



# **Natural Hazards and Disasters**

## **Chapter 17**

### **Impacts of Asteroids and Comets**

# Hazards Due To Comets And Asteroids

**John S. Lewis**



## **Hazards Due To Comets And Asteroids:**

*Hazards Due to Comets and Asteroids* Tom Gehrels, Mildred Shapley Matthews, A. M. Schumann, 1994 In 1993 the U S Department of Defense declassified information dealing with frequent explosions in the upper atmosphere caused by meteoric impact It is estimated that impacts have occurred of a magnitude equivalent to the atomic bomb detonated at Hiroshima Not all such space voyagers meet their end in the atmosphere however huge craters attest to the bombardment of earth over millions of years and a major impact may have resulted in the extinction of dinosaurs An impact in Siberia near the beginning of this century proves that such events are not confined to geologic time *Hazards Due to Comets and Asteroids* marks a significant step in the attempt to come to grips with the threats posed by such phenomena It brings together more than one hundred scientists from around the world who draw on observational and theoretical research to focus on the technical problems related to all aspects of dealing with these hazards searching for and identifying hazardous comets and asteroids describing their statistics and characteristics intercepting and altering the orbits of dangerous objects and applying existent technologies rocket boosters rendezvous and soft landing techniques instrumentation to such missions The book considers defensive options for diverting or disrupting an approaching body including solar sails kinetic energy impacts nuclear explosives robotic mass drivers and various propulsion systems A cataclysmic impact posing a threat to life on Earth is a possibility that tomorrow s technology is capable of averting This book examines in depth the reality of the threat and proposes practical measures that can be initiated now should we ever need to deal with it

*Hazards Due to Comets and Asteroids* Tom Gehrels, 2021-11-30 In 1993 the U S Department of Defense declassified information dealing with frequent explosions in the upper atmosphere caused by meteoric impact It is estimated that impacts have occurred of a magnitude equivalent to the atomic bomb detonated at Hiroshima Not all such space voyagers meet their end in the atmosphere however huge craters attest to the bombardment of earth over millions of years and a major impact may have resulted in the extinction of dinosaurs An impact in Siberia near the beginning of this century proves that such events are not confined to geologic time *Hazards Due to Comets and Asteroids* marks a significant step in the attempt to come to grips with the threats posed by such phenomena It brings together more than one hundred scientists from around the world who draw on observational and theoretical research to focus on the technical problems related to all aspects of dealing with these hazards searching for and identifying hazardous comets and asteroids describing their statistics and characteristics intercepting and altering the orbits of dangerous objects and applying existent technologies rocket boosters rendezvous and soft landing techniques instrumentation to such missions The book considers defensive options for diverting or disrupting an approaching body including solar sails kinetic energy impacts nuclear explosives robotic mass drivers and various propulsion systems A cataclysmic impact posing a threat to life on Earth is a possibility that tomorrow s technology is capable of averting This book examines in depth the reality of the threat and proposes practical measures that can be initiated now should we ever need to

deal with it     Mitigation of Hazardous Comets and Asteroids M. J. S. Belton, 2004-09-06 It is known that large asteroids and comets can collide with the Earth with severe consequences Although the chances of a collision in a person's lifetime are small collisions are a random process and could occur at any time This book collects the latest thoughts and ideas of scientists concerned with mitigating the threat of hazardous asteroids and comets It reviews current knowledge of the population of potential colliders including their numbers locations orbits and how warning times might be improved The structural properties and composition of their interiors and surfaces are reviewed and their orbital response to the application of pulses of energy is discussed Difficulties of operating in space near or on the surface of very low mass objects are examined The book concludes with a discussion of the problems faced in communicating the nature of the impact hazard to the public     Hazards Due to Comets and Asteroids, 1994     Comet and Asteroid Impact Hazards on a Populated Earth John S. Lewis, 2000 Disk contains HAZARDS version 5.5 designed to predict asteroid or comet impacts with the Earth

