

## Environmental Biotechnology Bruce Rittmann Solution

The book is intended for advanced undergraduates and first-year graduate students in the general fields of water resources and environmental engineering. It offers a selective presentation of some of the most common problems encountered by practicing engineers with the inclusion of recent research advances and personal computer applications. Increased awareness surrounding environmental protection has prompted the development of more ecofriendly technologies. This book provides useful information on technologies based upon the use of biological agents for environmental clean-up, including bacteria, yeast, fungi, algae, and plants. Some chapters refer to the direct application of products derived from plants and microorganisms for designing strategies of environmental remediation. The combination of strategies helps in efficient removal of pollutants generated from anthropogenic activities with minimal environmental impact. This book is meant for professionals involved in environmental technology and waste management.

**Biofilms in Wastewater Treatment: An Interdiscipli**

This book combines the results of current research with essential background material to provide complete, in-depth coverage of every aspect of in situ and ex situ bioremediation, as well as an extensive overview of the physical and chemical processes currently available for treating petroleum-contaminated soils. Critical information has been collected and assembled under one cover to provide a convenient reference for anyone who must contend with this worldwide problem. **Remediation of Petroleum Contaminated Soils: Biological, Physical, and Chemical Processes** describes how to optimize the biodegradation of petroleum hydrocarbons in soil-water systems. It reports on the susceptibility of various petroleum components to biodegradation by microorganisms, and considers all groups of microorganisms for their potential contributions. The book also deals with problem areas such as the transport of organisms, oxygen, or nutrients throughout the subsurface, as well as biodegradation of polynuclear aromatic hydrocarbons (PAHs) and nonaqueous phase liquids (NAPLs). In addition, the book presents a variety of methods for monitoring bioremediation. This reference discusses current soil remediation processes and includes many innovative approaches. It also investigates means of controlling volatile organic compounds (VOCs) and leachate, and addresses methods for collecting and treating these secondary waste streams. The expansive coverage of this book will furnish readers with a wide range of options for developing treatment strategies and for customizing procedures for specific requirements.

The application of biologically-engineered solutions to environmental problems has become far more readily acceptable and widely understood. However there remains some uncertainty amongst practitioners regarding how and where the microscopic, functional level fits into the macroscopic, practical applications. It is precisely this gap which the book sets out to fill. Dividing the topic into logical strands covering pollution, waste and manufacturing, the book examines the potential for biotechnological interventions and current industrial practice, with the underpinning microbial techniques and methods described, in context, against this background. Each chapter is supported by located case studies from a range of industries and countries to provide readers with an overview of the range of applications for biotechnology. Essential reading for undergraduates and Masters students taking modules in Biotechnology or Pollution Control as part of Environmental Science, Environmental Management or Environmental Biology programmes. It is also suitable for professionals involved with water, waste management and pollution control.

In recent years, air pollution has become a major worldwide concern. Air pollutants can affect metabolic activity, impede healthy development, and exhibit carcinogenic and toxic properties in humans. Over the past two decades, the use of microbes to remove pollutants from contaminated air streams has become a widely accepted and efficient alternative to the classical physical and chemical treatment technologies. **Air Pollution Prevention and Control: Bioreactors and Bioenergy** focusses on these biotechnological alternatives looking at both the optimization of bioreactors and the development of cleaner biofuels. Structured in five parts, the book covers: Fundamentals and microbiological aspects Biofilters, bioscrubbers and other end-of-pipe treatment technologies Specific applications of bioreactors Biofuels production from pollutants and renewable resources (including biogas, biohydrogen, biodiesel and bioethanol) and its environmental impacts Case studies of applications including biotrickling filtration of waste gases, industrial bioscrubbers applied in different industries and biogas upgrading **Air Pollution Prevention and Control: Bioreactors and Bioenergy** is the first reference work to give a broad overview of bioprocesses for the mitigation of air pollution. Primarily intended for researchers and students in environmental engineering, biotechnology and applied microbiology, the book will also be of interest to industrial and governmental researchers.

