humus Theory"
 - 5.2. Soil As An Evolutionary Body
 - 5.3. Beginnings Of Soil Mapping
- 6. Soil Science Becomes A True Science (19th Century)
 - 6.1. Lewis And Clark
 - 6.2. The "Mineral Theory"
 - 6.3. Agrogeology
 - 6.4. Soil Mapping
 - 6.5. Darwin And Soil Biology
 - 6.6. The Profile Concept
 - 6.7. Dokuchaiev And The Birth Of Genetic Soil Science
- 7. Modern Soil Science (20th Century)
 - 7.1. Genetic Soil Science Spreads
 - 7.2. National Detailed Mapping Programs
 - 7.3. Soil Erosion
 - 7.4. The Internationalization Of Soil Science
 - 7.5. Soil Science Moves Beyond Agriculture
- 8. Concluding Remarks

A History of Astronomy, Astrophysics and Cosmology

185 Cambril

- Malcolm Longair, Cavendish Laboratory, University Of Cambridge, JJ Thomson Avenue, Cambridge CB3 0HE
- 1. Introduction
- 2. Prehistoric, Ancient and Mediaeval Astronomy up to the Time of Copernicus

- 3. The Copernican, Galilean and Newtonian Revolutions
- 4. From Astronomy to Astrophysics the Development of Astronomical Techniques in the 19th Century
- 5. The Classification of the Stars the Harvard Spectral Sequence
- 6. Stellar Structure and Evolution to 1939
- 7. The Galaxy and the Nature of the Spiral Nebulae
- 8. The Origins of Astrophysical Cosmology Einstein, Friedman, Hubble, Lemaître, Eddington
- 9. The Opening Up of the Electromagnetic Spectrum and the New Astronomies
- 10. Stars and Stellar Evolution from 1945
- 11. The Interstellar Medium
- 12. Galaxies, Clusters Of Galaxies and the Large Scale Structure of the Universe
- 13. Active Galaxies, General Relativity and Black Holes
- 14. Classical Cosmology since 1945
- 15. The Evolution of Galaxies and Active Galaxies with Cosmic Epoch
- 16. The Origin of Galaxies and the Large-Scale Structure of The Universe
- 17. The Very Early Universe

Foundations of Geophysics and Geochemistry

Jan Lastovicka, Institute of Atmospheric Physics, Prague, Czech Republic Oldrich Novotny, Charles University, Prague, Czech Republic Emil Jelinek, Charles University, Prague, Czech Republic

- 1. Introduction
- 2. History of Geophysics and Geochemistry
- 3. Branches of Geophysics and Geochemistry
 - 3.1. Gravimetry
 - 3.1.1. Gravity Field
 - 3.1.2. Fundamental Parameters and Relations
 - 3.1.3. Gravity Measurements and their Applications
 - 3.1.4. Earth Tides
 - 3.2. Seismology and the Structure of the Earth
 - 3.2.1. Basic Data on Earthquakes
 - 3.2.2. Strength of Earthquakes
 - 3.2.3. Seismic Waves
 - 3.2.4. Seismic Model of the Earth
 - 3.3. Geothermics
 - 3.4. Geodynamics
 - 3.5. Geomagnetism
 - 3.5.1. Internal (Main) Magnetic Field
 - 3.5.2. External Magnetic Field
 - 3.5.3. Magnetic Properties of Rocks and Paleomagnetism
 - 3.6. Geoelectricity
 - 3.7. Aeronomy
 - 3.8. Magnetospheric Physics and Solar Wind
 - 3.8.1. Magnetosphere
 - 3.8.2. Solar Wind
 - 3.9. Planetology
 - 3.10. Branches of Geochemistry 3.10.1. Applied Geochemistry

Index

About EOLSS

345

VOLUME III

History Of Measurement Theory

J. A. Díez, Department of Logic, History and Philosophy of Science, University of Barcelona

- 1. Measurement and Measurement Theory
 - 1.1. Measurement as Numerical Representation
 - 1.2. Derived and Fundamental Measurement
- 2. The Formation Period
 - 2.1. Helmholtz on Alikeness and Additivity
 - 2.2. Holder on Axiomatics and Real Morphisms
 - 2.3. Campbell on Order and Additivity
 - 2.4. Stevens on Scale Types
- 3. Suppes on Representation and Uniqueness
 - 3.1. Suppes on Representation and Uniqueness for Extensive Systems
 - 3.2. Suppes' Foundational Role
- 4. The Mature Theory
 - 4.1. Non-extensive Systems
 - 4.2. Other Issues

Historical Review of Elementary Concepts in Physics

Peter Otto Hess, Instituto de Ciencias Nucleares, Universidad Nacional Autonoma de Mexico (UNAM), México

