Atlas of the Galilean Satellites

Complete color global maps and high-resolution mosaics of Jupiter's four large moons – Io, Europa, Ganymede and Callisto – are compiled for the first time in this important atlas.

The satellites are revealed as four visually striking and geologically diverse planetary bodies: Io's volcanic lavas and plumes and towering mountains; Europa's fissured ice surface; the craters, fractures and polar caps of Ganymede; and the giant impact basins, desiccated plains and icy pinnacles of Callisto.

Featuring images taken from the pathfinding Voyager and the recent Galileo orbiter missions, this atlas is a comprehensive mapping reference guide for researchers. It contains 65 global and regional maps, nearly 250 high-resolution mosaics, and images taken at resolutions as high as 6 meters.

Paul Schenk is a Staff Scientist at the Lunar and Planetary Institute in Houston, Texas, where he specializes in impact craters and other features on icy satellites, and in 3-D imaging. He is currently analyzing released *Cassini* data of the icy satellites of Saturn, and assisting the *New Horizons* team plan their encounter with Pluto in 2015.

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Galilean Satellites

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I dedicate this *Atlas* to Alice and Bernard, Carl Seyfert, William McKinnon and David Bonett, Pup, and lastly Robby the Robot (*Forbidden Planet*, 1956), for that immortal refrain, "Sorry, miss, I was giving myself an oil job."

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Preface

This *Atlas* is not what it should be. If fate had been kinder, each of the four planetary bodies represented here would have had its own *Atlas*, each larger than this volume. Don't blame the author, though; the culprit is an elegant yet critical device called the HGA, explained in Chapter 1.3. Should you pass over this book on your way to the used "pilates-at-home" bookshelf or toss it in the recycle paper bin? I hope not. Despite its shortcomings, this *Atlas* is the most complete representation we will have of the surfaces of Jupiter's large Galilean satellites for the next decade, objects that should be called planets, regardless of anyone's peculiar definition of that term.

Complex in detail and beautiful in a universe of wonders, the Galilean satellites fill the eye and mind in equal measure. They are also of considerable historical importance. My place in their history begins in 1972, the year I entered high school. A notice in the *Buffalo Evening News* announced the hiring of a manager to lead a new *Mariner* mission to the outer planets and their moons. At the time, these worlds were little more than dusky points of light. The *Voyager* mission, as it came to be called, was in reality a poor-cousin replacement for the Grand Tour, an ambitious plan to tour the entire Outer Solar System with a fleet of spacecraft.

Younger than NASA by only 31 days, I followed the USA into space along with Walter Cronkite and Jules Bergman on live TV, collecting newspaper and magazine clippings (the Internet was two decades away, information flowed a little more slowly). As awesome as the Apollo landings were to watch (I was but 10 years old), and the first Mars pictures of huge volcanoes and canyons that followed, it was the cold distant giant planets and especially their unfamiliar moons that were the great frontier of my imagination. The two *Voyager* spacecraft, launching in 1977, were the first true exploration of this frontier.

In 1979, I joined the *Voyager* mission as one of three NASA summer interns (Figure *i*). I arrived at the Jet Propulsion Lab in Pasadena two weeks before the *Voyager* 2 encounter with Jupiter and entered the beehive

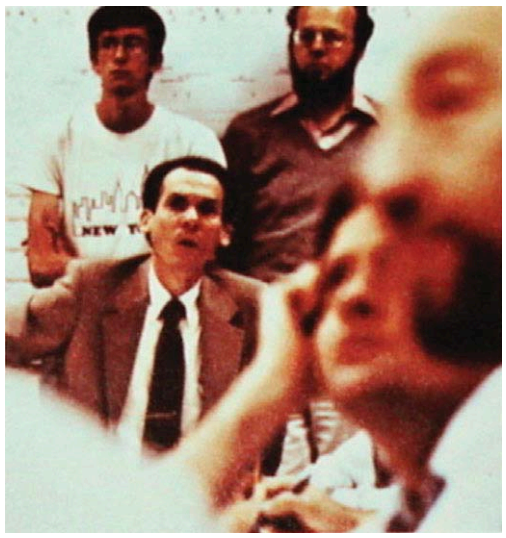

Figure *i* The author, beardless, standing behind Dr. Ed Stone, *Voyager* Project Scientist, looks on dispassionately during a daily situation briefings during the heady days of Jupiter encounter, July 1979. Why a lowly summer intern was allowed into such important meetings I'll never know! I can no longer recall the subject that captured Dr. Stone's attention that day. That's a fuzzy Dr. Lonnie Lane in the far right foreground.

known as Science Investigation Support Team on the third floor of Bldg. 264. There I met Ellis Miner, Jude Montalbano, Linda (Horn) Spilker, and a bunch of crazy wonderful people supremely dedicated to the success of the project. Each day Jupiter appeared a little bit bigger in our TV monitors until the crescendo on July 9th. A highlight would be the first high-resolution views of Europa, which appeared on our monitors at about noon as I recall. It was a unique experience never repeated. JPL employees and scientists alike witnessed exploration live on TV as *Voyager* images were displayed in real time. For me there was no looking back from that rapturous summer.

This *Atlas* represents three decades of personal effort invested in these planetary bodies since 1979. It came into being because of the work I have been doing mapping the topography of these worlds. In the course of that work I accumulated knowledge of the geography of these worlds and a library of images representing their surfaces that are unavailable anywhere else. It was time to assemble that knowledge in one place and "tell the world." The digital images used in the *Atlas* were produced using software mostly developed at the US Geologic Survey in Flagstaff, AZ, and maintained by the staff of the Lunar and Planetary Institute, to all of whom I am indebted. However, image selection, geometric control and registration, mosaic and map formatting, and all other aspects of map production are the sole responsibility of the author.

The purpose of the *Atlas* is to present the collective imaging data set for these satellites as currently possessed by the human race in the year 2009 in a compact complete format. (*New Horizons* data from the Jupiter system are being processed as of this writing but nowhere exceed *Voyager* or *Galileo* coverage in resolution.) Brief descriptions are included to explain the nature of the images, introduce key topics, and provide context for the maps and images and some of the important features shown. But the basic goal here is to show the pictures, not to present an extended discourse on planetary geology or geophysics.

I have experienced my fair share of scientific insights, those unique exhilarating moments when seemingly disparate ideas or data merge into a unifying concept previously unknown. Many of those are described here, including plate tectonics and polar wander on Europa, mountain formation on Io, crater chains on Callisto formed by disrupted comets, among others. As a result, the text tends to be biased toward my own perspective, for which I make no apologies. Although I endeavor to reflect

our current best understanding of the evolution of these bodies, the text simply cannot be regarded as complete, fair, or perfect, for the pen had to be put down at some point. (Please report errors to galsat400@gmail.com) Indeed it may not matter much as some, or perhaps most, of the details or even the basic outline of their planetary histories are likely different in reality than described here. Paraphrasing Dr. Morbius, "My evil self is at the keyboard, and I have no power to stop it!"

The second goal of the *Atlas* is to provide a complete and accurate reference resource of the *Galileo* and *Voyager* image library, with all high-resolution image mosaics properly located on the surface for the first time. This *Atlas* is the first compilation to show all the highest resolution image data (all those better than 750 meters per pixel) complete and in their regional context. It is hoped that these words and pictures will be only a starting point for the reader on their own voyage of discovery!

All image products in this *Atlas*, unless noted, are the work of the author and should be credited to Paul Schenk, Lunar and Planetary Institute.

Paul Michael Schenk
April 2009

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