SAMPLE

Worlds Beyond Earth: Sedna

The Distant Wanderer

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Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

Within the range of uncertainty, it is tied with Ceres in the asteroid belt as the largest dwarf planet not known to have a moon. Owing to its lack of known moons, Sedna's mass and density remain unknown. Sedna takes approximately 11,400 years to complete one orbit around the Sun. Its orbit is one of the widest known in the Solar System. Its aphelion is located 937 astronomical units (AU) away, about 19 times farther than that of Pluto.

Sedna's orbit is also one of the most elliptical discovered, with an eccentricity of 0.85. As of 2026, Sedna is 83.0 AU (12.4 billion km) from the Sun, 2.5 times as far away as Neptune. Upon its discovery, Sedna was initially classified as a member of the scattered disc, a group of objects sent into high-eccentricity orbits by the gravitational influence of Neptune.

Some astronomers instead referred to it as the first known member of the inner Oort cloud, as its perihelion at 76.2 AU (11.4 billion km) is far too distant for it to have been scattered by any of the known planets. It has since become the prototype of a new class of objects characterized by highly eccentric orbits with very distant perihelia, the sednoids. The astronomer Michael E.

Brown, co-discoverer of Sedna, has argued that its unusual orbit could provide information on the early evolution of the Solar System. Sedna might have been perturbed into its orbit through a close gravitational encounter with the hypothetical Planet Nine. Sedna (provisionally designated 2003 VB12) was discovered by Michael Brown (Caltech), Chad Trujillo (Gemini Observatory), and David Rabinowitz (Yale University) on 14 November 2003.

The discovery formed part of a survey begun in 2001 with the Samuel Oschin telescope at Palomar Observatory near San Diego, California, using Yale's 160-megapixel Palomar Quest camera. On that day, an object was observed to move by 4.6 arcseconds over 3.1 hours relative to stars, which indicated that its distance was about 100 AU.

Follow-up observations were made in November and December 2003 with the SMARTS (Small and Medium Research Telescope System) at Cerro Tololo Inter-American Observatory in Chile, the Tenagra IV telescope in Nogales, Arizona, and the Keck Observatory on Mauna Kea in Hawaii. Combined with precovery observations taken at the Samuel Oschin telescope in August 2003, and by the Near-Earth Asteroid Tracking consortium in 2001 and 2002, these observations allowed the accurate determination of its orbit.

The calculations showed that the object was moving along a distant and highly eccentric orbit, at a distance of 90.3 AU from the Sun. Precovery images have

since been found in the Palomar Digitized Sky Survey dating back to 25

September 1990. Brown initially nicknamed Sedna "The Flying Dutchman", or "Dutch", after a legendary ghost ship, because its slow movement had initially masked its presence from his team.

He eventually settled on the official name after the goddess Sedna from Inuit mythology, partly because he mistakenly thought the Inuit were the closest polar culture to his home in Pasadena, and partly because the name, unlike Quaoar, would be easily pronounceable by English speakers. Brown further justified his choice of naming by stating that the goddess Sedna's traditional location at the bottom of the Arctic Ocean reflected Sedna's large distance from the Sun.

He suggested to the International Astronomical Union's (IAU) Minor Planet Center that any objects discovered in Sedna's orbital region in the future should be named after mythical entities in Arctic mythologies. The team made the name "Sedna" public before the object had been officially numbered, which caused some controversy among the community of amateur astronomers. Brian Marsden, the head of the Minor Planet Center, stated that such an action was a violation of protocol, and that some members of the IAU might vote against it.

One amateur astronomer, Reiner Stoss, unsuccessfully attempted to name one of his asteroid discoveries "Sedna" (after the singer Katy Sedna) in protest of Brown's premature naming. Despite the complaints by amateur astronomers, no objection was raised to Brown's name by members of the IAU and no competing names were suggested for Brown's object.

Sedna, sometimes written Sanna, is the goddess of the sea and marine animals in Inuit religion, also known as the Mother of the Sea or Mistress of the Sea.

Her parents thought she was to blame for the storm and threw her into the sea. She clung to the kayak, but her father cut her fingers off: first the tips, then the second knuckle, then the last knuckle. Her disembodied fingers turned into sea creatures. Sedna gained control over the animals.

Sedna (minor-planet number 90377) is a dwarf planet in the outermost reaches of the Solar System, or as some prefer, the first known member of the detached fringe beyond the Kuiper belt: a round red world on a slow eleven-thousand-year circuit that no planet controls, found in 2003 and named for the Inuit sea goddess, and the subject of this book. "Eventually, when other fossil records are found, Sedna will help tell us how the Sun formed and the number of stars that were close to the Sun when it formed." A survey in 2007 and 2008

by Brown, Rabinowitz, and Megan Schwamb attempted to locate another member of Sedna's hypothetical population.The Sun as seen from the world itself ends the introduction, the image the whole book keeps returning to.

