INTRODUCTION

QUANTAVOLUTION VS. EVOLUTION

Some millions of persons have lately begun to read about ancient catastrophes. In this, they have been recapturing a habit of their ancestors who had been schooled, whatever their religion, to believe that once upon a time, in the beginning of mankind, terrible disasters of earth, air, fire and water engulfed the world.

As so often happens, what interests the public coincides with what interests scientists. Impelled by an intuition that is common to both the multitude of persons and the body of scholars, the human mind today is moving into an area "where the action is". For perhaps no more exciting and important a set of problems is to be found anywhere in there alms of science and scholarship.

Every discipline is implicated in the theory of ancient catastrophes - psychology, sociology, linguistics, archaeology, biology, physics, chemistry, astronomy, and geology, together with their many subdivisions down to special and new sciences, such as plasma physics, dendrochronology, and mega-vitamin therapy.[1] It has something to say about "the Jupiter Effect," "the Ion Effect," and "the Bermuda Triangle," not to mention "Ancient Astronauts," and the hominids of Olduvai Gorge. Every bite of the archaeologist's spade, every oceanographer's deep coring of the sea

[1] A. de Grazia (1975)

bottom, every penetration of outer spaces seems capable of attracting the attention of the catastrophist - that is, the potential quantavolutionist of natural history and human origins.

THE UNIFORMITARIAN RESISTANCE

The history of science took a sharp turn around 150 years ago.[2] Before then it was assumed that life on earth had originated recently and was wracked by natural disasters. Although this was believed largely on the "say-so" of ancient theologians and scientists, fresh evidence was being unearthed by famous scientists such as Georges Cuvier and William Buckland.(Figure 1 gives the names and main positions of some prominent catastrophists.)

Cuvier, who is sometimes called "the father of paleontology," divided the history of the world into four epochs, each with its own animals, each ended by great flood. In only the last of these ages, the present epoch, were men and living mammals present, stated Cuvier.[3] He was here mistaken; hardly had he laid down his pen, when human remains were found alongside the bones of extinct mammoths.

By contrast, the upcoming scientists of the last century argued that the world's history was long and evolutionary. On their side were those who were to become the treasured ancestors of science today - Charles Lyell (1795-1875) in geology, Charles Darwin (1809-1882) in biology, Pierre-Simon Laplace (1749- 1827) in astronomy, and Lewis H. Morgan (1818-1881) as well as the versatile communist, Friedrich Engels (1820-1895), in sociology and anthropology.

The new group came to dominate scientific circles and scientific thought. The catastrophists disappeared from the scientific mind save as an old enemy. The victors advanced the principle of uniformitarianism. Their minions scorned the catastrophists.

In the words of Charles Lyell, "the ancient changes of the animate and inanimate world, of which we find memorials in the Earth's crust, may be similar both in kind and degree to those which are now in progress."[4] Given time, the forces of nature that we experience today would have

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[2] Gillispie (1951)

[3] Cuvier (1831)

[4] Lyell (1831-4), quoted by Albritton (1974) 857

caused everything in life and nature that greets our senses. The tallest mountains and the most bizarre fish would have come about gradually, over a long time and by small increments of change.

Indeed, asserted the uniformitarians, the short span of time demanded by the catastrophists was absurdly incapable of bringing forth the great variety of nature; a reader will sometimes encounter, as a ludicrous target, the date proposed by Archbishop James Ussher (1581-1656), which set the creation of the world by God at 9 a. m. on October 26, 4004 B. C.

