

dom on both sides.

Metaphysics, the study of first principles, is "the highest science," Hutchins maintained, and therefore it should pervade the college curriculum. The social and natural sciences should be taught as the subordinate sciences that they are. To the pragmatist Dewey, however, metaphysics was not a genuine science. Metaphysical ideas, by themselves, did not constitute knowledge in his eyes; their only use was in forming theoretical hypotheses to explain empirical facts. Shaping education according to perceived metaphysical truths, Dewey argued, would mean giving it an authoritarian cast. As he saw it, Arcilla explains, metaphysics "prevents us in principle from investigating whether empirical and practical facts may to some degree also determine, and help us criticize, the meta-

physical truths we hold. Yet we need to criticize these truths in this way in order to cultivate a democratic and liberal society." Aristotelian metaphysics, after all, had countenanced slavery.

In the field of education, Dewey's position is now "common sense," Arcilla says. Yet that ought not to mean that ultimate questions about the nature and purpose of human life should go unasked. "Hutchins may have been wrong to believe that we possess, or could possess, metaphysical truths," but he may well have been right that "the questions that have spurred the quest for such truths" should be taken up. Just because its results are "unscientific," Arcilla says, does not mean that metaphysical speculation must be "in conflict with our scientific interests in education, or . . . that it has no pragmatic value at all."

SCIENCE, TECHNOLOGY & ENVIRONMENT

Nature's Starring Role

"Starry Messengers: Supernovas, Comets and Sunspots Herald the Scientific Revolution" by Frederic J. Baumgartner, in *The Sciences* (Jan.-Feb. 1992), The New York Academy of Sciences, 2 East 63rd St., New York, N.Y. 10021.

The 17th-century scientific revolution that overturned the Aristotelian-Ptolemaic view of the universe is usually credited to such giants as Copernicus, Kepler, and Galileo, and to the invention of the telescope. Baumgartner, an historian at Virginia Polytechnic Institute and State University, points out another major contributor: nature itself.

When Nicolaus Copernicus (1473-1543) proposed in *De revolutionibus orbium coelestium* (1543) that the planets, including Earth, revolved around the sun, his arguments made not a dent in the Aristotelian-Ptolemaic orthodoxy. The orthodoxy held that Earth was at the center of the universe and that the world beyond the moon's orbit was virtually unchanging. In Copernicus's time, astronomers had found no heavenly evidence that seriously disrupted the Ptolemaic cosmology.

In 1572, however, a new point of light

appeared in the sky and remained there for more than a year. It was what modern astronomers call a supernova, a massive explosion of a dying star. "To astronomers of the day," notes Baumgartner, "the appearance of a new star in the heavens was simply impossible."

Danish astronomer Tycho Brahe's discovery of that "impossible" star was just the beginning. Five years later, a great comet blazed across the sky where it was not supposed to be, far beyond the orbit of the moon, and it dealt an even stronger blow to the traditional wisdom. Nor was that the end of what was an extraordinary succession of dramatic celestial phenomena. Over a 70-year period that began with Brahe's first excited discovery, Europeans witnessed two of only three supernovas ever recorded in Europe, two of the greatest comets ever seen, unusually high sunspot activity, two total eclipses of the sun,



Tycho Brahe, with his pre-telescope instruments.

a great conjunction of Jupiter and Saturn, and a transit of Mercury across the face of the sun.

Galileo Galilei (1564–1642) was only eight years old when the first supernova appeared; the appearance of the second in 1604 helped turn his interest to astronomy. He quickly grasped the supernova's cosmological implications. Four years after it faded from view, he took the telescope, which had been invented about 1600, “turned [it] on the heavens for the first time and ushered in a new age of astronomy.” When the second large comet appeared in the heavens in 1618, astronomers across Europe viewed it not only with new telescopes but with new eyes.

The rare celestial show that nature put on over the course of seven decades did not do more than the invention of the telescope to create the revolution in scientific thought, Baumgartner says. But it certainly helped. By the time the show was over, the curtain had been brought down on the traditional theory.

Call of the Tame

“In From the Cold” by Stephen Budiansky, in *The New York Times Magazine* (Dec. 22, 1991), 229 W. 43rd St., New York, N.Y. 10036.

Strident animal-rights activists insist that dogs, cattle, horses, and other domesticated beasts have been enslaved by that tireless despoiler of nature, man. And most other people take for granted that man at least imposed domestication on the animals. Journalist Budiansky, author of *The Covenant of the Wild: Why Animals Chose Domestication* (1992), suggests that animals “chose us as much as we chose them.” Far from being a crime against nature, the domestication of animals, he argues, was “a product of nature, an evolutionary process driven by the animals’ own need to adapt to the rapidly changing climatic conditions that swept the earth at the end of the ice age.”

The glaciers that repeatedly swept the continents of North America, Europe, and Asia during the ice age demanded adaptability, Budiansky argues. The million years that preceded the glaciers’ final re-

treat was really a series of small ice ages, marked by enormous swings in climate. Natural selection favored in many animals the “youthful” characteristics of curiosity, an ability to learn, and lack of fear of new situations. These opened the way for them to approach and be approached by humans.

Human efforts to domesticate beasts by force alone would have been impossible, Budiansky says. The ancient Egyptians, for example, tried and failed to domesticate gazelles and other species. And there is mounting evidence to suggest that the rise of agriculture and animal husbandry some 9,000 years ago was not at first “an obvious improvement” for man. Early agriculturalists suffered “an epidemic of injuries, malnutrition and infectious disease” unlike anything experienced by hunter-gatherers. Over the long term, however, the advantages to man and beast alike are plain.