**Microbial Wastewater Treatment** focuses on the exploitation of microorganisms as decontaminating tools to treat polluted wastewater, a worldwide concern. Microorganism-based processes are seen as promising technologies to treat the ever-increasing problem of polluted wastewater. The book covers recently developed process technologies to solve five major trends in the field of wastewater treatment, including nutrient removal and recovery, trace organic compounds, energy saving and production, sustainability and community involvement. Illustrates the importance of microorganisms in wastewater treatment Points out the reuse of the treated wastewater Highlights the recovery of resources from wastewater Pays attention to the occurrence of novel micro-pollutants Introduces new trends in wastewater technology

Today, in the arena of food, the primary goals of food biotechnology are to provide a more abundant, less expensive, and a more nutritious food supply in order to address the needs of our growing global population. Today, food biotechnology utilizes the knowledge of plant science and genetics to further this tradition. Through the use of modern biotechnology, scientists can move genes for valuable traits from one plant to another. This process results in tangible environmental and economic benefits that are passed on to the farmer and the consumer. This book

on Food Biotechnology is divided into seven sections and contains 24 chapters and a case study. The book caters to the requirement of the syllabus prescribed by various Indian universities for undergraduate and postgraduate courses in engineering. It has been prepared with meticulous care, aiming at making the book error-free. Constructive suggestions are always welcome from users of this book.

During the past five years increased awareness of environmental contamination by nitroaromatic compounds has led to a dramatic increase in research on their biodegradation. The resulting discoveries have markedly extended our understanding of degradation mechanisms and pathways in bacteria and fungi. Furthermore, this new basic knowledge promises the development of field applications of biodegradation systems for nitroaromatic compounds. In May of 1994, an International Symposium on the Biodegradation of Nitroaromatic Compounds was held in Las Vegas, Nevada. This symposium brought together the scientists at the frontiers of research into the biodegradation of nitroaromatic compounds. The invited speakers were asked to review their area of expertise and write a critical, comprehensive synthesis of their work and related work by others. This book is the result of their efforts. The emphasis of the reviews is on basic research in biodegradation and biotransformation. Therefore, the reactions of nitroaromatic compounds in plants, animals, bacteria, fungi, soil, and even nonbiological systems are considered. The goal of the work is to provide the reader with an appreciation of the tremendous range of possibilities for metabolism of aromatic nitro compounds and the experimental approaches used to understand them. This volume should be of interest to biochemists, microbiologists, engineers, toxicologists, and anyone interested in the behavior of synthetic chemicals in the environment or in living systems. Furthermore, a variety of commercial applications can be envisioned for some of the reactions described here.

"Details the legal, organizational, hierarchical, and environmental components of pollution prevention and waste reduction. Illustrates fundamental concepts of pollution prevention, including life-cycle planning and analysis, risk-based pollution control, and industrial ecology."

Periphyton: Functions and Application in Environmental Remediation presents a systematic overview of a wide variety of periphyton functions and applications in environmental remediation, providing readers with an understanding of the biological/ecological features of periphyton, the methodology of their study, and their application in environmental conservation. With increases in environmental stress, anthropogenic impacts, and the global decline in biodiversity, there is a pressing need for methods to assess and improve environmental quality that are rapid, reliable, and cost-effective. Periphyton is an important component of benthic communities and plays a crucial role in the functioning of microbial food webs. Because of a number of advantages, such as a short lifecycle, relative immobility, more rapid responses to environmental stress and anthropogenic impact than any metazoa, ease of sampling, availability of taxonomic/molecular identification, and standardized methodologies for temporal/spatial comparisons, there has, in recent decades, been an increased interest in periphyton as a tool in biological conservation in aquatic ecosystems. Presents case studies that help readers implement similar ecological designs Focuses on the function of periphyton in remediating destructed ecosystems Provides readers with an understanding of periphyton in practice, especially the value of periphyton in enhancing environmental and ecosystem qualities Discusses the role of periphyton in purifying water and its effect on abiotic elements

Environmental Biotechnology: Principles and Applications, Second Edition McGraw Hill Professional

The past 30 years have seen the emergence of a growing desire worldwide that positive actions be taken to restore and protect the environment from the degrading effects of all forms of pollution – air, water, soil, and noise. Since pollution is a direct or indirect consequence of waste production, the seemingly idealistic demand for “zero discharge” can be construed as an unrealistic demand for zero waste. However, as long as waste continues to exist, we can only attempt to abate the subsequent pollution by converting it to a less noxious form. Three major questions usually arise when a particular type of pollution has been identified: (1) How serious is the pollution? (2) Is the technology to abate it available? and (3) Do the costs of abatement justify the degree of abatement achieved? This book is one of the volumes of the Handbook of Environmental Engineering series. The principal intention of this series is to help readers formulate answers to the last two questions above. The traditional approach of applying tried-and-true solutions to specific pollution problems has been a major contributing factor to the success of environmental engineering, and has accounted in large measure for the establishment of a “methodology of pollution control.” However, the realization of the ever-increasing complexity and interrelated nature of current environmental problems renders it imperative that intelligent planning of pollution abatement systems be undertaken.