From Sedna's distance, even at its nearest, the Sun is a point of light, brilliant but starlike, and at the far end of the orbit it is simply the brightest star in a dark sky, the kind of Sun a child could cover with a fingertip; that image belongs planted before the chapters begin, because every fact the book assembles, the red surface, the dead cold, the fossil orbit, is the environment of a world that orbits at the edge of what the word sunlight means, the deepest outrider of the reader's own star, and the subject's whole atmosphere follows from the one observation, that this is a world where the Sun is a star.

This book asks one standing question of the red world on the fringe, and the introduction states it plainly: what does the Solar System's loneliest orbit remember? The world holds a circuit that no known planet could have made, a perihelion safely beyond the reach of Neptune's most patient stirring, and the fact is the whole reason the discovery mattered in 2004 and matters now; whatever lifted this object into its present orbit did its work before the Solar System's arrangement was finished, and the orbit has been holding the evidence ever since, unbothered, unvisited, and unread except by light. The chapters that follow are the field's attempt to read that evidence at a distance, and the introduction's promise to the reader is the series' usual one: every claim in this book arrives with its uncertainty attached, because on this subject the honest error bars are half the story.

The reader is also owed the book's plain method, because the fringe is a place where numbers matter. Distances in this account are given in astronomical units, each unit the span from the Earth to the Sun, and a moment's arithmetic with that yardstick sets the scale for everything else: Neptune, the last planet, circles at thirty units, the Kuiper belt's busy heart runs to fifty, and the world of this book never comes closer than about seventy-six, swinging out beyond nine hundred at the far end of its eleven-thousand-year circuit. Between those two numbers lies the entire mystery this book contains, a region the early textbooks drew as empty and the surveys have since drawn as inhabited, and the introduction files that correction as the discovery's real legacy: not a new world so much as a new map, with this object as the first pin in it.

Chapter 01: The Discovery of Sedna

Sedna has no symbol in astronomical literature, as the usage of planetary symbols has been discouraged in professional astronomy for generations; the minor-planet catalogs number it plainly, and the only quasi-symbol ever registered for it sits unused in a font table, a curiosity of the encoding standards rather than of the sky.

Its orbit is extremely eccentric, with an aphelion of approximately 937 AU and a perihelion of 76.19 AU. Near aphelion, Sedna is one of the coldest places in the Solar System, located far past the termination shock, where temperatures never rise above about minus 240 degrees Celsius due to its extreme distance. At aphelion, the Sun as viewed from Sedna is a particularly bright star, among the other stars, in the otherwise black sky, being about 45% as bright as the full moon as seen from Earth.

Its perihelion was the largest for any known Solar System object until the discovery of the sednoid 2012 VP113. At its aphelion, Sedna orbits the Sun at a meagre 377 m/s, 1.3% that of Earth's average orbital speed. When Sedna was first discovered, it was 89.6 AU away from the Sun, approaching perihelion, and was the most distant object in the Solar System observed. Sedna was later surpassed by Eris, which was detected by the same survey near its aphelion at 97 AU.

Because Sedna is near perihelion as of 2024, both Eris and Gonggong are farther from the Sun, at 96 AU and 89 AU respectively, than Sedna at 84 AU, despite both of their semi-major axes being shorter than Sedna's. The orbits of some long-period comets extend further than that of Sedna; they are too dim to be discovered except when approaching perihelion in the inner Solar System.

As Sedna nears its perihelion in mid-2076, the Sun will appear merely as a very bright pinpoint in its sky, too far away to be visible as a disc to the naked eye. When first discovered, Sedna was thought to have an unusually long rotational period (20 to 50 days). It was initially speculated that Sedna's rotation was slowed by the gravitational pull of a large binary companion, similar to Pluto's moon Charon.

However, a search for such a satellite by the Hubble Space Telescope in March 2004 found no such objects. Subsequent measurements from the MMT telescope showed that Sedna in reality has a much shorter rotation period of about 10 hours, more typical for a body its size. It could rotate in about 18 hours instead, but this is thought to be unlikely.

In 2012, measurements from the Herschel Space Observatory suggested that Sedna's diameter was 995 km, give or take eighty, which would make it smaller than Pluto's moon Charon. In 2013, the same team re-analyzed Sedna's thermal data with an improved thermophysical model and found a consistent value of about 906 kilometers, with error bars the field itself calls generous, suggesting that the original model fit was too precise. Australian observations of a stellar occultation by Sedna in 2013 produced similar results on its diameter, giving chord lengths roughly a thousand kilometers and about thirteen hundred, each with wide error bars.

