How Gauss Determined The Orbit of Ceres

by Jonathan Tennenbaum

and Bruce Director

PREFACE

The following presentation of Carl Gauss's determination of the orbit of the asteroid Ceres, was commissioned by Lyndon H. LaRouche, Jr., in October 1997, as part of an ongoing series of Pedagogical Exercises highlighting the role of metaphor and paradox in creative reason, through study of the great discoveries of science. Intended for individual and classroom study, the weekly installments—now "chapters"—were later serialized in The New Federalist *newspaper. They are collected here, in their entirety, for the first time, incorporating additions and revisions to both text and diagrams.*

Through the course of their presentation, it became necessary for the authors to review many crucial questions in the history of mathematics, physics, and astronomy. All of these issues were subsumed in the primary objective, the discovery of the orbit of Ceres. And, because they were written to challenge a lay audience to master unfamiliar and conceptually dense material at the level of axiomatic assumptions, the installments were often purposefully provocative, proceeding by way of contradictions and paradoxes.

Nonetheless, the pace of the argument moves slowly, building its case by constant reference to what has gone before. It is, therefore, a mountaintop you need not fear to climb!

We begin, by way of a preface, with the following excerpted comments by Lyndon H. LaRouche, Jr. The authors return to them in the concluding stretto. —*KK*

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From Euclid through Legendre, geometry depended upon axiomatic assumptions accepted as if they were self-evident. On more careful inspection, it should be evident, that these

