Early Investigations of Ceres and the Discovery of Pallas

Clifford Cunningham

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Foreword

It is my privilege and my pleasure to present this new book by Clifford Cunningham to intellectual readers. The book is devoted to one of the most dramatic moments in the history of astronomy—the discovery of the first two minor planets (asteroids) Ceres and Pallas. It is not the first book written by Cunningham—he is well known as a talented writer who came to science armed with knowledge of physics and having experience of astronomical observations. It is quite natural that his interests are concentrated mainly upon the history of astronomy and in particular upon investigations of minor planets. It is also not his first book on the discovery of Ceres—his earlier book has been well received.

In the present book the author pursues the theme traced in the preceding one. Therefore to look through *Discovery of the First Asteroid, Ceres,* can be recommended to any curious reader. Nevertheless, the present book possesses its own interest. Cunningham thoroughly reproduces the broad picture of events that agitated the educated world 200 years ago. He now focuses the readers' attention on such psychological problems as temptation by glory, envy and jealousy, grandeur and serenity of astronomers in answer to pinpricks by others. The differences between, and opposition of, the German and French schools of celestial mechanics are treated at some length. All these problems are considered against a background of events directly or indirectly connected with the dramatic story of Ceres' discovery, of its "near-loss" and rediscovery, and the unexpected finding of one more asteroid (Pallas) at approximately the same mean heliocentric distance that seemed to contradict the beautiful progression of the planetary distances from the Sun found by Titius and then by Bode long before this discovery.

A great deal of work has been done by the author in the search for new documents of the epoch; these constitute an important component of the book. Many of them are published here for the first time in English. The presentation of events is emotionally saturated. The author does not hide from readers his interpretation of what is going on. This makes a retrospective journey into the history of astronomy especially fascinating. The author's position reflects the displeasure and irritation of

the astronomical community of that time caused by the sluggishness of Piazzi when informing other astronomers about his discovery.

Taken as a whole the book presents a serious and captivating historical investigation of the epoch and considered events, and it can be recommended for reading by professionals and amateurs alike.

St. Petersburg, Russia Victor Shor

Artist's Preface

What a fascinating book this is! Clifford Cunningham has done an extraordinary amount of research in preparation for detailing the discovery of two unknown planets in the early nineteenth century. His material is presented in a mosaic of illustrations and words that, for me, gave true feelings of being alive in the period.

Imagine how thrilling it must have been to live in a world that had just thrown off the shroud of a religion-dominated environment. A world where the Age of Enlightenment in the eighteenth century had made ordinary people like ourselves think "The world *is* understandable!" "Human beings can discover why we are here on this ball whirling through space!" "The leap of faith isn't necessary; we'll find out for ourselves what this is all about!" It must have been a blast.

Now we assume science will finally explain everything only to find out we still know little about our reasons for inhabiting this rapidly revolving orb. But for all the gentlemen in this interesting book, all decked out in their wigs, lace jabots, and frock coats, each new discovery that certain planets revolved around the Sun in a stately pattern, there for us to discover, must have been wonderfully exciting and full of meaning. Door after door on our own place in space was being thrown open!

Clifford Cunningham evokes this world and under their wigs and behind their jabots, these scientists become real. As real as that college professor you thought so strange and wonderful; your intellectual neighbor in your hometown; that smart guy you met at your cousin's wedding. Cunningham's subjects become just as real as people you have met yourself and their world with them. They are obviously so obsessed, so fascinated, so competitive. Science had real glamor then, and they were captivated by it.

I know little of science or its history, at least until this book, but I found the vitality of the world Cunningham recounts wonderful. It brought another time alive for me. Who needs science fiction when the very history of science can be so interesting, even for science-innocents like myself?

Miami Beach, FL
August 2015

David Leddick

Preface

The discovery of Ceres and Pallas represented a challenge. It was a challenge not only to mathematics and our vision of the cosmic order but also to the supremacy of France as the leading light of science. How those challenges were met, sometimes with failure and sometimes with success, is the story told in this book.