Figure 1

PROMINENT CATASTROPHISTS (QUANTAVOLUTIONISTS) SINCE THE BEGINNINGS OF MODERN SCIENCE*

	Significant publication date	**Requires divine action**	**Short-term for reconstructed earth**	**Intrusion of extra-terrestrial forces**	**Mankind was catastrophized**
Giordano Bruno	1584			X	X
William Whiston	1719	X	X	X	X
Giambattista Vico	1730		X	X	X
Nic.-Ant. Boulanger	1766		X	X	X
Giov. R. Carli-Rubbi	1780		X	X	X
Georges Cuvier	1826		X		
William Buckland	1883	X	X		
Ignatius Donnelly	1883		X	X	
Isaac Vail	1905		X	X	
Hans Hoerbiger	1913		X	X	
George McCr. Price	1926	X	X		
W. Comyns Beaumont	1932		X	X	

Howard B. Baker	1932		X	X	
Hans Bellamy	1936		X	X	
Claude Schaeffer	1948				
Immanuel Velikovsky	1950		X	X	X
A. Kellv & F. Dachille	1953		X	X	
Hugh A. Brown	1967		X		
Melvin Cook	1966	X	X		
Donald Patten	1966		X	X	
Charles Hapgood	1970		X		

* The list excludes the work of lesser-known and mostly younger quantavolutionists. I. Velikovsky, Ralph Juergens, Livio Stecchini, Gilbert Davidowitz, and Zvi Rix have recently died, leaving many unpublished manuscripts. A few of the scholars who are currently active are Robert Bass, John Bimson. Dwardu Cardona, William Corliss, Eric Crew, Frank Dachille, Eva Danelius, Ragnar Forshufvud, Brendan O'Gheoghan, Stephen Gould, Lewis Greenberg, George Grinnell. Peter James, Julian Jaynes, Frederic Jueneman. Allan Kelly, Alexander Kondratov, Malcolm Lowery, Christoph Marx. Earl Milton, Brian Moore, William Mullen, G. van Oosterhout, Alan Parry, C. J. Ransom, M. G. Reade, Lynn Rose, Eddie Schorr, Martin Sieff, Warner Sizemore, David Talbott, S. K. Vsekhsvyatskii, Robert Wescott, Irving Wolfe, and Jerry Ziegler; *j'en passe et des meilleurs.* Also the *Creation Research Quarterly* group (Ann Arbor, Mich.); the group of the Society for the Study of Interdisciplinary issues (England); the *Kronos* group (Glassboro College, N. J.); the Lethbridge University, Canada, group (E. R. Milton). and the *Catasirophist Geology* group (Rio de Janeiro, H. Kloostermann). Nor does the table include the "Ancient Astronaut" school (Robert Temple, Erich von Däneken) or "life on other planets" students (Carl Sagan), or contemporary "flying saucer" discussants, or "biblical literalists." Furthermore, the list does not include many scientists. such as C. E. R. Bruce, D. Ager, H. Urey, J. Lamar Worzel., or C. Emiliani, who use catastrophe to explain important episodes of natural history. It may be of interest to place C. Lyell, C. Darwin, S. Freud, A. Wegener, and A. Einstein in the chart: all would vote "No" on all questions. Yet interesting passages and events in the lives of all of them have to do with catastrophic episodes and anomalies.

Actually, when pressed on the matter today, a uniformitarian will say

that he is pursuing a method, not assuming an absolute reality[5] . He is saying: I can explain almost everything I see very well by assuming at the start that, whether a mountain or man, it came about gradually, in increments, point by point. That is, he uses a *uniformitarian model* to frame what be discovers.

QUANTAVOLUTION BY CATASTROPHE

By the same token, in this book, I advance a catastrophic model. It, too, is a method. By using the idea that great forces can cause great changes in a short time, I am enabled to achieve a fairly consistent and defensible reconstruction of natural history and human history. I use new terms in referring to this point of view. I call it "quantavolution", for in contrast to evolution, it considers "quanta-jumps" to be the main feature of change (-(-volution). "Primeval quantavolution," then, would be the saltatory evolutionary science characterizing the first ages (primeval) of nature and humanity.