- 1. Introduction
- 2. Newtonian Physics
- 3. Electricity Magnetism and Optics
- 4. Thermodynamics
- 5. Quantum Mechanics
- 6. Theory of Relativity
- 7. Final Remarks

Mathematics through Millenia

Vagn Lundsgaard Hansen, Department of Mathematics, Technical University of Denmark, Denmark

- 1. Introduction
- 2. The dawn of mathematics
 - 2.1. Egyptian Mathematics
 - 2.2. Mesopotamian Mathematics
 - 2.3. Mayan Mathematics
- 3. The Greek heritage in mathematics
 - 3.1. Geometry
 - 3.2. Number Theory
- 4. The golden period of the Hindus and the Arabs in mathematics
 - 4.1. Hindu Mathematics
 - 4.2. Islamic Mathematics
 - 4.3. Mathematics in Europe in the Middle Ages
- 5. Mathematics in China
 - 5.1. Ancient Chinese Mathematics
 - 5.2. The "Nine Chapters on the Mathematical Art"
 - 5.3. In the Shadows of the Great Masters
 - 5.4. A Golden Century for Mathematics in China
- 6. European mathematics in the Renaissance
 - 6.1. The Solution of Cubic Equations
 - 6.2. Mathematics inspired by Applications

I

33

- 7. Mathematics and the scientific revolution
 - 7.1. Analytic Geometry
 - 7.2. Calculus gets off the Ground
 - 7.3. Other Mathematical Discoveries from the Seventeenth Century
- 8. The tools of calculus are developed and consolidated
 - 8.1. The Birth of Mathematical Analysis
 - 8.2. Further Remarks on Mathematics in the Eighteenth Century
- 9. Abstract mathematical structures emerges
 - 9.1. New Algebraic Structures
 - 9.2. Groundbreaking New Discoveries in Geometry
 - 9.3. Rigor in Analysis
 - 9.4. Further Developments in the Nineteenth Century
- 10. Mathematics in the twentieth century
 - 10.1. Problems in the Foundations of Set Theory
 - 10.2. Tendencies in Twentieth Century Mathematics
 - 10.3. Highlights from Twentieth Century Mathematics
- 11. Mathematics forever

History of Continuum Mechanics

Robert W. Soutas-Little, Department of Mechanical Engineering, Michigan State University

- 1. History of the General Theories and Fundamental Equations
- 2. History of Constitutive Equations; Rheology
- 3. Development of the Mathematical Methods of Solution of the Equations

History of Rheology

Kenneth Walters, *Institute of Mathematical and Physical Sciences, Aberystwyth University, Aberystwyth, UK.*

- 1. Introduction
- 2. Early Departures from the Classical Extremes
- 3. 1890 1940
- 4. 1940 1950
- 5. 1950 1960
- 6. 1960 1970
- 7. 1970 1980
- 8. What of the Future

Philosophy Of Economics

Adolfo Garcia de la Sienra, Faculty of Economics, Institute of Philosophy, Universidad Veracruzana, Xalapa, Mexico

- 1. Introduction
- 2. The Point of View of "Pure Economics"
- 3. Economically Qualified Entities
- 4. Abstraction and Idealization
- 5. Ideal Objects
- 6. Epistemological Views
- 7. Fundamental Measurement
- 8. Economics and Philosophy

The Socio-Economic Aspects of Technology

Antonio López Peláez, Department of Sociology, Universidad Nacional de Educación a Distancia, Madrid, Spain

135

106

77

- 1. Introduction
- 2. Technology, Economy and Society
- 3. The Organization of Technological Development
- 4. The Technological System
 - 4.1. Characteristics of the Technological System
 - 4.2. The Institutions of Technological Research
 - 4.3. The Technological Resources.
 - 4.4. The Impact of Technological Innovation
- 5. Technology and Globalization
- 6. Technological Policy: Patterns of Management and Financing
 - 6.1. R&D Programmes (Research and Development)
 - 6.2. Patterns of Financing, Organization and Scientific-Technological Development
 - 6.3. Technocracy and Social Participation
 - 6.4. Looking at the Future

Philosophies of the Social Sciences

Piet Strydom, Department of Sociology, University College Cork, Ireland

156

- 1. Introduction
 - 1.1. Sources and directions
 - 1.1.1. Hermeneutics
 - 1.1.2. Science
 - 1.1.3. Critique
 - 1.2. Phases and controversies
- 2. Vicissitudes of the Philosophy of Social Science
 - 2.1. First phase: 1840-1914
 - 2.2. Second phase: 1920s-early 1950s
 - 2.3. Third phase: mid-1950s-1970s
 - 2.4. Fourth phase: late 1970s-2000s
- 3. Basic Cognitive Paradigms
- 4. Contemporary Philosophies of Social Science
 - 4.1. Post-empiricism
 - 4.2. Critical Realism
 - 4.3. Constructivism or constructionism
 - 4.4. Deconstructionism
 - 4.5. Functionalism
 - 4.6. Feminism
 - 4.7. Pragmatism
 - 4.8. Critical theory
 - 4.9. Rational choice
 - 4.10. Cognitivism
- 5. Conclusion