Tacitus wrote in *The Annals* (Book 15) "The spirit of a noble rivalry and the desire of glory" are "emotions which stir men in success." This book tells of the rivalry and desire for glory amongst those astronomers who sought to study and name the object Zach referred to as the "coquettish little Ceres."

The initial discovery of Ceres, covered in *Discovery of the First Asteroid, Ceres,* is extended here to examine in more depth the response at both the national and the personal level. Professional rivalries between individual researchers are central to this study, and all the scientific papers about Ceres are provided here.

The story of Pallas in correspondence is followed through the year 1802; the scientific papers on Pallas will be in another volume. The discovery of a second asteroid was seen by some, including Johann Bode, as a frustration of their scheme for the cosmos. This manifested itself as a refusal to admit the planetary nature of Pallas. In game theoretic terms, "scientific inquiry is a non-zerosum game of imperfect information in which the neutral universe is not antagonistic towards human exploration" (Swirski, 2000: 82). It was best put by Norbert Wiener (1954), the founder of cybernetics. "Nature plays fair, and if, after climbing one range of mountains, the physicist sees another on the horizon before him, it has not been deliberately put there to frustrate the effort he has already made." The challenge from physics posed by Ceres had no sooner been addressed than a new 'mountain' appeared. Pallas upset the orderly notion of a single 'missing planet' between Mars and Jupiter. How the difficulties posed by the existence of Pallas were explained by the astronomers of the day is explored here and in the next volume of this series.

This volume begins with a study of the philosophical underpinnings of mathematics and astronomy as the eighteenth century ended. This was to a large extent the work of the Philosophes, whose arcane knowledge helped unlock the secrets of the cosmos. Here is Carl Becker, Professor of History at Cornell University, writing in 1932.

> There must be some private passageway to the heavenly throne, some secret backstairs entry that all the *Philosophes* know of, some door, closed to us, that will open to them when they give it a certain understood succession of raps. We should like to enter this door.

Clifford J. Cunningham

About the Author

Clifford J. Cunningham earned his Ph.D. in the history of astronomy at the University of Southern Queensland in Australia, and he is a research associate with the National Astronomical Research Institute of Thailand. His undergraduate degrees in physics and classical studies were earned at the University of Waterloo in Canada. He has written or edited 14 books on the history of astronomy, and his papers have appeared in many major journals, including *Annals of Science, Journal for the History of Astronomy, Culture & Cosmos, Studia Etymologica Cracoviensia, The Asian Journal of Physics*, and *Renaissance and Reformation*. He is associate editor of the *Journal of Astronomical History and Heritage*, where several of his asteroid research papers have been published. He is also a contributor to *Encyclopedia Britannica*, and since 2001 he has been the history of astronomy columnist for *Mercury* magazine. Asteroid (4276) was named Clifford in his honor by the International Astronomical Union based on the recommendation of its bureau the Harvard-Smithsonian Center for Astrophysics.

Prologue: The Dual Challenges of Asteroids and Hieroglyphs

The phenomena are disemboweled
and embalmed with numbers and
signs, and on the scientific coffin
are painted bizarre figures.
—Goethe's comment on the mathematical approach, which reminded him of Egyptian tombs. From a letter of November 24, 1817.

Fig. 1 Johann Goethe in 1817

Deciphering the Symbols


A sketch of Gauss by his pupil J. B. Listing

Fig. 2 A sketch of Gauss by his pupil J. B. Listing

In 1801 the discovery of Ceres presented astronomers with a challenge from physical reality that could only be answered by mathematics: Carl Gauss faced the task of extracting, from a sequence of symbols in the form of numbers (positional data by Giuseppe Piazzi, shown below), the unknown orbit of the new planet. In this he succeeded, and by January of 1802 Ceres was no longer listed as "missing." The very next month, the Rosetta Stone arrived in England. Science was faced with another task of extracting hidden meaning from a sequence of symbols, in this case from a fragment of a stone that had lain hidden in Egypt for 2000 years. The decades-long struggle by Jean-Francois Champollion to decipher the ancient Egyptian language mirrors Gauss' titanic struggle in the years to come to determine the perturbations of Pallas, which was discovered just a few weeks after the Rosetta Stone reached London. These dual challenges can be understood in terms of consilience (Wilson, 1998).