From time to time, I also use the new term, "revolutionary" primevalogy, to stand for the science of catastrophe. For the theory presented and discussed is much more powerful in its range and effects than is conveyed by the idea of a great flood or fire. "Revolutionary" stands in contrast to "evolutionary" and "uniformitarian"; these last words imply small changes occurring over vast periods of time under conditions that have not basically altered over a billion years and more. By contrast, "revolutionary" means intense, abrupt, large-scale change (the same meaning as it has in politics). "A comet produced the last revolution of our globe," wrote G. R. Carli, an early scientific catastrophist, in his *American Letters* of 1780.[6] And it is the meaning that Georges Cuvier had in mind when, a half-century afterwards, he used the phrase "revolutions of the globe" in his discussion of fossil paleontology.

Much that we admire and respect in this world, including our very being as humans, must logically be thought of as the "good" side of the catastrophes of which we speak. Humanity, art, institutions and science are products of the most ancient catastrophes. So, again, the words

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[5] *Ibid.,* 859

[6] Carli (1780) 329

"quantavolution" and "revolution" may be preferable, or at least useful to remember, in connection with the wholly negative word "catastrophe".

Many quantavolutionists, unlike myself, may refuse to set down a base line of time. Some quantavolutionists may set a single clock of the ages ticking at four billion years ago, and introduce a great leap every million or hundred million years. As one of them, geologist Derek Ager, has concluded, "the history of any one part of the earth, like the life of a soldier, consists of long periods of boredom and short periods of terror."[7] Generally, the farther back a quantavolutionary sets his events, the more be is accepted by the scientific community; for the idea that contemporary scientists can least tolerate is the idea that the world has been catastrophized recently.

Nevertheless, after years of attempting to bridge the vast chasm between a quantavolution that uses the long time-scale of astronomy and geology and that which adopts the short timescale asserted by the unanimous traditions of humankind, I decided to try to reconcile the two scales to the brief period demanded by the early human voices. Only then could the model of natural and human history be integrated.

Consequently, as this book progresses, I shall be suggesting, with some reason, that human accounts provide a baseline for the age of catastrophes at 14,000 years ago. Also, in my opinion, the nature which offers itself to view-including the solar system, earth, and biosphere - may have assumed its present form in a series of recent sudden leaps. The holocene epoch, to which I allot the 14,000 years, has witnessed a connected set of catastrophes, these can be divided into nine periods, each characterized by natural outbursts but containing tranquil passages as well. I shall soon explain this

The original source of the saltatory changes of the earth and man has been in the skies, in disorders among the heavenly bodies. The celestial disturbances wrecked and reconstituted the atmosphere, rocks, and waters of the world. All combined to reorder the plant and animal kingdoms. Finally they created and molded modern humankind. In brief, forces of extra-terrestrial origin have recently catastrophized and transformed nature and mankind. Many ways in which nature and life behave today are best understood as tailing-off effects of the catastrophes of ancient times.

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[7] Ager (1973) 100

CHAPTER ONE

COSMIC INSTABILITY

The once preposterous idea is now a commonplace: worlds have collided. Even the naive image of colliding worlds two huge globes smashing, into one another is realized. The very event may be observed daily in the great telescopes of science. Furthermore, galaxies composed of millions of stars are in collision. Any unfortunate beings dwelling in those regions of the universe would not consider the word "collision" to be an exaggeration.

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The "discovery of the existence, almost omnipresence of a high-energy, explosive universe" is accredited to the 1960's by the Astronomy Survey Committee of the National Academy of Sciences. "The previously well-organized universe ... exploded into a bewildering universe of new types of objects, large and small, with exotic new names and marvelous new natures."[1]

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[1] Astronomy and Astrophysics for the 1970's (1972).

Some thousands of planetesimals of varied shapes and sizes, and much plain dust, orbit between planet Mars and planet Jupiter. These nameless fragments and bits were once part of a planet; it is scientifically respectable now to think so. Ovenden estimated the mass of the planet to have been ninety times that of the Earth.[2] This implies logically the belief that within our family of planets, a monstrous direct collision once occurred. Ovenden assigns the, explosion to an encounter with a hypothetical intruder passing through the solar system.