Social Sciences: Historical And Philosophical Overview Of Methods And Goals

186

M. H. Salmon, History and Philosophy of Science, University of Pittsburgh, Pittsburgh PA, USA

- 1. Early History
- 2. The Nineteenth-Century Scientific Study of Society
 - 2.1. August Comte (1798-1857)
 - 2.2. John Stuart Mill (1806-73)
- 3. Responses to Positivist's Proposals for a Genuine Social Science
 - 3.1. Individualism and Holism: Emile Durkheim (1858-1917)
 - 3.2. Laws of Social Science: Interpetivists' Response
 - 3.3. Max Weber (1864-1920)
 - 3.4. Value Neutrality of Science
- 4. Developments in the Twentieth Century

- 4.1. R.G. Collingwood (1889-1943)
- 4.2. C. G. Hempel: Models of Scientific Explanation
- 4.3. Strong Interpretivism and Davidson's Response
- 4.4. Critical Theory
- 4.5. T. Kuhn (1922-1996) and the Sociology Of Science
- Prospects for the Twenty-First Century 5.

Introduction To Ethics Of Science And Technology

210

258

León Olivé, Philosophical Research Institute, National Autonomous University of Mexico (UNAM)

- 1. Science, Techniques, Technology and Technoscience
 - 1.1. Science
 - 1.2. Technology
 - 1.3. Technoscience
- Ethics and Morality 2.
- Ethical Questions Regarding Science and Technology 3.
- Values in Science and Technology 4.
- Instrumental Rationality: "Rationality of Means to Ends" and "Rationality of Ends" 5. 5.1. Ends, Means and Values in Science and Technology
- The Ethical Responsibility of Scientists and Technologists 6.
 - 6.1. Knowing May Entail an Ethical Responsibility
 - 6.2. The Precautionary Principle
- 7. Evaluation of Technological Systems and Ethical Problems
 - 7.1. Evaluation of Technical Systems: Two Dimensions
 - 7.2. Internal Evaluation
 - 7.3. External Evaluation
 - 7.4. Who Should Participate in the Evaluation of Technological and Technoscientific Systems From an Ethical Standpoint?
 - 7.5. The Principle of Responsibility
- Justifiable Damage 8.
 - 8.1. Conditions for the Acceptability of Damage
 - 8.2. Indetermination of the Consequences of Technological Innovations
 - Technology, Technoscience and Risk
 - 9.1. Risk, Uncertainty and Ignorance
- 10. Duties of Scientists, Technologists, Techno-Scientists and the Institutions
- 11. Experiments on Animals and Animal Rights
 - 11.1. Experiments on Animals 11.2. Animal Rights
- 12. Conclusion

9.

The Ethics Of Science And Technology

Hugh Lacey, Philosophy Department, Swarthmore College, Swarthmore, PA 19081, USA Departamento de Filosofia, Universidade de São Paulo, São Paulo, Brazil.

- 1. Introduction
 - 1.1. Science as Value Free Free From Deep and Permanent Entanglement with Ethics 1.1.1.
 - Technology as Value Free
 - 'Science as Value Free' as Part of the Ethics of the Conduct of Scientific Practices 1.1.2.
 - 1.2. Ethics and Science 'Touch' But Do Not 'Interpenetrate'
- The 'Touch' of Ethics and Science 2.
 - 2.1. Experimental Methods Open to Ethical Appraisal
 - 2.2. The 'Scientific Ethos'
 - The Scientific Ethos and the Public Discourse of Scientific Spokespersons 2.2.1.
 - 2.3. Ethically Based Motivations for Research and Criticisms of Scientific Practices
 - 2.4. Ethics and the Application of Scientific Knowledge
 - Ethics-As-Reactive 2.4.1.

- 2.4.2. Precautionary Principle
- 2.4.3. Efficacy and Legitimacy
- 2.4.4. Ethical Responsibility of Scientists
- 2.4.5. Questioning 'Autonomy'
- The 'Penetration' of Ethics into Science: Questions about Impartiality
- 3.1. The Centrality of Impartiality

3.