The size of this object suggests it could have undergone differentiation and may have a sub-surface liquid ocean and possibly geologic activity. As Sedna has no known moons, the direct determination of its mass is as yet impossible without either sending a space probe or perhaps locating a nearby object which is gravitationally perturbed by the dwarf planet. It is the largest trans-Neptunian Sun-orbiting object not known to have a natural satellite.

As of 2024, observations from the Hubble Space Telescope in 2004 have been the only published attempt to find a satellite, and it is possible that a satellite could have been lost in the glare from Sedna itself. Observations from the

SMARTS telescope show that Sedna, in visible light, is one of the reddest objects known in the Solar System, nearly as red as Mars. Its deep red spectral slope is indicative of high concentrations of organic material on its surface.

Chad Trujillo and his colleagues suggest that Sedna's dark red color is caused by an extensive surface coating of hydrocarbon sludge, termed tholins. Tholins are a reddish-colored, amorphous, and heterogeneous organic mixture hypothesized to have been transmuted from simpler organic compounds, following billions of years of continuous exposure to ultraviolet radiation, interstellar particles, and other harsh environs as the dwarf planet either comes close to the Sun or transits interstellar space.

Its surface is homogeneous in color and spectrum; this may be because Sedna, unlike objects nearer the Sun, is rarely impacted by other bodies, which would expose bright patches of fresh icy material like that on 8405 Asbolus. Sedna and two other very distant objects, the numbered worlds 308933 and 87269, known as 2006 SQ372 and 2000 OO67 - share their color with outer classical Kuiper belt objects and the centaur 5145 Pholus, suggesting a similar region of origin.The day itself ends the discovery story, told by the field as a set piece. The object was found in a survey frame taken in the season of its nearest approach, moving so slowly against the stars that its distance had to be the far side of the known solar system, and the announcement, when it came, was handled with unusual drama, held for a re-measurement and released at a

briefing; the find inaugurated the detaching of the solar system's edge, because the catalog before that morning ended at the scattered disk, and every chapter since has been the story of the map growing outward into the dark.

The discovery file closes with the public moment, because the announcement was a news event the like of which the fringe had never had. The object was unveiled to the press with the honest uncertainty attached, its distance and its strangeness reported worldwide within days, and the headlines of the season called it the tenth planet by reflex, the same reflex that had greeted every big find since the planetary debate began; the field's own papers, careful as always, called it nothing yet, a numbered provisional object, and the name the discoverers had chosen was held back until the orbit was firm. The discovery chapter's closing note on the moment is characteristic: the world became famous before it was named, a celebrity for an orbit, and the fame has outlasted every correction the field has issued since.

The discovery file gains the naming aftermath, because the world's name arrived with a paperwork story the books rarely tell. The naming bodies for minor worlds ask that the mythological namesakes be handled with cultural care, and the discoverers, aware the choice would be quoted forever, documented their consultation and their reasoning when they proposed the sea goddess; the committee accepted the citation, and the world joined the small list of Solar System objects named from the far northern traditions rather than the Mediterranean ones. The discovery chapter's note on the aftermath is the book's characteristic aside: the orbit was certified before the name was, a reminder that in this field the mathematics clears faster than the paperwork.

The file also carries the discovery's honest near-miss, and the chapter keeps it because luck is part of the method. The surveys that found the world sweep the sky slowly, catching the slow drifters only when they cross the survey fields, and the world's own slow motion, a fraction of what a nearer mover would show, is precisely what had hidden it from the earlier machines; the discovery team's own account notes that the object had been faintly recorded before, on plates from earlier seasons, an unexamined smudge in the archives that nobody had followed. The chapter's closing note on the near-miss is the field's standing humility: the fringe yields its worlds to whoever looks longest, and the looking has barely begun.

The discovery file closes with the instruments' own biography, because the find was a collaboration between a world and three machines. The survey camera at the mountain observatory caught the mote; the southern telescopes recovered it on the following nights, certifying that the point moved

and merited a name; the space telescope was borrowed within months to search for a companion and to measure the world's own heat signature as a check on its size; and the infrared flagship overflew the discovery era like a census taker, catching or failing to catch the fringe's worlds in its nets. The chapter's closing entry on the machines is the field's standing reminder: a world this faint is discovered by committee, and the committee's minutes are the observatories' logbooks.

End of free sample. The full book is available at putrabooks.github.io

ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.