Even before Ovenden, scientists such as Kuiper, Bobrovnikoff, Whipple, and Tombaugh lent their authority, too, to the idea that comets and planets collided in the asteroid belt. Whipple went so far as to talk of collisions in that area only 4200 and -1500 years ago, in 1950, the same year in which Velikovsky published *Worlds in Collision.* But Whipple immediately became a dedicated crusader against Velikovsky.[3]

IMPACTS ON EARTH

It is also known that comets disappear into the sun, and that comets have hit planets. And that they will continue to strike planets, and that meteoroids, that is, fragments of unknown or eccentric paths, also strike planets, even Earth.[4] They can be, and have been, large.

At Ishim, Kazakhstan, U. S. S. R. is a meteoroid impact crater, recently demonstrated and said to be aged 350 million years. The initial impact penetrated to a depth of 12 km and amounted to 350 km in diameter. The rebound explosion and the collapsed rim enlarged the crater to a diameter of 700 km. The estimated kinetic energy of the event was ten billion times greater than that of the San Francisco earthquake of 1906, the Alaska earthquake of 1964 or the Chinese earthquake of 1976.[5] The fall, in a different time and place, could have obliterated France or Germany. And

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[2] Ovenden (1973).

[3] Velikovsky (1955) 288-9; Juergens, 30 and de Grazia 212-3 in de Grazia et al (1966).

[4] In addition to the older writers, Whiston, Boulanger, Carli, Donnelly, and Beaumont, see Velikovsky (1950); and entries in A. Miller (1977); Ransom (1976) 73-9; Kugler (1927); Patten (1973); Kelly and Dachille; Pensée, nos I-X; Kronos, vol. I-III; Richter; Rix (1975); Vsekhsvyatskii (1976).

[5] Dachille (1975) 51.

from the explosion would have emerged a catastrophic typhoon that would have towered into outer space. It would have darkened the globe with dust, caused universal seismism, and brought worldwide floods from the concussion and from the tilting and/or rotational interruption of the Earth.

In the course of its encounters in space, the Earth has gained gases, rocks, metals and minerals, possibly even some forms of life, and mechanical motions and electrical charges. It has lost gases and rocks and life, motions and charges. It has changed greatly its surface, its atmosphere, and its life forms in the encounters. Examples of all of these occurrences will be found in the pages to follow. Many processes that still continue, such as the cutting back of Niagara Falls, the adaptation of species to desert conditions, earthquakes and volcanism, not to mention various mental processes of humans, can be interpreted as dying effects of the encounters.

Quantavolutional thought is often said to be unable to explain the fantastic amount of energy that must be present and converted in changing large-body motions [6] . After all, to account for an orbital change in distance between the Sun and the Earth requires a power which, if it were expressed as dynamite, would be sufficient, when properly placed, to blow the Earth to smithereens.

However, such images can be unrealistic, balancing forces operate. Warlow (1978) has, exhibited a wide range of data. and mechanisms -- legends, massive faunal destructions, abrupt salinity changes, tektite falls, then spinning top experiments and mathematical calculations -- relating to reversals of the Earth's magnetic field. He argues that the Earth is easily destabilized and can even turn over repeatedly in response to external influences. If the axis of the Earth tilts when an intruder approaches, the Earth's angular moments of rotation and revolution can respond less radically to the strange forces; the total sphere responds and there is less strain on its parts. Or if the Earth's rotation is interrupted, a fracture of the Earth's crust will reduce the energy of the braking and increase the time given to it.

Every day thousands of airplanes take off and land that would disintegrate if their acceleration or deceleration were in seconds instead of minutes; the rate of slow-down is all-important in the difference between an explosion and a glide, whatever the erg count.

The damping of the rotation of the Earth from a four-hour to a twenty-four hour cycle would require the disposal of 1. 2 x 10 10 erg/grams, or a

[6] Rose and Vaughan (1974); Michelson (1974).

heat equivalent to raising the temperature of the globe 1000º; but obviously the time factor here is ignored and is therefore instantaneous. Half the Earth gives up some degrees of heat every night, and a slowly decelerating Earth might do the same, night and day.