The depletion of petroleum-derived fuel and environmental concerns have prompted many millennials to consider biofuels as alternative fuel sources. But completely replacing petroleum-derived fuels with biofuels is currently impossible in terms of production capacity and engine compatibility. Nevertheless, the marginal replacement of diesel with biofuel could delay the depletion of petroleum resources and abate the radical climate change caused by automotive pollutants. Energy security and climate change are the two major driving forces for worldwide biofuel development, and also have the potential to stimulate the agro-industry. The development of biofuels as alternative and renewable sources of energy has become critical in national efforts towards maximum self-reliance, the cornerstone of our energy security strategy. At the same time, the production of biofuels from various types of biomass such as plants, microbes, algae and fungi is now an ecologically viable and sustainable option. This book describes the biotechnological advances in biofuel production from various sources, while also providing essential information on the genetic improvement of biofuel sources at both the conventional and genomic level. These innovations and the corresponding methodologies are explained in detail.

In the past decade, officials responsible for clean-up of contaminated groundwater have increasingly turned to natural attenuation-essentially allowing naturally occurring processes to reduce the toxic potential of contaminants-versus engineered solutions. This saves both money and headaches. To the people in surrounding communities, though, it can appear that clean-up officials are simply walking away from contaminated sites. When is natural attenuation the appropriate approach to a clean-up? This book presents the consensus of a diverse committee, informed by the views of researchers, regulators, and community activists. The committee reviews the likely effectiveness of natural attenuation with different classes of contaminants-and describes how to evaluate the "footprints" of natural attenuation at a site to determine whether natural processes will provide adequate clean-up. Included are recommendations for regulatory change. The committee emphasizes the importance of the public's belief and attitudes toward

remediation and provides guidance on involving community stakeholders throughout the clean-up process. The book explores how contamination occurs, explaining concepts and terms, and includes case studies from the Hanford nuclear site, military bases, as well as other sites. It provides historical background and important data on clean-up processes and goes on to offer critical reviews of 14 published protocols for evaluating natural attenuation.

Over 90% of bacterial biomass exists in the form of biofilms. The ability of bacteria to attach to surfaces and to form biofilms often is an important competitive advantage for them over bacteria growing in suspension. Some biofilms are "good" in natural and engineered systems; they are responsible for nutrient cycling in nature and are used to purify waters in engineering processes. Other biofilms are "bad" when they cause fouling and infections of humans and plants. Whether we want to promote good biofilms or eliminate bad biofilms, we need to understand how they work and what works to control them. *Mathematical Modeling of Biofilms* provides guidelines for the selection and use of mathematical models of biofilms. The whole range of existing models - from simple analytical expressions to complex numerical models - is covered. The application of the models for the solution of typical problems is demonstrated, and the performance of the models is tested in comparative studies. With the dramatic evolution of the computational capacity still going on, modeling tools for research and practice will become more and more significant in the next few years. This report provides the foundation to understand the models and to select the most appropriate one for a given use. *Mathematical Modeling of Biofilms* gives a state-of-the-art overview that is especially valuable for educating students, new biofilm researchers, and design engineers. Through a series of three benchmark problems, the report demonstrates how to use the different models and indicates when simple or highly complex models are most appropriate. This is the first report to give a quantitative comparison of existing biofilm models. The report supports model-based design of biofilm reactors. The report can be used as basis for teaching biofilm-system modeling. The report provides the foundation for researchers seeking to use biofilm modeling or to develop new biofilm models. Scientific and Technical Report No.18

This book features the reduction and removal of selenium in wastewater via bioremediation. Arranged over five chapters, this book provides information regarding the interaction between micro-organisms and selenium, and it also explains the biogeochemistry of selenium in engineered ecosystems designed for wastewater treatment. The analytical approaches currently adopted by the scientific community are also described and discussed. Readers will find examples of the biological treatment of selenium contaminated wastewater, and discover a concise overview of selenium removal processes that are currently implemented at lab-scale as well as at industrial scale.

This book examines the practices used or considered for biological treatment of water/waste-water and hazardous wastes. The technologies described involve conventional treatment processes, their variations, as well as future technologies found in current research. The book is intended for those seeking an overview to the biotechnological aspects of pollution engineering, and covers the major topics in this field. The book is divided into five major sections and references are provided for those who wish to dig deeper.

