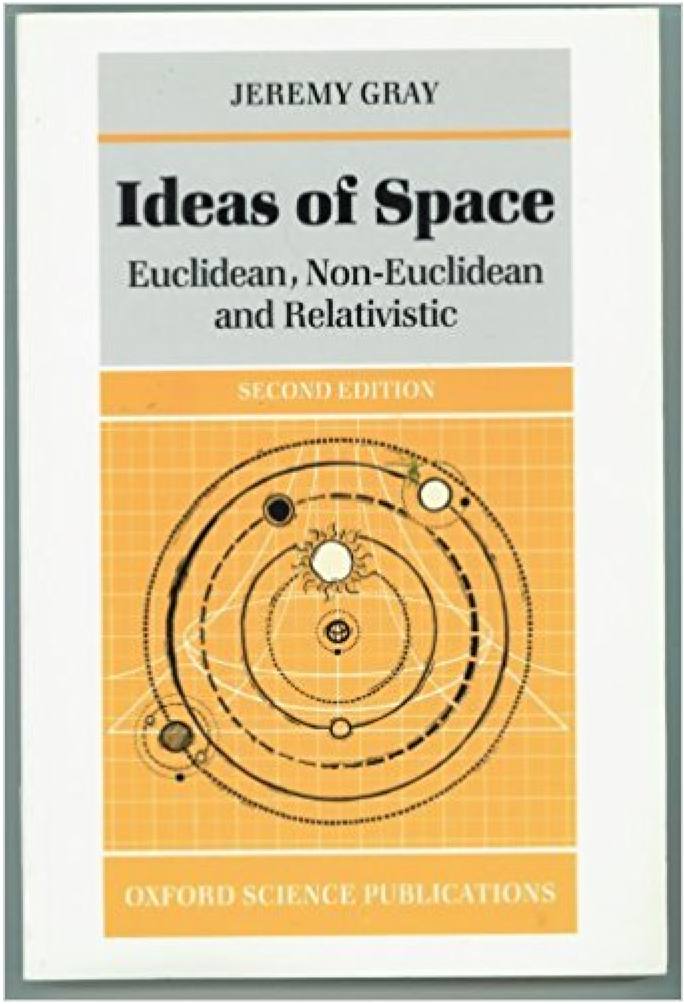
Ideas Of Space: Euclidean, Non-Euclidean, And Relativistic



Synopsis

Now in a revised and expanded new edition, this volume chronologically traces the evolution of Euclidean, non-Euclidean, and relativistic theories regarding the shape of the universe. A unique, highly readable, and entertaining account, the book assumes no special mathematical knowledge. It reviews the failed classical attempts to prove the parallel postulate and provides coverage of the role of Gauss, Lobachevskii, and Bolyai in setting the foundations of modern differential geometry, which laid the groundwork for Einstein's theories of special and general relativity. This updated account includes a new chapter on Islamic contributions to this area, as well as additional information on gravitation, the nature of space and black holes.

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Customer Reviews

From reviews of the first edition: "Jeremy Gray has provided a superb exposition which tells a good story." --Mathematics Teaching"Promises to become a classic text for those interested in considering changing mathematical perceptions of space. Gray's book is a pleasure to read." --Historia Mathematica"An admirable exposition for well-educated laymen of the evolution of geometrical thought from before Euclid to black holes." --American Mathematical Monthly --This text refers to the Hardcover edition.

Jeremy Gray is at Open University. --This text refers to the Hardcover edition.

An early book of Gray's, and isn't up to the brilliance of Plato's Ghost or the Poincare biography. But it’s plenty good enough to satisfy a need for the history of the parallel postulate. Actually, the chapter on Riemann is pedagogically excellent in the way the later books are.