There is literally all the difference in the world between an earth slowing in a day and an earth ceasing abruptly to rotate. Indeed, it is impossible for a sudden stop to occur. Even if an errant great body were to collide with the Earth, days before the explosive moment the Earth's rotation would have come to a halt, and its surface and atmosphere would be erupting in flames and lightning.

Finally, electrical adjustments are a form of energy disposal and can change a hot transaction into a cool one, and *vice versa.* Many a meteor that would scorch the atmosphere and bum itself up, or perhaps explode in great heat, is repelled by a like charge of the upper atmosphere and skips off into outer space.

Vast stretches of astronomical and geological time are not required by the delicacy of organized matter. Only small amounts of time may be needed in which to accumulate and dissipate great heat and pressures. From a molten mass, the Earth could have acquired a hard crust in a thousand years (if radioactive internal heating is ignored).[7] Both electricity and water increase greatly the metamorphosis of rocks and facilitate volcanic activity.[8]

That the Moon and Mars and Mercury are devastated and biologically dead, that Venus is rotating backwards and burning hot, that a ghost planet which should perhaps be called "Apollo" is represented by a host of asteroids flying between Mars and Jupiter - all these give one to suspect that the Earth has also suffered, but escaped the worst.

THE CLEAVAGE OF MARS: A PARTICULAR CASE

The planet Mars became a horror and great god to the people of 2700 years ago. Mesopotamians might well chant:

"Shine of horror, god Nergal, prince of battle,

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[7] Cook (1966).
[8] Kelly and Dachille, 67; Velikovsky (1950) 91-2; (1955) 133.

Thy face is glare, thy mouth is fire,
Raging flame-god, god Nergal."[9]

Nergal is god-Mars and planet-Mars. Only a god could fearlessly assault a god. And that is what Pallas Athene, goddess of the planet Venus, did to Mars-Ares-Nergal. It is the famous scene of the battle of the gods in Homer's *Iliad*.[10] Athene, with the blessing of Zeus drove her chariot towards Ares, "the bane of mortals," and drove her spear "mightily against his nether-most belly." A great black cloud arose from him, he "bellowed like ten thousand warriors," and fled into the high heavens.

Planet Mars is small compared with Venus and Earth, though larger than the Moon. It has a very thin atmosphere. In 1976, American's spacecraft landed upon it, sensing for signs of life, finding neither proof nor disproof, but ambiguous evidence. It is wracked by wind and storms of dust. It has changing polar caps of "dry ice". Most of all it has been bruised and battered.[11]

The most revealing feature of Mars is its Coprates canyon complex, photographed by Mariner IX (see Figure 2 with 1997 upgrade). The Coprates complex, as Alan Kelly has related, is a 7500 miles long line of volcanoes and canyon that are the "product of the same event, when some very large comet or other massive intruder from space passed too close to Mars.... This intruder literally sucked the lava from the interior of Mars to form the huge volcanoes.... As it came closer it caused a tremendous bulge, miles high, that burst open along the top and spewed out lava and great chunks of Martian crust, much of this material following the intruder into space."[12] Two million cubic miles of lava disappeared into space within a few hours [13] .

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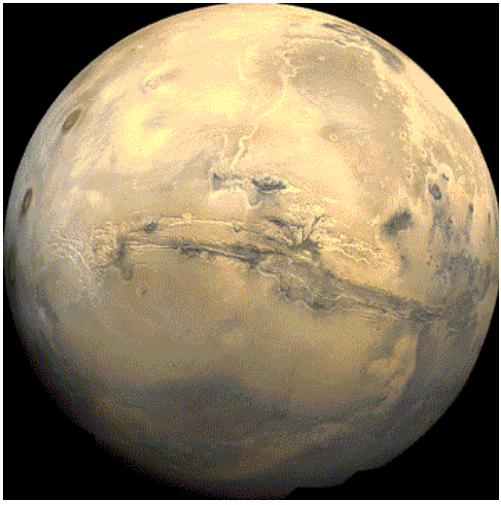
[9] Velikovsky (1950) 261, quoting Böllenrücker, 19.
[10] Iliad, Book V; here the quoted words are from the Murray translation. Loeb Classical Library (1925), Cf. Velikovsky (1950) 245 ff.
[11] Pollack (1975); Woronow (1972).
[12] Kelly (1974).
[13] Some of the huge duststorms of Mars may be of this material too. Cf. Vsekhsvyatskii (1967) on loss of material by planets. The solar system envelope contains a great deal of "meteoric" dust (Van Allen, 1975).