The classic first edition, now back in print! *Environmental Biotechnology: Principles and Applications* is the essential tool for understanding and designing microbiological processes used for environmental protection and improvement. The book lays a foundation in microbiology and engineering principles and provides comprehensive coverage of all the major environmental applications, from traditional ones like activated sludge and anaerobic digestion to emerging applications like detoxification of hazardous chemical and biofiltration of drinking water. An abundance of worked examples that show in a step-by-step way how the tools are used in analysis and design enrich the discussion. *Environmental Biotechnology* is the authoritative source for learning how processes in environmental biotechnology work and how to create reliable processes to meet contemporary and emerging needs. Students, practitioners, and researchers will find this book invaluable. Key features of this first edition include: Consistent backup of the fundamental principles of microbiological processes by their practical applications. Discussion of the traditional applications (e.g., activated sludge and anaerobic digestion) and the emerging applications (e.g., bioremediation and drinking water treatment). Numerous examples illustrating how the design and analysis tools are applied correctly. Each chapter consists of many problems, ranging in scope, that can be assigned as homework, used as supplemental examples in class, or used as study tools. Abundant use of figures to illustrate concepts.

*Microbial Electrochemical and Fuel Cells: Fundamentals and Applications* contains the most updated information on bio-electrical systems and their ability to drive an electrical current by mimicking bacterial interactions found in nature to produce a small amount of power. One of the most promising features of the microbial fuel cell is its application to generate power from wastewater, and its use in the treatment of water to remove contaminants, making it a very sustainable source of power generation that can feasibly find application in rural areas where providing more conventional sources of power is often difficult. The book explores, in detail, both the technical aspects and applications of this technology, and was written by an international team of experts in the field who provide an introduction to microbial fuel cells that looks at their electrochemical principles and mechanisms, explains the materials that can be used for the various sections of the fuel cells, including cathode and anode materials, and provides key analysis of microbial fuel cell performance looking at their usage in hydrogen production, waste treatment, and sensors, amongst other applications. Includes coverage of the types and principles of electrochemical cells Provides information on the construction of fuel cells and appropriate materials Presents the latest on this renewable source of energy and the process for the treatment of waste water

Here is the first book on biotechnological processes for controlling odor and air pollution emanating from industrial and municipal airstreams. Authors from academia and industry describe biotechnological methods ranging from those in laboratory stages to pilot evaluation to full-scale process implementation. In addition to the basic microbiology and

engineering, the design, modeling, and control of bioreactors are discussed in detail.

This book presents the first comprehensive text on construction biomaterials and bioprocesses. It details aspects of construction biotechnology, a new interdisciplinary area involving applications of environmental and industrial microbiology and biotechnology in geotechnical and civil engineering. It also critically reviews all existing and potential construction biotechnology processes. It discusses a number of topics including the biotechnological production of new construction materials such as self-healing concrete, construction biocomposites, construction bioplastics, and biotechnological admixtures to cement. It also addresses construction-related processes like biocementation, bioclogging, soil surface fixation and biosealing, microbial cements and grouts, the biocoating of construction material surfaces, the microbiology and biosafety of the construction environment, the prevention of biocorrosion as well as biodeterioration and biofouling in civil engineering. Biomediated precipitation of calcium, magnesium, and iron compounds as carbonates, phosphates, sulphides, and silicate minerals in soil for its clogging and strengthening are considered from geotechnical, chemical, and microbiological points of view. It offers an overview of the basic microbiology that will enable civil engineers to perform the construction biogeochemical processes. Design principles and considerations for different field implementations are discussed from a practical point of view. The book can be used as a textbook for graduate and senior undergraduate students in biotechnology, civil engineering and environmental engineering as well as a reference book for researchers and practitioners working in this new interdisciplinary area.

This book presents an in-depth, science-based approach to applying key project-management and spatial tools and practices in environmental projects. Providing important data for those considering projects that balance social-economic growth against minimizing its ill-effects on planet Earth, the book discusses various aspects of environmental engineering, as well as formula and analytical approaches required for more informed decision-making. Beginning with a broad overview of the factors and features of environmental processes and management, the book then clearly details the general application of fundamental processes, the characteristics of the different systems in which they occur, and the way in which these factors influence process dynamics, environmental systems, and their possible remedies. While primarily intended for professionals responsible for the management of environmental projects or interested in improving the overall efficiency of such projects, it is also useful for managers in the private, public, and not-for-profit sectors. Further, it is a valuable resource for students at both undergraduate and postgraduate levels, and an indispensable guide for anyone wanting to develop their skills in modern environmental management and related techniques.