- 3.1.1. Criteria of Appraisal Vs. Ethical Values Conducive To Making Impartial Judgments
- 3.1.2. Justification of a Knowledge Claim Vs. Explanation of the Fact that is known
- 3.1.3. Soundly Accepted Vs. Ethically Significant Knowledge Claims
- 3.1.4. Claims Authorized by the Scientific Community do not always Accord with Impartiality
- 3.1.5. Impartiality and Neutrality
- 3.2. Scientific Appraisal at Times when Accord with Impartiality cannot be reached
 - 3.2.1. Context of Application: Endorsing Hypotheses *Vs.* Accepting them in Accord with *Impartiality*
 - 3.2.2. Efficacy: Sufficient for Legitimacy?
 - 3.2.3. Endorsements about Risks: Interplay of Empirical Evidence and Ethical Judgments
- 4. The 'Penetration' of Ethics into Science: Relations between Research Methodologies and Holding Ethical Values
 - 4.1. Adopting Strategies in Research
 - 4.1.1. Strategies of the Decontextualized Approach
 - 4.2. Can the Ideal of *Applied Neutrality* be approached?
 - 4.2.1. Accord with Cognitive Neutrality but not with Applied Neutrality
 - 4.2.2. Applied Neutrality and Methodological Pluralism
 - 4.3. Adopting the Decontextualized Approach and Holding the Values of Technological Progress4.3.1. Values of Technological Progress
 - 4.3.2. Explaining and 'Justifying' the Virtual Exclusiveness of the Decontextualized Approach
 - 4.4. Ethical Values and Scientific Methodology
 - 4.4.1. The Ways for Ethics to 'Penetrate' Into Methodology
- 5. Conclusion

The Philosophy of Professional Ethics

Timo Airaksinen, University of Helsinki, Finland

- 1. Three Types of Professional Ethics
- 2. Sociological Foundations
- 3. Goals of Professional Work and Their Problems
- 4. Normative and Evaluative Elements in Professional Work
 - 4.1. Duty and Obligation
 - 4.2. Professional Rights
 - 4.3. Virtues in Professional Life
- 5. Engineering Ethics
 - 5.1. The Service Ideal of Engineering
 - 5.2. The Principle of Double Loyalties
- 6. Progress and Rationality in Engineering Ethics
 - 6.1. The Technological System and Its Main Characteristics
 - 6.2. The Future of Engineering Ethics

Ethics and Science

Koichiro Matsuura, Director-General of UNESCO

- 1. Ethics and Science
 - 1.1. From Harmony to Progress
 - 1.2. The Twentieth Century Jolt
 - 1.3. Science at the Moral Crossroads

- 1.4. The Threat to our Planet
- 1.5. Tinkering with the Alphabet-Blocks of Life
- 1.6. The Widening Gap Between Rich and Poor
- 2. UNESCO as the World's Forum for Ethics
 - 2.1. The International Bioethics Committee
 - 2.2. The Human Genome and Human Rights
 - 2.3. A World Commission for Ethics: COMEST
 - 2.4. Water for All: The Source of Life
 - 2.5. Sources of Energy for Today and Tomorrow
 - 2.6. Principle to Practice: An Education in Ethics
 - 2.7. For an Age of Wisdom

Index

321

About EOLSS

327

VOLUME IV

	e Control Of Nature And The Origins Of The Dichotomy Between Fact And Value R. Mariconda, Department of Philosophy - University of São Paulo – Brazil	1
1. 2. 3. 4. 5. 6. 7. 8.	Introduction First Idea: Sufficiency and Impartiality of the Natural Method Second Idea: The Distinction between Natural and Moral Disciplines Third Idea: Scientific Method and the theological Backdrop Fourth Idea: The Difference between Descritpion and Norm and Cognitive Neutrality Fifth Idea: Scientific Understandign and the Descontextualized Strategies Modern Science and the Control of Nature Conclusion	
	ence And Empire: The Geo-Epistemic Location Of Knowledge Canaparo, University of Exeter, Exeter, UK	20
1. 2. 3. 4. 5. 6. 7.	A Historiographical Construction Empire and Geo-epistemology The Evolution of the Ideas 3.1. The Historiographical Foundation of Empires 3.2. Science as Knowledge 3.3. The Material and the Imaginary Dimensions 3.4. The Levels of Engagement The Translation Effect From Building the Empire to Constructing Science Modernity, Science, Knowledge Towards a Scientific Imaginary and an Invisible Empire: From Historiography to Visual Cult	ure
	at Is That Thing Called Philosophy Of Technology? . Gomez, Department of Philosophy. California State University (LA). USA	47

- 1. Introduction
- 2. Locating technology with respect to science
 - 2.1. Structure and Content
 - 2.2. Method
 - 2.3. Aim

- 2.4. Pattern of Change
- 3. Locating philosophy of technology
- 4. Early philosophies of technology.
 - 4.1. Aristotelianism
 - 4.2. Technological Pessimism
 - 4.3. Technological Optimism
 - 4.4. Heidegger's Existentialism and the Essence of Technology
 - 4.5. Mumford's Megamachinism
 - 4.6. Neomarxism
 - 4.6.1. Adorno-Horkheimer
 - 4.6.2. Marcuse
 - 4.6.3. Habermas
- 5. Recent Philosophies of technology
 - 5.1. L. Winner
 - 5.2. A. Feenberg
 - 5.3. Ecosophy
- 6. Technology and values
 - 6.1. Shrader-Frechette Claims
- 6.2. H Jonas
- 7. Conclusions