Figure 2

THE RIPPING OF THE SURFACE OF MARS.



Kelly marks the following: the 2200 miles length of the canyon proper is more than 300 miles wide near its center and over 20,000 feet deep. The disturbed surface, however, marked by great mountain peaks such a Nix Olympica, begins before the rupture and continues far beyond it, giving a total length of 7500 miles, which is over half the equatorial circumference that it follows. Nix Olympica is over 300 miles at its base and over 15 miles high. All but one of the 20 volcano-like structures on Mars are along this same line of destruction. The walls of the canyon are slumped or subsided in a series of stair-steps. No evidence meets the eye of water erosion, sedimentation, delta fans, or eroded stream channels cutting across the surrounding plateaus (the expanded bulge of the gravitational attraction). Hence the canyon is not, nor was it ever a water system, nor ever transported water. Mars or Ares was assaulted and ripped open from space.

"ONE OR TWO CENTURIES" OF "ETERNAL ORDER"

The educated public has long held, as an article of faith, that Isaac Newton discovered the laws of planetary movements and that Laplace

(1749-1827) mathematically expressed their practically eternal stability.[14] Yet here I have suggested that the planetary movements are not so stable, nor have they been.

Lately astronomers have begun to reconsider the dogma of celestial stability. Ransom and Milton have collected studies of instability in the skies.[15] In 1953, W. M. Smart, Professor of Glasgow University, wrote in his book, *Celestial Mechanics,* that the maximum time-interval over which stability calculations of the type presented by Laplace, Lagrange, and Poisson can be trusted is 300 current solar years.[16] The words "one or two centuries" occur elsewhere as the time limit of validity.

Moving back, in 1931, E. W. Brown that the President of the American Astronomical Society, wrote that the mathematical statement of the stability of the mean distances, of the eccentricities, and of the inclinations of the planets "can only be regarded as valid over a limited interval of time of the order of 10^6 or perhaps 10^7 years at most."[17] Thus 10 million to 100 million years of stability.

Brown stated elsewhere in the same year that there were no logical or mathematical reasons to doubt that certain of the terrestrial planets might have interchanged their mean distances from the Sun. He felt that this interchange was unlikely, and believed the planets were probably in their initial order, "though the relative magnitudes of some of their distances may have been considerably changed."[18] Back again, in 1961 Arnol'd and before him, in general, Poincaré in 1899, proved that Simon Newcomb's 1895 mathematics providing 100 billion years of stability were wrong in form, but especially in not accounting for perturbing (possibly non-gravitational, said Brown) resonances.[19]

Newcomb had been attempting to bolster Poisson, Lagrange, and Laplace (1773) in their attempts to show that the mean planetary distance would always stay within bounds and that collisions were nearly impossible. Laplace (1749-1827) in 1784 declared that planetary inclinations and eccentricities must remain small.[20]

Laplace had guessed 10 million years as the duration of the present

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[14] Stecchini (1966) 80 ff.
[15] Ransom (1972); Milton (1975).
[16] 4, 94-5, 198 discussed in Bass (1976) 39-40.
[17] *Ibid.,* 39.
[18] *Ibid.,* 37 quoting from E. W. Brown's Presidential Address; cf. p. 30.
[19] *Ibid.,* 31-5 and Bass (1974) 8-20.
[20] *Ibid.*

stability, a soothing enough figure to unleash the uniformitarians to pursue time enough on Earth for sedimentation, surface changes, and evolution of life to occur. Or so they thought. With a present Earth-age estimate of some 5 billion years, 500 times greater than his 10 million years, there might have been 500 world collisions in Earth history, and another may be just around the corner.