Environmental Organic Chemistry focuses on environmental factors that govern the processes that determine the fate of organic chemicals in natural and engineered systems. The information discovered is then applied to quantitatively assessing the environmental behaviour of organic chemicals. Now in its 2nd edition this book takes a more holistic view on physical-chemical properties of organic compounds. It includes new topics that address aspects of gas/solid partitioning, bioaccumulation, and transformations in the atmosphere. Structures chapters into basic and sophisticated sections Contains illustrative examples, problems and case studies Examines the fundamental aspects of organic, physical and inorganic chemistry - applied to environmentally relevant problems Addresses problems and case studies in one volume

Actuating materials hold a promise for fast-spreading applications in smart structures and active control systems, and have attracted extensive attention from scientists of both mechanics and materials sciences communities. High performance and stability of actuating materials and structures play a decisive role in their successive applications as sensors and actuators in structural control and robotics. The advances of actuating materials, however, recently encountered a severe reliability issue. For a better understanding toward this issue, scientific efforts are of paramount significance to gain a deep insight into the intricate deformation and failure behaviors of actuating materials. To examine the state of the art in this subject, the general assembly of IUTAM approved in August, 2002 at Cambridge University, UK, a proposal to hold an IUTAM symposium to summarize the relevant research findings. The main themes of the symposium are: (i) the constitutive relations of actuating materials that couple mechanical, electrical, thermal and magnetic properties, as well as incorporate phase transformation and domain switch; (ii) the physical mechanisms of deformation, damage, and fatigue crack growth of actuating materials; (iii) the development of failure-resilient approaches that base on the macro-, meso-, and micro-mechanics analyses; (iv) the investigation of microstructural evolution, stability of phase transformation, and size effects of ferroelectric ceramics, shape memory alloys, actuating polymers, and bio-actuating materials. The above problems represent an exciting challenge and form a research thrust of both materials science and solid mechanics. The IUTAM Symposium (GA).

Potential benefits from the use of genetically modified organisms--such as bacteria that biodegrade environmental pollutants--are enormous. To minimize the risks of releasing such organisms into the environment, regulators are working to develop rational safeguards. This volume provides a comprehensive examination of the issues surrounding testing these organisms in the laboratory or the field and a practical framework for making decisions about organism release. Beginning with a discussion of classical versus molecular techniques for genetic alteration, the volume is divided into major sections for plants and microorganisms and covers the characteristics of altered organisms, past experience with releases, and such specific issues as whether plant introductions could promote weediness. The executive summary presents major conclusions and outlines the recommended decision-making framework.

"The book is intended for all professionals and researchers interested in wastewater management, whether or not they are familiar with source separation"--Back cover.

Publisher's Note: Products purchased from Third Party sellers are not guaranteed by the publisher for quality, authenticity, or access to any online entitlements included with the product. The classic environmental biotechnology textbook—fully updated for the latest advances This thoroughly revised educational resource presents the biological principles that underlie modern microbiological treatment technologies. Written by two of the field's foremost researchers, Environmental Biotechnology: Principles and Applications, Second Edition, clearly explains the new technologies that have evolved over the past 20 years, including direct anaerobic treatments, membrane-based processes, and granular processes. The first half of the book focuses on theory and tools; the second half offers practical applications that are clearly illustrated through real-world examples. Coverage includes: • Moving toward sustainability • Basics of microbiology • Biochemistry, metabolism, genetics, and information flow • Microbial ecology • Stoichiometry and energetics • Microbial kinetics and products • Biofilm kinetics • Reactor characteristics and kinetics • Methanogenesis • Aerobic suspended-growth processes • Aerobic biofilm processes • Nitrogen transformation and recovery • Phosphorus removal and recovery • Biological treatment of drinking water

This critical review of the status of in situ bioremediation, which is used to clean up contaminated groundwater aquifers and surface soils, has been organized according to possibilities and restrictions. Possibilities are based on present knowledge and indicate that in situ bioremediation can achieve decontamination of aquifers and soils. Restrictions encompass the scientific, engineering, legal, and other questions that stand in the way of successful development and application of in situ bioremediation. Although much has been written about bioremediation, this critical review is unique because it is comprehensive, critical, and integrated. This situation was no accident; the organization of the authorship team and the report's contents were designed to achieve each of the three attributes. Combining a good plan, outstanding individuals contributing, and an incredible amount of work, they created a critical review that defines the technical and

non-technical issues that will determine how much of an impact in situ bioremediation makes on solving the world's challenges for cleanup of our legacy of improperly disposed of materials. Readers of this review will find the issues identified and connected. They will have a solid foundation for research, application, or evaluation of in situ bioremediation in the future.