Transitions From Function-Oriented To Effect-Oriented Technologies - Some Thoughts On The Nature Of Modern Technology 82

C. J. Tully, Deutsches Jugendinstitut, Munich, Germany

1. Introduction

2

- 1.1. Function-oriented vs. Unspecified Effects
- 1.2. Appropriating Technology by Means of Contextualization
- 1.3. Socialization in Different Technical Worlds
- The Technology of Machines T I Instrumental and Efficient
- 2.1. Establishing Rules and Creating a Scientific World
- 2.2. Predictable Conditions the Industrialization and Standardization of Labor
 - 2.2.1. Standardization Work Organization According to Technological Models
 - 2.2.2. Implementing Planned Work Processes in Production: Some Important Concepts
- 3. Instrumental Rationality as the Rationality of Actions
- 4. Unspecified Technology and its Consequences
 - 4.1. Computers as Universal Machines an Example of Technology II
 - 4.2. From the Service Society to the Self-Service Society
 - 4.3. From Playful to Sanctioned Use
 - 4.4. Work versus Non-Work
 - 4.5. Highly Specialized Production and Product Technologies "Just in Time"
 - 4.6. Effect Rather Than Purpose an Invitation to Self-Contextualization

Technical Agency And Sources Of Technological Pessimism

Fernando Broncano, Universidad Carlos III de Madrid, Spain

- 1. Contemporary experiences with technology
 - 1.1. Modernization
 - 1.2. The Age of Machines
- 2. Mechanisation and the origins of technological pessimism
 - 2.1. Criticisms of Technical Civilization
 - 2.2. Critical tradition and criticism of technology
- 3. The idea of technical agency and power

Non-Western Science - Mining Civilizational Knowledge

Susantha Goonatilake, Center for the Study of Social Change, New School for Social Research, New York and at Vidyartha, Colombo, Sri Lanka

- 1. Civilizational Knowledge
- 2. The European Classical Period
- 3. Arab and Other Transmissions
- 4. Independent "Modern" Discoveries
- 5. Mining: Illustrative Examples
 - 5.1. Medicine
 - 5.2. Psychology
 - 5.3. Cognitive Sciences and Artificial Intelligence
 - 5.4. Mathematics and Physics
- 6. Some Speculative Possibilities
- 7. Social Theory for New Technologies
- 8. Using Metaphors
- 9. Some Potentials
- 10. Some Estimates
- 11. Conclusion

Social Sciences, Science Policy Studies, Science Policy-making

Jean-Jacgues Salomon, Conservatoire National des Arts et Métiers, Centre Science, Technologie et Société, Paris, France

- 1. Introduction
- 2. The Field of Science Policy Studies and its uses
 - 2.1. Why Should Science be Supported? In What Proportions?
 - 2.2. The Measurement of Innovation and its Systemic Conditions
 - 2.3. Science, Technology and Development Economics
- 3. A Research Agenda

Science and Technology Policy Professionals: Jobs, Work, Knowledge, and Values Susan E. Cozzens, *Georgia Institute of Technology, USA*

- 1. Introduction
- 2. Careers in S&T Policy
- 3. The Work of S&T Policy Professionals
- 4. The Knowledge Base
- 5. The Value of, and Values of, S&T Professionals

The New Knowledge Economy and Science and Technology Policy 189

Geoffrey C. Bowker, Department of Communication, University of California, San Diego, USA

- 1. Introduction
- 2. The New Technoscientific Information Infrastructure
 - 2.1. What is Infrastructure?
 - 2.2. Building an Infrastructure
 - 2.3. Ownership of Scientific and Technological Ideas and Data
 - 2.4. Sharing Data
- 3. Working Collaboratively
 - 3.1. International Technoscience
 - 3.2. Distributed Collective Work
- 4. Conclusion