**Controversy Catastrophism and Evolution** Trevor Palmer, 2012-12-06 In *Controversy* Trevor Palmer fully documents how traditional gradualistic views of biological and geographic evolution are giving way to a catastrophism that credits cataclysmic events such as meteorite impacts for the rapid bursts and abrupt transitions observed in the fossil record According to the catastrophists new species do not evolve gradually they proliferate following sudden mass extinctions Placing this major change of perspective within the context of a range of ancient debates Palmer discusses such topics as the history of the solar system present day extraterrestrial threats to earth hominid evolution and the fossil record     **Planetary Defense** Nikola Schmidt, 2018-12-26 Planetary defense from near Earth objects such as asteroids is a far more nuanced and challenging topic than it might seem Each day technology is making it easier to detect asteroid impact threats in advance but at present there is still no easy way to design and implement any form of global defense This book examines how various asteroid deflection methods can change global political affairs The authors believe that the final policy for potential Earth impacts should be based on practical engineering solutions and innovative architectural structures while at the same time reflecting the most recent political science contributions in ethical security studies and security cosmopolitanism Their focus is not limited to effective engineering solutions but rather extends to how such proposals resonate in possible political structures of the future Planetary defense cannot be achieved with technology alone the chapters in this volume highlight the issues that arise when space science and technology intersect with political science This complex interdisciplinary project not only demands global participation and collaboration but also proposes the way we can achieve it The authors explore various concepts of governance and their far reaching implications for planetary defense and vice versa how scientific progress in Solar System observations and asteroid collision engineering influence political science and put pressure on the international legal framework The text is intentionally written for a diverse scholarly and diplomatic audience in a style accessible to non specialists and practitioners and can be read by those across diverse disciplinary backgrounds     **Dynamics of Comets**

**and Asteroids and Their Role in Earth History** Shin Yabushita, Jacques Henrard, 2013-06-29 The last decade of this century has seen a renewed interest in the dynamics and physics of the small bodies of the Solar System Asteroids Comets and Meteors New observational evidences such as the discovery of the Edgeworth Kuiper belt refined numerical tools such as the symplectic integrators analytical tools such as semi numerical perturbation algorithms and in general a better understanding of the dynamics of Hamiltonian systems all these factors have converged to make possible and worthwhile the study over very long time spans of these minor objects Also the public the media and even some political assell blies have become aware that these minor objects of our planetary environnement could become deadly weapons Apparently they did have a role in Earth history and a role more ominous than predicting defeat or victory why not to batches of credulous rulers Remembering what may have happened to the dinosaurs but keeping all the discretion necessary to avoid creating irrational scares it may not be unwise or irrelevant to improve our knowledge of the physics and dynamics of these objects and to study in particular their interactions with our planet *Frontiers of Space Risk* Richard J. Wilman, Christopher J. Newman, 2018-06-13 CHOICE Recommended Title March 2019 This book brings together diverse new perspectives on current and emerging themes in space risk covering both the threats to Earth based activities arising from space events natural and man made and those inherent in space activity itself Drawing on the latest research the opening chapters explore the dangers from asteroids and comets the impact of space weather on critical technological infrastructure on the ground and in space and the more uncertain threats posed by rare hazards further afield in the Milky Way Contributors from a wide range of disciplines explore the nature of these risks and the appropriate engineering financial legal and policy solutions to mitigate them The coverage also includes an overview of the space insurance market engineering and policy perspectives on space debris and the sustainability of the space environment The discussion then examines the emerging threats from terrorist activity in space a recognition that space is a domain of war and the challenges to international cooperation in space governance from the nascent asteroid mining industry Features Discusses developments and risks relevant to the public and private sectors as access to the space environment expands Offers an interdisciplinary approach blending science technology and policy Presents a high level international focus with contributions from academics policy makers and commercial space consultants *Asteroids III* William F. Bottke, Alberto Cellino, Paolo Paolicchi, Richard P. Binzel, 2002-12-01 Two hundred years after the first asteroid was discovered asteroids can no longer be considered mere points of light in the sky Spacecraft missions advanced Earth based observation techniques and state of the art numerical models are continually revealing the detailed shapes structures geological properties and orbital characteristics of these smaller denizens of our solar system This volume brings together the latest information obtained by spacecraft combined with astronomical observations and theoretical modeling to present our best current understanding of asteroids and the clues they reveal for the origin and evolution of the solar system This collective knowledge prepared by a team of more than one hundred international

authorities on asteroids includes new insights into asteroid meteorite connections possible relationships with comets and the hazards posed by asteroids colliding with Earth The book s contents include reports on surveys based on remote observation and summaries of physical properties results of in situ exploration studies of dynamical collisional cosmochemical and weathering evolutionary processes and discussions of asteroid families and the relationships between asteroids and other solar system bodies Two previous Space Science Series volumes have established standards for research into asteroids Asteroids III carries that tradition forward in a book that will stand as the definitive source on its subject for the next decade