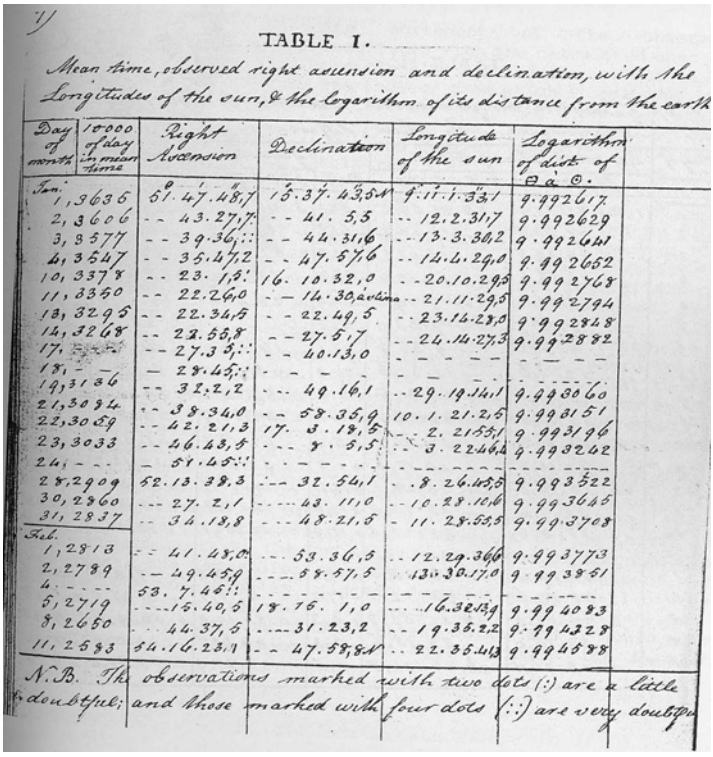

TABLE I.

Mean time, observed right ascension and declination, with the Longitudes of the sun, & the Logarithm of its distance from the earth

Day of month	10000 of day in mean time	Right Ascension	Declination	Longitude of the sun	Logarithm of dist. of ☉
Jan.					
1,	3636	51. 47. 48,7	15. 37. 43,5	9. 11. 1. 33,1	9.992617
2,	3606	43. 27,7	41. 5,5	12. 2. 31,7	9.992629
3,	3577	39. 36,:	44. 31,6	13. 3. 30,2	9.992641
4,	3547	35. 47,2	47. 57,6	14. 4. 29,0	9.992652
10,	3378	23. 15,:	16. 10. 32,0	20. 10. 29,5	9.992768
11,	3350	22. 26,0	14. 30,	21. 11. 29,5	9.992794
13,	3295	22. 34,5	22. 49, 5	23. 14. 28,0	9.992848
14,	3268	23. 56,8	27. 5,7	24. 14. 27,3	9.992882
17,		27. 3 5,:	40. 13,0		
18,		28. 45,::			
19,	3136	32, 2,2	49. 16,1	29. 19. 14,1	9.993060
21,	3094	38. 34,0	58. 35,9	10. 1. 21. 2,5	9.993151
22,	3069	42. 21,3	17. 3. 18,5	2. 21 55,1	9.993196
23,	3033	46. 43,5	7. 5,5	3. 22 46,4	9.993242
24,		51. 45,::			
28,	2909	52. 13. 38,3	32. 54,1	8. 26. 45,5	9.993522
30,	2860	27. 2,1	43. 11,0	10. 28. 10,6	9.993645
31,	2837	34. 13,8	48. 21,5	11. 28. 55,5	9.993703
Feb.					
1,	2813	41. 48,0	53. 36,5	12. 29. 36,6	9.993773
2,	2789	49. 45,9	58. 57,5	13. 30. 17,0	9.993851
4,		53. 7. 46,::			
5,	2719	15. 40,5	18. 16. 1,0	16. 32. 43,9	9.994023
8,	2650	44. 37,5	31. 23,2	19. 35. 22,2	9.994328
11,	2583	54. 16. 23,1	47. 58,8	22. 35. 41,3	9.994588