The first part of the book introduces Euclidean geometry and runs through many attempted proofs of the parallel postulate. It seems that "ideas of space" were of secondary interest at best to all these authors, who were probably more enticed by the challenge of the mathematical problem itself. Embarrassing "proofs" were given even by Lagrange and Legendre. Real progress was only made possible by the recognition that other geometries are possible and that the true geometry of space may be non-Euclidean. But this point of view had trouble catching on since Euclidean geometry was so deeply anchored in tradition and indeed freshly supported by Kant and others.Gauss was perhaps the first to break free from these shackles. "In 1816 he expressed his own doubts about the parallel postulate in a review, but the great care with which he expressed himself did not save him from being ’dragged through the mud’ as he later wrote." So Gauss chose not to publish on these matters. It was left instead for Lobachevsky and Bolyai (about whose work Gauss modestly said "to praise it would be to praise myself"). They both achieved much the same things, succeeding in developing geometry with the parallel postulate replaced with a more general "theory of parallels". In such a geometry they considered three fundamental entities: planes, horospheres and spheres. A plane is of course just the plane of hyperbolic geometry, which we hope to describe. A horosphere is a special surface whose geometry is Euclidean (it is a "circle of infinite radius" of sorts; today we may think of it as, e.g., a plane z=constant in the half space model), which we can use to prove that the geometry on a hyperbolic sphere is ordinary spherical geometry. This linchpin result grants us spherical trigonometry, which we can then canonically project to the hyperbolic plane, making hyperbolic plane geometry susceptible to concrete analytic formulae. All of this was proved by both Lobachevsky and Bolyai. It makes hyperbolic geometry seem very real indeed, although only computationally.Next we look at how Riemann and Beltrami realised that differential geometry provides a new approach to non-Euclidean geometry---indeed to the foundations of geometry altogether---and how this lead to the discovery of the standard geometric models of hyperbolic geometry. The tone of the book has here turned a bit sweeping and shallow; Gray has suddenly stopped writing out meticulous proofs. Stillwell’s hyperbolic geometry source book gives a meatier and better account.The last part of the book give a standard, non-technical account of relativity theory. Mathematical details are mostly limited to a few fairly dull calculations in special relativity, and continuity with previous material is mostly limited to a few retrospective remarks (hyperbolic geometry embeds in spacetime; analogies between disc models of hyperbolic geometry and hot plate models of general relativity).

Although the author, as to be expected, is knowledgeable about his subject matter, my concern is again the perpetuation of mistaken thinking in the fields concerned.The author sees instead as mistaken the contrary thinking of the past, in which he often could indeed be right, in view of the undeniable progress in the sciences. But this progress can make associated practitioners overconfident in the rightness of their ideas.To be more specific, the author paints the rosiest picture he can of non-Euclidean geometry, while deprecating classical geometry as "deadening" (p.86). And like much of the mathematical community, he does not for a moment pause and wonder if there could be any mentioned mistakes in its accepted proposals, as current thinkers themselves submit finding mistakes in understandings held for centuries.One of present-day contentions, as I brought up elsewhere, is that the parallel postulate, central to the rise of non-Euclidean geometry, is unprovable, and an entire system of arguments was built around this and in support of the newer geometries.In these I find fundamental fallacies, a main one being, as I noted, a redefinition of critical concepts like straightness. In trying to by this means disprove something about Euclidean geometry, one commits the fallacy of equivocation, of speaking about something else, about, for instance, what happens on a sphere rather than in a plane.Yet the author, for example, says (p.160) "it cannot be the case" that a line "equidistant from a straight line [be] itself straight" (for an equivalence to the parallel postulate), because in e.g. elliptic geometry (dealing with surface curvatures, not the originally meant plane) "the equidistant [line] is a circle". Or, he speaks (p.107) of the "mistaken belief" "that the parallel postulate must hold", although it is under fallaciously changed definitions of such as "line" or "infinity" that it was determined not to hold.

Non-Euclidean Geometry (Dover Books on Mathematics) Non-Euclidean Geometry (Mathematical Association of America Textbooks) Non-Euclidean Geometry in the Theory of Automorphic Functions (History of Mathematics) Non-Euclidean Adventures on the LÃƒÂ©nÃƒÂ¡rt Sphere The Non-Euclidean Revolution (Modern BirkhÃƒÂ¤user Classics) The Non-Euclidean Revolution The elements of non-Euclidean geometry