132

158

 Steve Matthewman, <i>Department of Sociology, University of Auckland</i> 1. What is Technology? 2. What Does Technology Do? 3. How has Technology been Theorised? 4. Technology, Systems and Social Interests 5. Our Times: Technology, Complexity and Risk 6. Conclusion Science, Governance, Complexity, and Knowledge Assessment Silvio Funtowicz, <i>European Commission, Joint Research Centre (EC-JRC), Italy</i> Martin O'Connor, <i>Universite de Versailles Saint-Quentin en Yvelines, France</i> Iain Shepherd, <i>European Commission, Joint Research Centre (EC-JRC), Italy</i> 1. Introduction 2. Science and Governance	V 1	adislav P. Kotchetkov, UNESCO consultant, Russia	
 Science policy publications Regional Ministerial Conferences Information Exchange and Normative-making Activities Training in science and technology policy Termination of UNESCO Science and Technology Policy Programme Prechnology Termination of UNESCO Science and Technology Policy Programme Steve Matthewman , Department of Sociology, University of Auckland What Does Technology Do? How has Technology been Theorised? Technology, Systems and Social Interests Our Times: Technology, Complexity and Risk Conclusion Science, Governance, Complexity, and Knowledge Assessment Science, Governance, Complexity, and Knowledge Assessment Science, Governance, Complexity, and Knowledge Assessment Science and Governance Science and Governance Scientific Challenges 3.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.8. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 5.5.4. Other Interpretations Knowledge Quality in Policy-Related Science 4.1. Purposes		Genesis of science and technology policy in UNESCO	
I. Regional Ministerial Conferences Information Exchange and Normative-making Activities Training in science and technology policy Termination of UNESCO Science and Technology Policy Programme Pechnology Steve Matthewman, Department of Sociology, University of Auckland What is Technology Pol? What Does Technology been Theorised? Technology, Systems and Social Interests Our Times: Technology, Complexity and Risk Conclusion Science, Governance, Complexity, and Knowledge Assessment Science, Governance, Complexity, and Knowledge Assessment Science and Governance Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.3.3. Risk and Uncertainty 3.4. Forecasting Outcomes 3.5. The Precautionary Principle 3.5. The Precautionary Principle 3.5. The Precautionary Principle 3.6. Other Interpretations Scientific Challenge of Precautionary Principle 3.6. Other Interpre	2.	Science policy consultancy services	
 Information Exchange and Normative-making Activities Training in science and technology policy Termination of UNESCO Science and Technology Policy Programme Technology Technology What is Technology Do? What Does Technology Do? How has Technology been Theorised? Technology, Systems and Social Interests Our Times: Technology, Complexity and Risk Conclusion Science, Governance, Complexity, and Knowledge Assessment Silvio Funtowicz, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France ain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France ain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France ain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Science and Govern	5.		
 5. Training in science and technology policy Termination of UNESCO Science and Technology Policy Programme 23. Termination of UNESCO Science and Technology Policy Programme 23. What is Technology? 23. What Does Technology Do? 24. What Does Technology been Theorised? 25. Technology, Systems and Social Interests 26. Our Times: Technology, Complexity and Risk 27. Conclusion 27. Science, Governance, Complexity, and Knowledge Assessment 25. Science, Governance, Complexity, and Knowledge Assessment 25. Science, Governance, Complexity, and Knowledge Assessment 25. Science, Governance & Versailles Saint-Quentin en Yvelines, France ain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy 26. Sciencific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5. The Precautionary Principle 3.5. The Burden of Proof 3.5. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4. Newledge Quality in Policy-Related Science 4. Newledse Quality in Policy-Related Science 			
7. Termination of UNESCO Science and Technology Policy Programme 23 Steve Matthewman, Department of Sociology, University of Auckland 23 Steve Matthewman, Department of Sociology, University of Auckland 23 I. What is Technology Do? 3 How has Technology been Theorised? 4 Technology, Systems and Social Interests 5 Our Times: Technology, Complexity and Risk 5 Conclusion 5 Science, Governance, Complexity, and Knowledge Assessment 25 Science, Governance, Commission, Joint Research Centre (EC-JRC), Italy 4 Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France 25 Science and Governance 3 Scientific Challenges 3.1.1. Establishing a Dose-Response Relationship 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2.1. Understanding Processes 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertaint			
Technology 23 Steve Matthewman, Department of Sociology, University of Auckland 23 I. What is Technology Do? 2. What Does Technology been Theorised? 1. Technology, Systems and Social Interests 5. Our Times: Technology, Complexity and Risk 5. Our Times: Technology, Complexity and Risk 5. 6. Conclusion 25 Science, Governance, Complexity, and Knowledge Assessment 25 Silvio Funtowicz, European Commission, Joint Research Centre (EC-IRC), Italy 25 Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France 26 alin Shepherd, European Commission, Joint Research Centre (EC-IRC), Italy 27 1. Introduction 2. 3. 2. Science and Governance 3. 3. Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle			
 Steve Matthewman, Department of Sociology, University of Auckland What is Technology? What Does Technology Do? How has Technology been Theorised? Technology, Systems and Social Interests Our Times: Technology, Complexity and Risk Conclusion Science, Governance, Complexity, and Knowledge Assessment Science and Governance Science and Governance Science and Governance Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes	/.	Termination of UNESCO Science and Technology Policy Programme	
 What is Technology? What Does Technology Do? How has Technology been Theorised? Technology, Systems and Social Interests Our Times: Technology, Complexity and Risk Conclusion Conclusion Science, Governance, Complexity, and Knowledge Assessment (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France lain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats The Environment 3.2.1. Objectives and Challenges 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes Risk and Uncertainty Acceptable Risk S. The Precautionary Principle S.1. Triggering of Precautionary Principle S.2. Application of Precautionary Principle S.3. The Burden of Proof S.4. Knowledge Quality in Policy-Related Science 4. Knowledge Quality in Policy-Related Science 			233