Water Recycling and Resource Recovery in Industry: Analysis, Technologies and Implementation provides a definitive and in-depth discussion of the current state-of-the-art tools and technologies enabling the industrial recycling and reuse of water and other resources. The book also presents in detail how these technologies can be implemented in order to maximize resource recycling in industrial practice, and to integrate water and resource recycling in ongoing industrial production processes. Special attention is given to non-process engineering aspects such as systems analysis, software tools, health, regulations, life-cycle analysis, economic impact and public participation. Case studies illustrate the huge potential of environmental technology to optimise resource utilisation in industry. The large number of figures, tables and case studies, together with the book's multidisciplinary approach, makes Water Recycling and Resource Recovery in Industry: Analysis, Technologies and Implementation the perfect reference work for academics, professionals and consultants dealing with industrial water resources recovery. Contents Part I: Industrial reuse for environmental protection Part II: System analysis to assist in closing industrial resource cycles Part III: Characterisation of process water quality Part IV: Technological aspects of closing industrial cycles Part V: Examples of closed water cycles in industrial processes Part VI: Resource protection policies in industry

The use of membranes is increasing throughout industry, and particularly the water industry. The municipal water industry, which is concerned with the provision of clean drinking water to the population, is a big user and developer of membrane technology which helps it to provide water free of pathogens, chemicals, odours and unwanted tastes. Municipal authorities also have to process sewage and waste water, and membranes are used extensively in these processes. The MBR Book covers all important aspects of Membrane BioReactors in water and waste water treatment, from the fundamentals of the processes via design principles to MBR technologies. Industrial case studies help interpret actual results and give pointers for best practice. Useful appendices provide data on commercial membranes and international membrane organisations. \* Major growth area in the water industries \* Internationally-known author \* Principles and practice, backed by case studies

Principles of Water Treatment has been developed from the best selling reference work Water Treatment, 3rd edition by the same author team. It maintains the same quality writing, illustrations, and worked examples as the larger book, but in a smaller format which focuses on the treatment processes and not on the design of the facilities.

At hundreds of thousands of commercial, industrial, and military sites across the country, subsurface materials including groundwater are contaminated with chemical waste. The last decade has seen growing interest in using aggressive source remediation technologies to remove contaminants from the subsurface, but there is limited understanding of (1) the effectiveness of these technologies and (2) the overall effect of mass removal on groundwater quality. This report reviews the suite of technologies available for source remediation and their ability to reach a variety of cleanup goals, from meeting regulatory standards for groundwater to reducing costs. The report proposes elements of a protocol for accomplishing source remediation that should enable project managers to decide whether and how to pursue source remediation at their sites.

A provocative analysis of what it means to be human in an era of incomprehensible technological complexity and change. In The Techno-Human Condition, Braden Allenby and Daniel Sarewitz explore what it means to be human in an era of incomprehensible technological complexity and change. They argue that if we are to have any prospect of managing that complexity, we will need to escape the shackles of current assumptions about rationality, progress, and certainty, even as we maintain a commitment to fundamental human values. Humans have been co-evolving with their technologies since the dawn of prehistory. What is different now is that we have moved beyond external technological interventions to transform ourselves from the inside out—even as we also remake the Earth system itself. Coping with this new reality, say Allenby and Sarewitz, means liberating ourselves from such categories as “human,” “technological,” and “natural” to embrace a new techno-human relationship. Contributors Boris Barbour, Mario Biagioli, Paul S. Brookes, Finn Brunton, Alex Csiszar, Alessandro Delfanti, Emmanuel Didier, Sarah de Rijcke, Daniele Fanelli, Yves Gingras, James R. Griesemer, Catherine Guaspare, Marie-Andrée Jacob, Barbara M. Kehm, Cyril Labbé, Jennifer Lin, Alexandra Lippman, Burkhard Morganstern, Ivan Oransky, Michael Power, Sergio Sismondo, Brandon Stell, Tereza Stöckelová, Elizabeth Wager, Paul Wouters

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