Astrophysicist Robert W. Bass has related this story much more fully elsewhere.[21] If anything can be added to his account, it may be that Laplace, the mathematical godfather of the stability of the heavens (with Newton as father), had himself expressed original doubts on their stability despite his mathematical proofs. Stecchini has published Laplace's doubts.[22]

It develops that Laplace was more sinned against than sinner, by those who made a uniformitarian religious dogma out of his mathematics of stability. For the same Laplace had written: "The sky itself, despite the orderliness of its movements, is not inalterable." Further the stability of the present order "is disturbed by various causes that can be ascertained by careful analysis, but which are impossible to frame within a calculation."[23]

Laplace warned that he had not taken comets and meteoroids into account, and encouraged the study of history, however brief, for enlightenment on such experiences. He also wondered, Stecchini declares, "whether heavenly bodies might not be affected by forces other than gravitation, such as electric and magnetic forces."[24] And he even presented a cometary collision scenario, following evidence from mechanics, geology, natural and human history. Thus Laplace may be placed in the company of Giordano Bruno, Galileo Galilei, William Whiston, Nicholas Antoine Boulanger, and perhaps even Isaac Newton, when he strongly supported Whiston, his younger colleague.

Nevertheless, Bass is correct in his account of how Laplace was used in history by scientists who were fighting for uniformitarianism and against the need for any divine intervention in world affairs. He has shown how the successors of Laplace expressed themselves in intuitive language, supposedly the bane of the conventional astronomers. "Whenever these allegedly authoritative statements about time intervals of validity [of calculations of celestial stability] have been made, they are without exception accompanied by words like 'supposed', 'appeared', 'hope',

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[21] (1974), (1976).
[22] (1966) 105-9.
[23] Oeuvres Complètes, VII, 121, quoted *Ibid.,*107
[24] Stecchini (1966), 108, citing Laplace VI. 347.

'seems', 'might', and 'think', revealing clearly that the writer was relying on his personal intuition rather than quantitative evidence [25] . It is ironic that Harlow Shapley, the famous astronomer, admonished the Macmillan company for considering a venture into the "Black Arts" with the publication of Velikovsky's *Worlds in Collision.*[26]

A review of cases such as that the comet Oterma III may be in order, for both the solar system and beyond. A report on Oterma III was presented by A. V. Folcin of the U. S. S. R. in 1958. Before 1938, this comet has an orbit lying entirely between the orbits of Jupiter and Saturn. In that year, it approached near to Jupiter and then swung around so that it acquired a new orbit entirely between Mars and Jupiter. Bass points out that "for Venus one can, with negligible error substitute any smaller mass."[27] That is, what happened to Oterma could also happen to Venus, to Mars, or to Mercury, for all are of the same minute order in comparison with Jupiter.

In sum, this brief chapter has intimated several conclusions. Astronomers often have fallen victim to the myth of the eternal order of the heavens. The mathematics of the classics writers concerning immutable motions are vulnerable. The "guaranteed" stability of the solar system, when recalculated in their own terms, may be uncomfortably short. Recent events such as Oterma III encourage a review of theories of celestial order.

As Professor John A. Simpson expressed the new mood, writing while Pioneer XII was speeding towards Jupiter: "Much of the new astrophysics is based on non-equilibrium - even explosive - phenomena, rather than the steady state thermal phenomena which have been the primary concerns of astrophysics in the past. It is the violence of the phenomena discovered in the astrophysics of the past fifteen years that has changed dramatically our current view of the universe."

Changing celestial behavior excites great forces to work upon Earth. After assembling the evidence for the quantavolution of life forms, the Russian paleontologist and geologist, L. J. Salop concludes: "The Earth, together with the life it supports, is not a closed self-developing system but constitutes an integral part of the cosmos."[28]

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[25] Bass (1976).
[26] Juergens (1966), 20.
[27] (1974), 15.
[28] (1977), 40.