The Dynamics of Small Bodies in the Solar System B.A. Steves, Archie E. Roy, 2013-06-29 The reader will find in this volume the Proceedings of the NATO Advanced Study Institute held in Maratea Acquafredda Italy between June 29 and July 12 1997 entitled THE DYNAMICS OF SMALL BODIES IN THE SOLAR SYSTEM A MAJOR KEY TO SOLAR SYSTEM STUDIES This Advanced Study Institute was the latest in the Cortina series of NATO ASI s begun in the early 1970 s firstly under the directorship of Professor Victor Szebehely and subsequently under Professor Archie Roy All except the latest were held at the Antonelli Institute Cortina d Ampezzo Italy Many of those now active in the field made their first international contacts at these Institutes The Institutes bring together many of the brightest of our young people working in dynamical astronomy celestial mechanics and space science enabling them to obtain an up to date synoptic view of their subjects delivered by lecturers of high international reputation The proceedings from these institutes have been well received in the international community of research workers in the disciplines studied The present institute included 15 series of lectures given by invited speakers and some 45 presentations made by the other participants The majority of these contributions are included in these proceedings Comets and the Origin and Evolution of Life Paul J. Thomas, Christopher F.

Chyba, Christopher P. McKay, 2013-03-09 This volume considers the role comets may have played in the origins and evolution of life particularly in light of recent investigations of Halley s comet of new insights into organic synthesis in meteorites and comets and of new results of numerical simulations of cometary orbits and impacts on Earth The book is intended as a comprehensive review of current research accessible to graduate students and others new to the field Each chapter was prepared by an expert to give an overview of an aspect of the field and carefully revised by the editors for uniformity in style and presentation **Comet/Asteroid Impacts and Human Society** Peter T. Bobrowsky, Hans Rickman, 2007-06-10

Leading specialists in various disciplines were first invited to a multidisciplinary workshop funded by ICSU on the topic to gain a better appreciation and perspective on the subject of comet asteroid impacts as viewed by different disciplines This volume provides a necessary link between various disciplines and comet asteroid impacts Collisional Processes in the Solar System Mikhail Ya. Marov, Hans Rickman, 2012-12-06 The exploration of our Solar System is rapidly growing in importance as a scientific discipline During the last decades great progress has been achieved as the result of space missions to planets and small bodies as asteroids and comets and improved remote sensing methods as well as due to refined techniques

of laboratory measurements and a rapid progress in theoretical studies involving the development of various astrophysical and geophysical models. These models are based in particular on the approach of comparative planetology becoming a powerful tool in revealing evolutionary processes which have been shaping the planets since their origin. Comets and asteroids being identified as remnants of planetary formation serve as a clue to the reconstruction of Solar System history because they encapsulated the primordial material from which the planets were built up. At the same time these interplanetary carriers of original matter and messengers from the past being triggered by dynamical processes well outside our neighboring space were responsible for numerous catastrophic events when impacting on the planets and thus causing dramatic changes of their natural conditions. In the crossroads of astronomy and geophysics recent years have seen a growing understanding of the importance of collisional processes throughout the history of the Solar System and therefore the necessity to get more insight into the problem of interactions of planets and small bodies.

**Perilous Planet Earth**  
Trevor Palmer, 2003-06-12 A readable account of the history of natural disasters throughout history Asteroids, Comets, Meteors 1993 A. Milani, Mario Badiale, A. Cellino, 2012-12-06 THE MEETING The IAU Symposium 160 ASTEROIDS COMETS METEORS 1999 has been held at Villa Carlotta in Belgirate on the shore of Lago Maggiore Italy from June 14 to June 18 1993. It has been organized by the Astronomical Observatory of Torino and by the Lunar and Planetary Institute of Houston. It has been a very large meeting with 323 registered participants from 38 countries. The scientific program included 29 invited reviews, 106 oral communications and 215 posters. The subjects covered included all the aspects of the studies of the minor bodies of the solar system including asteroids, comets, meteors, meteorites, interplanetary dust with special focus on the interrelationships between these. The meeting was structured as follows: 5 morning plenary sessions have been devoted to invited reviews on 1 search programs, 2 populations of small bodies, 3 dynamics, 4 physical observations and modelling, 5 origin and evolution. Two afternoon plenary sessions have been devoted to space missions to small bodies and to interrelationships between the different populations. The afternoon parallel sessions have been devoted to dynamics of comets, Toutatis, Ida, Gaspra, physical processes in cometary comae and tails, meteorites, the cosmogonic message from cometary nuclei, physics of asteroids, the interplanetary dust complex, comet nuclei, meteors, composition and material properties of comets, dynamics of asteroids.