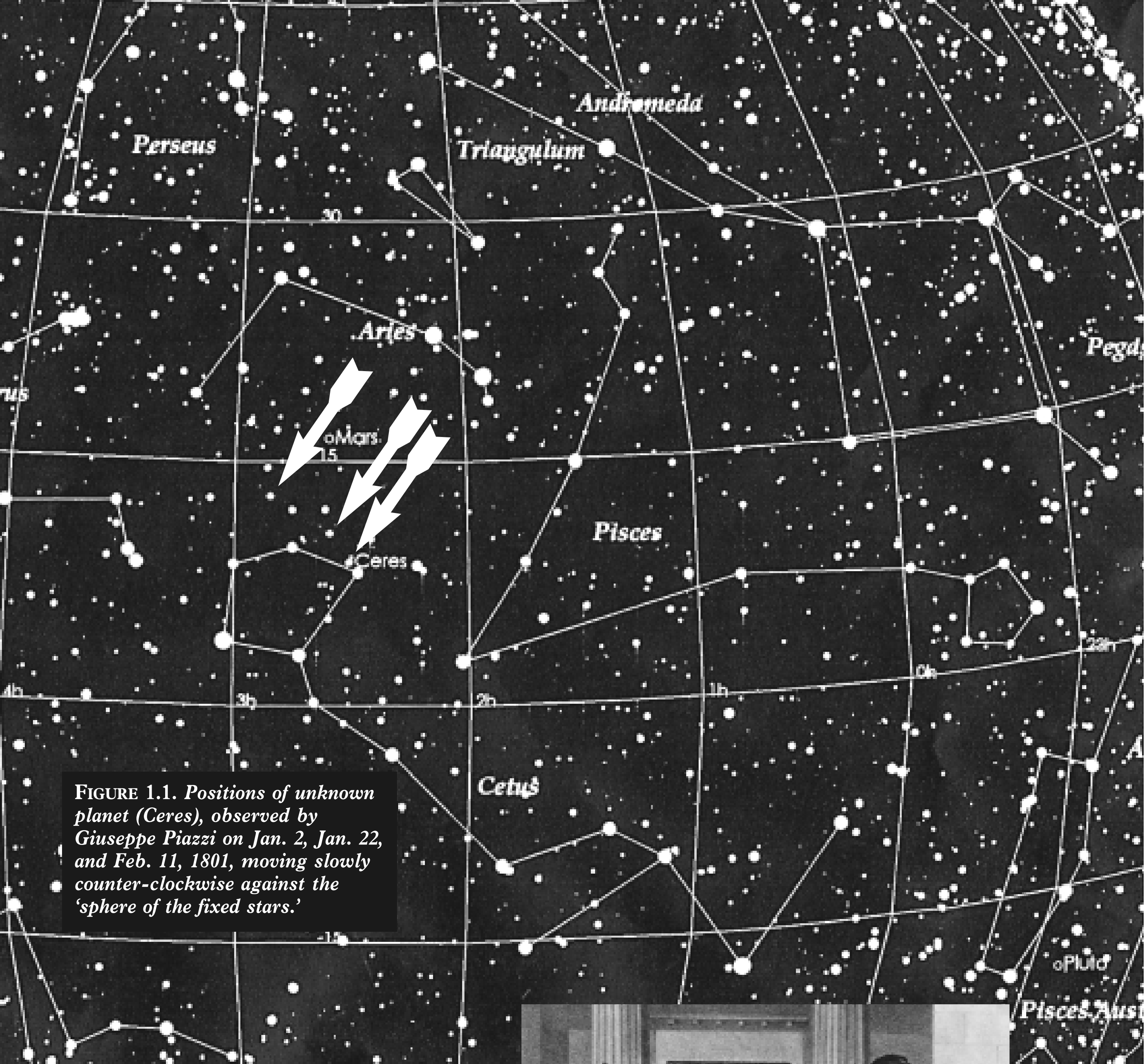
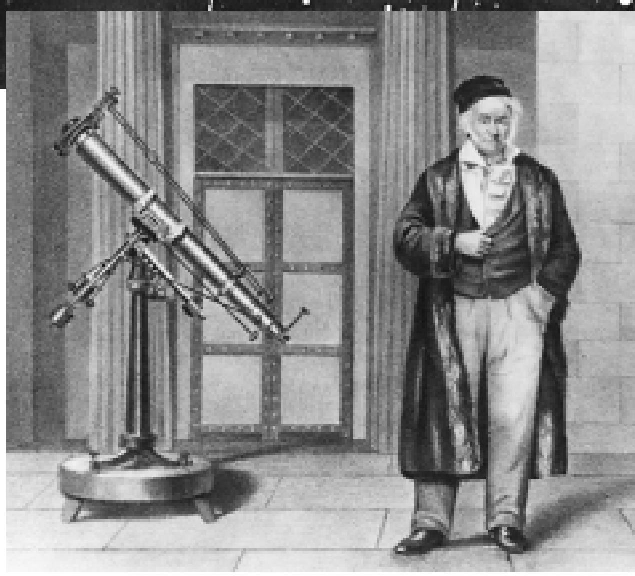


FIGURE 1.1. ***Positions of unknown planet (Ceres), observed by Giuseppe Piazzi on Jan. 2, Jan. 22, and Feb. 11, 1801, moving slowly counter-clockwise against the 'sphere of the fixed stars.'***

assumptions are not necessarily true. Furthermore, the interrelationship among those axiomatic assumptions, is left entirely in obscurity. Most conspicuous, even today, generally accepted classroom mathematics relies upon the absurd doctrine, that extension in space and time proceeds in perfect continuity, with no possibility of interruption, even in the extremely small. Indeed, every effort to prove that assumption, such as the notorious tautological hoax concocted by the celebrated Leonhard Euler,



Carl F. Gauss

was premised upon a geometry which preassumed perfect continuity, axiomatically. Similarly, the assumption that extension in space and time must be unbounded, was shown to have been arbitrary, and, in fact, false.

Bernhard Riemann's argument, repeated in the concluding sentence of his dissertation "On the Hypotheses Which Underlie Geometry," is, that, to arrive at a suitable design of geometry for physics, we must depart the realm of mathematics, for the realm of experimental physics. This is the key to solving the crucial problems of representation of both living processes, and all processes which, like physical economy and Classical musical composition, are defined by the higher processes of the individual human cognitive processes. Moreover, since living processes, and cognitive processes, are efficient modes of existence within the universe as a whole, there could be no universal physics whose fundamental laws were not coherent with that anti-entropic principle central to human cognition. . . .