N. B. The observations marked with two dots (:) are a little doubtful; and those marked with four dots (::) are very doubtful

Fig. 3 Piazzi's observational data on Ceres

Fig. 4 Jean-Francois Champollion

Consilience, or the unity of knowledge, was first mentioned by William Whewell in 1840. In this synthesis Whewell explained that, "The Consilience of Inductions takes place when an Induction, obtained from one class of facts, coincides with an induction, obtained from another different class. Thus Consilience is a test of the truth of the Theory in which it occurs." The scientific method has become universally accepted as the exclusive method for testing the status of any scientific hypothesis or theory. 'Inductions' which arise out of applications of the scientific method are, by definition, the only accepted indicators of consilience. From one class, Gauss deciphered the symbols of celestial mechanics to derive the orbits of Ceres and Pallas, while, from another class, Champollion worked to decipher the symbols of a forgotten language on the Rosetta Stone. These dual challenges of trying to gain knowledge from the study of symbols both arose in 1802 in a way that had never before happened in scientific inquiry.

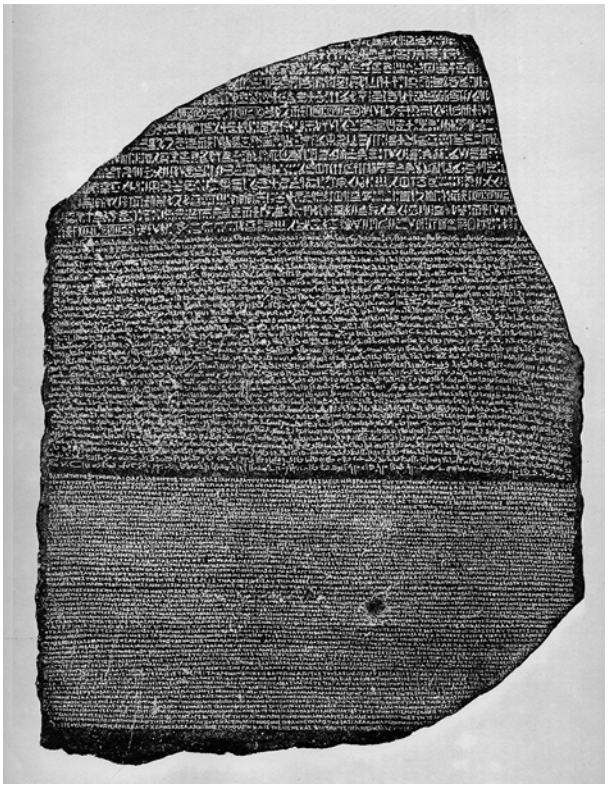

Fig. 5 The Rosetta stone

In addition to the temporal link, two other links exist between the asteroids and the Rosetta Stone. The Greek inscription on the Stone was first deciphered by Stephen Weston, who was asked in 1802 by Joseph Banks to coin a word to describe Ceres and Pallas. A literary connection exists between Champollion and Kepler, who first posited the existence of a planet between Mars and Jupiter. It comes from Edgar Allan Poe, who also wrote about Bode's Law. Poe (1848), in *Eureka*, writes about a "letter from the future" dated 2848 AD which concludes with Kepler's exclamation when he discovered his third law, and a comparison to the decipherment of the Stone:

> I care not whether my work be read now or by posterity. I can afford to wait a century for readers when God himself has waited 6000 years for an observer. I triumph. I have stolen the golden secret of the Egyptians.

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