DOWNLOAD PDF THE BIG SPLAT, OR, HOW OUR MOON CAME TO BE

Chapter 1 : The Big Splat, or How Our Moon Came to Be - Ebook pdf and epub

"The Big Splat: Or How Our Moon Came to Be" by Dana Mackenzie is a concise and exceptionally readable account of how a significant but divisive scientific question came to be settled through the investigation of the Moon made possible by sending human and robotic missions there in the s and s.

History[edit] In , George Darwin made the suggestion that the Earth and Moon were once a single body. This drifting was later confirmed by American and Soviet experiments, using laser ranging targets placed on the Moon. Hartmann and Donald R. Their models suggested that, at the end of the planet formation period, several satellite-sized bodies had formed that could collide with the planets or be captured. They proposed that one of these objects may have collided with the Earth, ejecting refractory, volatile-poor dust that could coalesce to form the Moon. This collision could potentially explain the unique geological and geochemical properties of the Moon. Cameron and American astronomer William R. Ward , who suggested that the Moon was formed by the tangential impact upon Earth of a body the size of Mars. It is hypothesized that most of the outer silicates of the colliding body would be vaporized, whereas a metallic core would not. Hence, most of the collisional material sent into orbit would consist of silicates, leaving the coalescing Moon deficient in iron. The more volatile materials that were emitted during the collision probably would escape the Solar System, whereas silicates would tend to coalesce. This designation was proposed initially by the English geochemist Alex N. Halliday in and has become accepted in the scientific community. One of the attractive features of the giant-impact hypothesis is that the formation of the Moon and Earth align; during the course of its formation, the Earth is thought to have experienced dozens of collisions with planet-sized bodies. The Moon-forming collision would have been only one such "giant impact" but certainly the last significant impactor event. The Late Heavy Bombardment by much smaller asteroids occurred later - approximately 3. Basic model[edit] Simplistic representation of the giant-impact hypothesis. Astronomers think the collision between Earth and Theia happened at about 4. Theia is thought to have struck the Earth at an oblique angle when the Earth was nearly fully formed. However, a significant portion of the mantle material from both Theia and the Earth would have been ejected into orbit around the Earth if ejected with velocities between orbital velocity and escape velocity or into individual orbits around the sun if ejected at higher velocities. The material in orbits around the Earth quickly coalesced into the Moon possibly within less than a month, but in no more than a century. Estimates based on computer simulations of such an event suggest that some twenty percent of the original mass of Theia would have ended up as an orbiting ring of debris around the Earth, and about half of this matter coalesced into the Moon. The Earth would have gained significant amounts of angular momentum and mass from such a collision. The smaller moon may have remained in orbit for tens of millions of years. As the two moons migrated outward from the Earth, solar tidal effects would have made the Lagrange orbit unstable, resulting in a slow-velocity collision that "pancaked" the smaller moon onto what is now the far side of the Moon, adding material to its crust. One possible explanation is that Theia formed near the Earth. For this scenario to be viable, however, the proto-lunar disk would have to endure for about years. Work is ongoing to determine whether or not this is possible. Synestia model[edit] Further modelling of the transient structure has given rise to the concept of a synestia , a doughnut-shaped body that existed for a century before it cooled down and gave birth to the Earth and the moon. The highly anorthositic composition of the lunar crust, as well as the existence of KREEP -rich samples, suggest that a large portion of the Moon once was molten; and a giant impact scenario could easily have supplied the energy needed to form such a magma ocean. Several lines of evidence show that if the Moon has an iron -rich core, it must be a small one. Appropriate impact conditions satisfying the angular momentum constraints of the Earthâ€” Moon system yield a Moon formed mostly from the mantles of the Earth and the impactor, while the core of the impactor accretes to the Earth. Comparison of the zinc isotopic composition of Lunar samples with that of Earth and Mars rocks provides further evidence for the impact hypothesis. Moon rocks contain more heavy isotopes of zinc, and overall less zinc, than corresponding igneous Earth or Mars rocks, which is consistent with zinc being depleted from the Moon through evaporation, as expected for the giant impact origin. For example, the giant-impact hypothesis implies that a surface magma ocean would have formed following the impact. Yet there is no evidence that the Earth ever had such a magma ocean and it is likely there exists material that has never been processed in a magma ocean. If the giant-impact hypothesis is correct, they must be due to some other cause. A moon that formed around Venus by this process would have been unlikely to escape. If such a moon-forming event had occurred there, a possible explanation of why the planet does not have such a moon might be that a second collision occurred that countered the angular momentum from the first impact. For typical terrestrial planets with a mass of 0. For example, some orbits may cause the moon to spiral back into the planet. Likewise, the proximity of the planet to the star will also affect the orbital evolution. The net effect is that it is more likely for impact-generated moons to survive when they orbit more distant terrestrial planets and are aligned with the planetary orbit. Such objects may have stayed within the Earthâ€"Moon system for as long as million years, until the gravitational tugs of other planets destabilized the system enough to free the objects. Especially, the indistinguishable relation of oxygen isotopes cannot be explained by the classical form of this hypothesis. According to research on the subject that is based on new simulations at the University of Bern by physicist Andreas Reufer and his colleagues, Theia collided directly with Earth instead of barely swiping it. The collision speed may have been higher than originally assumed, and this higher velocity may have totally destroyed Theia. None of these hypotheses can account for the high angular momentum of the Earth-Moon system. In this hypothesis, the formation of the Moon occurs 60â€" million years after the formation of the Solar System. Previously, the age of the Moon had been thought to be 4. The shared metal vapor bridge would have allowed material from the Earth and proto-Moon to exchange and equilibrate into a more common composition. The new model, developed by Robin M. Canup , suggests that the Moon and the Earth have formed as a part of a massive collision of two planetary bodies, each larger than Mars, which then re-collided to form what we now call Earth. After the recollision, Earth was surrounded by a disk of material, which accreted to form the Moon. This hypothesis could explain facts that others do not.