By definition, any experimentally validated principle of (for example) physics, can be regarded as a dimension of an "*n*-dimensional" physical-space-time geometry. This is necessary, since the principle was validated by measurement; that is to say, it was validated by measurement of *extension.* This includes experimentally grounded, axiomatic assumptions respecting space and time. The question posed, is: How do these "*n*" dimensions interrelate, to yield an effect which is characteristic of that physical space-time? It was Riemann's genius, to recognize in the experimental applications which Carl Gauss had made in applying his approach to bi-quadratic residues, to crucial measurements in astrophysics, geodesy, and geomagnetism, the key to crucial implications of the approach to a general theory of curved surfaces rooted in the generalization from such measurements. . . .

What Art Must Learn from Euclid

The crucial distinction between that science and art which was developed by Classical Greece, as distinct from the work of the Greeks' Egyptian, anti-Mesopotamia, anti-Canaanite sponsors, is expressed most clearly by Plato's notion of *ideas.* The possibility of modern science depends upon, the relatively perfected form of that Classical Greek notion of *ideas,* as that notion is defined by Plato. This is exemplified by Plato's Socratic method of hypothesis, upon which the possibility of Europe's development depended absolutely. What is passed down to modern times as Euclid's geometry, embodies a crucial kind of demonstration of that principle; Riemann's accomplishment was, thus, to have corrected the errors of Euclid, by the same Socratic method employed to produce a geometry which had been, up to Riemann's time, one of the great works of antiquity. This has crucial importance for rendering transparent the underling principle of motivic thorough-composition in Classical polyphony. . . .

The set of definitions, axioms, and postulates deduced from implicitly underlying assumptions about space, is exemplary of the most elementary of the literate uses of the term *hypothesis.* Specifically, this is a *deductive* hypothesis, as distinguished from higher forms, including *non-linear* hypotheses. Once the hypothesis underlying a known set of propositions is established, we may anticipate a larger number of propositions than those originally considered, which might also be consistent with that deductive hypothesis. The implicitly open-ended collection of theorems which might satisfy that latter requirement, may be named a *theorem-lattice* . . . .

The commonly underlying principle of organization internal to each such type of deductive lattice, is *extension,* as that principle is integral to the notion of measurement. This notion of extension, is the notion of a type of extension characteristic of the domain of the relevant choice of theorem-lattice. All scientific knowledge is premised upon matters pertaining to a generalized notion of extension. Hence, all rational thought, is intrinsically geometrical in character.

In first approximation, all deductively consistent systems may be described in terms of theorem-lattices. However, as crucial features of Riemann's discovery illustrate most clearly, the essence of human knowledge is *change,* change of hypothesis, this in the sense in which the problem of ontological paradox is featured in Plato's *Parmenides.* In short, the characteristic of human knowledge, and existence, is not expressible in the mode of deductive mathematics, but, rather, must be expressed as *change,* from one hypothesis, to another. The standard for change, is to proceed from a relatively inferior, to superior hypothesis. The action of scientific-revolutionary change, from a relatively inferior, to relatively superior hypothesis, is the characteristic of human progress, human knowledge, and of the lawful composition of that universe, whose mastery mankind expresses through increases in potential relative population-density of our species.

The process of revolutionary change occurs only through the medium of metaphor, as the relevant principle of contradiction has been stated, above. Just as Euclid was necessary, that the work of descriptive geometry by Gaspard Monge *et al.,* the work of Gauss, and so forth, might make Riemann's overturning Euclid feasible, so all human progress, all human knowledge is premised upon that form of revolutionary change which appears as the *agapic* quality of solution to an ontological paradox.

—Lyndon H. LaRouche, Jr.,
adapted from "Behind the Notes"
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