 What Does Technology Do? How has Technology been Theorised? Technology, Systems and Social Interests Our Times: Technology, Complexity and Risk Conclusion Science, Governance, Complexity, and Knowledge Assessment Science, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France ain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	Ste	eve Matthewman, Department of Sociology, University of Auckland	
 3. How has Technology been Theorised? 4. Technology, Systems and Social Interests 5. Our Times: Technology, Complexity and Risk 5. Conclusion 25 25 25 25 26 27 28 29 29 20 20 20 21 21 22 25 25 26 27 28 29 29 20 20 21 21 22 25 25 25 26 27 28 29 20 21 25 25 25 26 27 28 29 29 20 20 21 22 22 23 24 25 25 26 27 28 29 20 21 22 22 23 24 25 25 26 27 28 29 20 21 22 22 23 24 25 25 26 27 27 28 29 20 21 22 23 24 25 25 26 27 28 29 20 21 22 22 23 24 25 25 26 27 28 29 20 21 22 23 24 25 25 26 27 28 29 20 21 22 23 24 25 25 26 27 27 28 29 29 20 21 22 23 24 25 25 26 27 28 29 20 21 21 22 23 24 25 26 27 27 28 28 29 29 20 <li< td=""><td>1.</td><td>What is Technology?</td><td></td></li<>	1.	What is Technology?	
 Technology, Systems and Social Interests Our Times: Technology, Complexity and Risk Conclusion Science, Governance, Complexity, and Knowledge Assessment Science, Governance, Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges Scientific Challenges Health Scientific Challenges Health Scientific Challenges The Environment S.2.1. Health Scientig Processes Scientig Processes Scienting the State of the Environment-Reference Measurements Acceptable Risk The Precautionary Principle Scienting of Precautionary Principle Sciention of Precautionary Principle Sciention of Precautionary Principle Conclusion Conclusion 	2.		
 5. Our Times: Technology, Complexity and Risk 5. Conclusion 25. Science, Governance, Complexity, and Knowledge Assessment 25. Silvio Funtowicz, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France lain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy 1. Introduction 2. Science and Governance 3. Sciencific Challenges 3.1. Health 3.1. Establishing a Dose-Response Relationship 3.1. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4. Knowledge Quality in Policy-Related Science 4. Knowledge Quality in Policy-Related Science 			
 Conclusion Science, Governance, Complexity, and Knowledge Assessment Silvio Funtowicz, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France lain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 1. Health I. Establishing a Dose-Response Relationship I. Facing New Threats The Environment I. Objectives and Challenges I. Objectives and Challenges I. Hoetstanding Processes Scientific Challenge Understanding Processes Scientific Outcomes Risk and Uncertainty Acceptable Risk The Precautionary Principle I. Triggering of Precautionary Principle Sci. The Burden of Proof Sci. Other Interpretations Knowledge Quality in Policy-Related Science Purposes 			
Science, Governance, Complexity, and Knowledge Assessment 25 Silvio Funtowicz, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France Iain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy 1 1. Introduction 2 2. Science and Governance 3 3. Scientific Challenges 3.1. Health 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes			
 Silvio Funtowicz, European Commission, Joint Research Centre (EC-JRC), Italy Martin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France lain Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy 1. Introduction 2. Science and Governance 3. Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4. Knowledge Quality in Policy-Related Science 4. Purposes 	6.	Conclusion	
 Science and Governance Scientific Challenges 3.1. Health Stablishing a Dose-Response Relationship Lestablishing a Dose-Response Related Science Purposes 	Sil	vio Funtowicz, European Commission, Joint Research Centre (EC-JRC), Italy	
 Science and Governance Scientific Challenges 3.1. Health Stablishing a Dose-Response Relationship Science and Governance Health Stablishing a Dose-Response Relationship Science and Challenges Acceptable Risk Science And Uncertainty Acceptable Risk The Precautionary Principle Science and Challenge of Precautionary Principle Science and the proof Action of Precautionary Principle Science and the proof Action of Proof Actio		artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France	
 Scientific Challenges Health 	lai	artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy	
 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	[ai 1.	artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction	
 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	[ai 1. 2.	artin O'Connor, <i>Universite de Versailles Saint-Quentin en Yvelines, France</i> n Shepherd, <i>European Commission, Joint Research Centre (EC-JRC), Italy</i> Introduction Science and Governance	
 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	[ai 1. 2.	artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges	
 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	[ai 1. 2.	artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health	
 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	lai	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 	
 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	[ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 	
 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 	
 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 	
 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 4. Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 	
 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 	
 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 	
 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 	
 3.5.3. The Burden of Proof 3.5.4. Other Interpretations Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 	
 Knowledge Quality in Policy-Related Science 4.1. Purposes 	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 	
4.1. Purposes	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France in Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 	
4.1. Purposes	ai 1. 2.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 	
4.2. People	ai 1. 2. 3.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations 	
4.3 Problems	lai 1. 2. 3.	 artin O'Connor, Universite de Versailles Saint-Quentin en Yvelines, France n Shepherd, European Commission, Joint Research Centre (EC-JRC), Italy Introduction Science and Governance Scientific Challenges 3.1. Health 3.1.1. Establishing a Dose-Response Relationship 3.1.2. Facing New Threats 3.2. The Environment 3.2.1. Objectives and Challenges 3.2.2. Understanding Processes 3.2.3. Measuring the State of the Environment-Reference Measurements 3.2.4. Forecasting Outcomes 3.3. Risk and Uncertainty 3.4. Acceptable Risk 3.5. The Precautionary Principle 3.5.1. Triggering of Precautionary Principle 3.5.2. Application of Precautionary Principle 3.5.3. The Burden of Proof 3.5.4. Other Interpretations Knowledge Quality in Policy-Related Science 4.1. Purposes 	