Disaster Medicine Gregory R. Ciotto, 2006-01-01 This new volume includes Individual Concepts and Events sections that provide information on the general approach to disaster medicine and practical information on specific disasters. You will also find an exhaustive list of chapters on the conceivable chemical and biologic weapons known today as well as strategies for the management of future events or possible scenarios for which there is no precedent.

**BOOK JACKET Catastrophic Events Caused by Cosmic Objects** Vitaly Adushkin, Ivan Nemchinov, 2007-10-09 An asteroid or comet will inevitably strike the Earth some day and potentially cause great destruction. This volume considers hazards due to collisions with cosmic objects particularly in light of recent investigations of impacts by

the authors Each chapter written by an expert contains an overview of an aspect and new findings in the field Coverage describes and numerically estimates the main hazardous effects

**International Seminar on Nuclear War and Planetary Emergencies** Antonino Zichichi,2001 Full Title Water OCo Pollution Biotechnology OCo Transgenic Plant Vaccine Energy Black Sea Pollution AIDS OCo Mother Infant HIV Transmission Transmissible Spongiform Encephalopathy Limits of Development OCo Megacities Missile Proliferation and Defense OCo Information Security Cosmic Objects Desertification Carbon Sequestration and Sustainability Climatic Changes Global Monitoring of Planet Mathematics and Democracy Science and Journalism Permanent Monitoring Panel Reports Water for Megacities Workshop Black Sea Workshop Transgenic Plants Workshop Research Resources Workshop Mother Infant HIV Transmission Workshop Sequestration and Desertification Workshop Focus Africa Workshop Contents Opening Session T D Lee K M B Siegbahn A Zichichi J K C Ma D Bodansky R G Will W P T James C M Wilfert A D Lopez Water OCo Pollution A A Keller S M Hassanizadeh Biotechnology OCo Transgenic Plant Vaccine F Sala R X Fang J P Kraehenbuhl Energy J Ongena A Yu Gagarinski Pollution OCo Black Sea V I Mikhailov I Salihoglu AIDS OCo Mother Infant HIV Transmission G de Th r F Barre Sinoussi M F Rea H Pratomo Transmissible Spongiform Encephalopathy P Brown Limits of Development OCo Megacities W J Cosgrove K C Sivaramakrishnan J M Borthagaray Missile Proliferation and Defense OCo Information Security L Wood V Tsigichko A Kroutskikh A Lehmann A Piontkovsky Cosmic Objects W F Huebner A Cellino A F Cheng Desertification Carbon Sequestration and Sustainability N J Rosenberg Climatic Changes OCo Cosmic Objects Global Monitoring of Planet Mathematics and Democracy Science and Journalism T Dyson W M Washington R Walgate K C Sivaramakrishnan Permanent Monitoring Panel Reports K M B Siegbahn D Johnson R Ragaini Z Rudzikas G Palshin H Schubert J Pozela Megacities Workshop OCo Water as a Limit to Development W J Cosgrove J M Borthagaray A G Pozo G G Serra P F Ricci K C Sivaramakrishnan I A Amer Workshop on Environmental Impacts of Oil Pollution in the Black Sea R Ragaini V Mikhailov L Mirianashvili I Salihoglu K Thompson E Okandan D Dorogan Transgenic Plants as Vaccines Impact on Developing Countries Workshop G Levi C J Arntzen M Pezzotti J P Kraehenbuhl J K C Ma Z Eshhar Z K Xu R X Fang Research Resources Workshop W Sprigg P Uhler Mother Infant HIV Transmission Workshop G de Th r C M Wilfert H Pratomo M F Rea R ZetterstrAm D Birx Linking the Conventions Soil Carbon Sequestration and Desertification Control Workshop L Olsson Limits of Development Focus Africa C A Reynolds J F Kuka M Farah M Diop Readership Ecologists meteorologists biotechnologists AIDS researchers doctors physicists and social scientists

**Water-pollution - Proceedings Of The International Seminar On Nuclear War And Planetary Emergencies - 25th Session** Richard C Ragaini,2001-07-19 Full Title Water Pollution Biotechnology Transgenic Plant Vaccine Energy Black Sea Pollution AIDS Mother Infant HIV Transmission Transmissible Spongiform Encephalopathy Limits of Development Megacities Missile Proliferation and Defense Information Security Cosmic Objects Desertification Carbon Sequestration and Sustainability Climatic Changes Global Monitoring of Planet Mathematics and Democracy Science and



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