Chapter 2 : The Big Splat, or How Our Moon Came to Be by Dana Mackenzie

The first popular book to explain the dramatic theory behind the Moon's genesisThis lively science history relates one of the great recent breakthroughs in planetary astronomy-a successful theory of the birth of the Moon. Science journalist Dana Mackenzie traces the evolution of this theory, one.

Hardcover If there is one dramatic moment--as opposed to myriad important but mundane events--in the history of lunar science it is the conference in Kona, Hawaii, in which scientists around the world presented papers on the sole topic of how the Moon originated. What made this conference so remarkable, however, was that a new consensus on the subject emerged through this process of presentation and discussion. Usually, positions are well known prior to any scientific meeting and few scientists change their minds right away. As the author of this outstanding popular history phrased it, "other specialists have to go home and process the new information. Old theories have to be sifted through and reappraised. More papers come out in favor of the new hypothesis, and others come out against it. Eventually, sometimes after many years, a new consensus emerges" p. Not so at Kona. The consensus on the origins of the Moon that came about there has enjoyed remarkable exceptional staying power since. Or How Our Moon Came to Be" by Dana Mackenzie is a concise and exceptionally readable account of how a significant but divisive scientific question came to be settled through the investigation of the Moon made possible by sending human and robotic missions there in the s and s. The Kona conference established a consensus in favor of a theory of origins known as the "big whack," or "big splat. This theory was predicated on the study of lunar rock and soil samples returned from the Moon by the Apollo astronauts, and over the course of the next decade further analysis allowed scientists to resolve most of the questions plaguing other theories of lunar origin by applying the "big splat" hypothesis. So contentious had the question of lunar origins been prior to the Apollo program, as Mackenzie shows, that many scientists just threw up their hands in frustration at ever being able to develop a reasonable hypothesis. Their concern was legitimate based on what had gone before. Prior to the Apollo missions the origin of the Moon had been a subject of considerable scientific debate and careers had risen and fallen on championing one or another theory. Prior to the s there had been three principal theories: Co-accretion--a theory which asserted that the Moon and the Earth formed at the same time from the Solar Nebula. Fission--a theory that asserted that the Moon split off from the Earth. Capture--a theory that held that the Moon formed elsewhere and was subsequently drawn into orbit around the Earth. The data supporting these various theories had been developed to an amazingly fine point over time but none of these theories actually explained enough open questions to convince a majority of planetary scientists. As Mackenzie recounts in "The Big Splat," the new and detailed information from the Moon rocks pointed toward an impact theory--which suggested that the Earth had collided with a very large object as big as Mars and named after the fact "Theia" --and that the Moon formed from the ejected material. This proved to be a theory that fit the fact that although the Earth has a large iron core the Moon does not, because the debris blown out of both the Earth and the impactor would have come from iron-depleted, rocky mantles. Also lending credence to this theory, although the Earth has a mean density of 5. The Moon has exactly the same oxygen isotope composition as the Earth, whereas Mars rocks and meteorites from other parts of the Solar System have different oxygen isotope compositions. While there were some details to this theory that have yet to be worked out, the impact theory came out as the consensus at the Kona conference and is now widely accepted. In the end, further research will be required but all evidence to date seems to fit into the confines of this giant impact theory. Clinging to the marketplace of ideas, it insists that practitioners explicate their theories in a manner that is rigorous, peer-reviewed, and replicable. In all cases, the mode of science is to seek to disprove or at least modify these new theories. Doing so helps to self-correct the state of knowledge, and there is no higher calling in science. Of course, this road to scientific understanding is rugged and winding, and "The Big Splat" states this well in the context of lunar origins. What we learn is that scientific understanding is infinitely more complex, convoluted, interesting, and significant than most popular conceptions allow. Dana Mackenzie is to be commended for showing this process in detail and in so doing restates the positive nature of the process. Apply this case study to the major scientific debates of the present, of which there are many, and it is apparent that there are few easy answers. Dana Mackenzie has written as fascinating detective story in which scientists act as Sherlock Holmes deciphering discreet but imperfect clues to piece together the set of incidents that led to the formation of the Moon. It will be of interest to historians, non-specialist readers, and students of all types.