- 4.3. Problems
- 4.4. Procedures
- 4.5. Products
- 4.6. Extended Peer Assessment
- 4.7. Access to Background Information
- 4.8. The Delivery of Scientific Advice to policy
- 5. Knowledge Management and Knowledge Assessment

Need for Environmental Research

Bhaskar Nath, European Centre for Pollution Research, London, UK

- 1. Introduction
- 2. How did we get here? Evolution of the "consumption culture"
 - 2.1. Evolution of the Western "throw-away consumption culture"
 - 2.2. The main consequences
- 3. Cause-Effect Relationship
- 4. Criteria for Research
 - 4.1. Focus of research
 - 4.2. Reactive and proactive research
 - 4.3. A clear understanding of what science and technology can and cannot do
- 5. Suggested Areas of Environmental Research
 - 5.1. Reactive (end-of-the-pipe) areas of research
 - 5.1.1. Water resources and waste water treatment
 - 5.1.2. Solid waste management
 - 5.1.3. Efficacy of environmental standards
 - 5.2. Proactive ("before-the-pipe") strategies
 - 5.2.1. Non-technical
 - 5.2.2. Technical -- example of atmospheric pollution
 - 5.3. Affordable technology
 - 5.4. Transboundary pollution
 - 5.4.1. Transboundary air pollution
 - 5.4.2. Transboundary water pollution
 - 5.4.3. Import-Export of Waste
- 6. Conclusion

Urban Wastewater Treatment: Past, Present And Future

308

C. Davis, S. Vigneswaran, J. Kandasamy, *Faculty of Engineering and Information Technology, University of Technology, Sydney, Australia* A. Chanan, *State Water Corporation, Sydney, Australia*

- 1. Water Management Systems: A Brief History
 - 1.1. Greco-Roman Influence on Water Management
 - 1.2. Water Supply and the Industrial Revolution
 - 1.3. Water Engineering in the 20th Century
- 2. Conventional Sewage Treatment Techniques
- 3. Third Generation Wastewater Treatment Systems
 - 3.1. Facultative Ponds
 - 3.2. Constructed Wetlands
 - 3.2.1. Limiting Factors of Wetland Processes
- 4. Reassessing the Conventional Systems
 - 4.1. A Soft Path for the Future
 - 4.1.1. Decentralised Wastewater Management Systems
- 5. Water & Wastewater Management In Future: A Preview
 - 5.1. Climate Change and Wastewater Treatment
 - 5.1.1. Estimation & Reduction of GHG Emissions
 - 5.1.1.1. Liquid Process Modifications
 - 5.1.1.2. Energy Reduction
- 6. Advanced Treatment Technologies for the Fourth Generation Water Management
 - 6.1. Flocculation
 - 6.2. Adsorption
 - 6.3. Ion Exchange
 - 6.4. Advanced Oxidation Process (AOP)
 - 6.5. Membrane Technology
 - 6.6. Membrane Hybrid System
 - 6.6.1. Membrane Bioreactors (MBRs)

6.6.2. Coagulation – Membrane hybrid system6.6.3. Adsorption – Membrane hybrid system6.7. Nanotechnology for Wastewater Treatment

7. Conclusion

Index

About EOLSS

339