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Chapter 3 : Wednesdayâ€™s Book Review: â€œThe Big Splat: Or How Our Moon Came to Beâ€• | Roger

The Big Splat, or How Our Moon Came to Be Erik Asphaug is a planetary scientist at the University of California, Santa Cruz, who studies asteroids and comets, their geologic makeup and evolution, their impacts into planets, and their relation to the origin of solar systems.

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Chapter 4 : Giant-impact hypothesis - Wikipedia

The Big Splat: How our Moon came to be by Dana Mackenzie, John Wiley, Â£/$, ISBN IF YOU stayed up late to watch the total lunar eclipse on 16 May you may have.

Posted on December 14, by launiusr The Big Splat: If there is one dramatic momentâ€"as opposed to myriad important but mundane eventsâ€"in the history of lunar science it is the conference in Kona, Hawaii, in which scientists around the world presented papers on the sole topic of how the Moon originated. What made this conference so remarkable, however, was that a new consensus on the subject emerged through this process of presentation and discussion. Usually, positions are well known prior to any scientific meeting and few scientists change their minds right away. Old theories have to be sifted through and reappraised. More papers come out in favor of the new hypothesis, and others come out against it. Not so at Kona. The consensus on the origins of the Moon that came about there has enjoyed remarkable exceptional staying power since. Or How Our Moon Came to Be by Dana Mackenzie is a concise and exceptionally readable account of how a significant but divisive scientific question came to be settled through the investigation of the Moon made possible by sending human and robotic missions there in the s and s. So contentious had the question of lunar origins been prior to the Apollo program, as Mackenzie shows, that many scientists just threw up their hands in frustration at ever being able to develop a reasonable hypothesis. Their concern was legitimate based on what had gone before. Prior to the Apollo missions the origin of the Moon had been a subject of considerable scientific debate and careers had risen and fallen on championing one or another theory. Prior to the s there had been three principal theories: Co-accretionâ€"a theory which asserted that the Moon and the Earth formed at the same time from the Solar Nebula. Fissionâ€"a theory that asserted that the Moon split off from the Earth. Captureâ€"a theory that held that the Moon formed elsewhere and was subsequently drawn into orbit around the Earth. The data supporting these various theories had been developed to an amazingly fine point over time but none of these theories actually explained enough open questions to convince a majority of planetary scientists. This proved to be a theory that fit the fact that although the Earth has a large iron core the Moon does not, because the debris blown out of both the Earth and the impactor would have come from iron-depleted, rocky mantles. Also lending credence to this theory, although the Earth has a mean density of 5. The Moon has exactly the same oxygen isotope composition as the Earth, whereas Mars rocks and meteorites from other parts of the Solar System have different oxygen isotope compositions. While there were some details to this theory that have yet to be worked out, the impact theory came out as the consensus at the Kona conference and is now widely accepted. In the end, further research will be required but all evidence to date seems to fit into the confines of this giant impact theory. Clinging to the marketplace of ideas, it insists that practitioners explicate their theories in a manner that is rigorous, peer-reviewed, and replicable. In all cases, the mode of science is to seek to disprove or at least modify these new theories. Doing so helps to self-correct the state of knowledge, and there is no higher calling in science. Of course, this road to scientific understanding is rugged and winding, and The Big Splat states this well in the context of lunar origins. What we learn is that scientific understanding is infinitely more complex, convoluted, interesting, and significant than most popular conceptions allow. Dana Mackenzie is to be commended for showing this process in detail and in so doing restates the positive nature of the process. Apply this case study to the major scientific debates of the present, of which there are many, and it is apparent that there are few easy answers. Dana Mackenzie has written as fascinating detective story in which scientists act as Sherlock Holmes deciphering discreet but imperfect clues to piece together the set of incidents that led to the formation of the Moon. It will be of interest to historians, non-specialist readers, and students of all types.

Chapter 5 : The Big Splat (Audiobook) by Dana Mackenzie | blog.quintoapp.com

For years or so, scientists have toiled over the exact origins of Earth's moon. Even once humans set foot there, the mystery was still not solved. Some astrophysicists argued that the moon was ripped from a rapidly spinning Earth or that *it came from elsewhere in the solar system and got caught.*

Chapter 6 : The big splat theory | Physics Forums

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Chapter 7 : blog.quintoapp.com: Customer reviews: The Big Splat, or How Our Moon Came to Be

Read "The Big Splat, or How Our Moon Came to Be" by Dana Mackenzie with Rakuten Kobo. The first popular book to explain the dramatic theory behind the Moon's genesis This lively science history relates one.