## SCIENCE & TECHNOLOGY

# *Huygens Had Some Help*

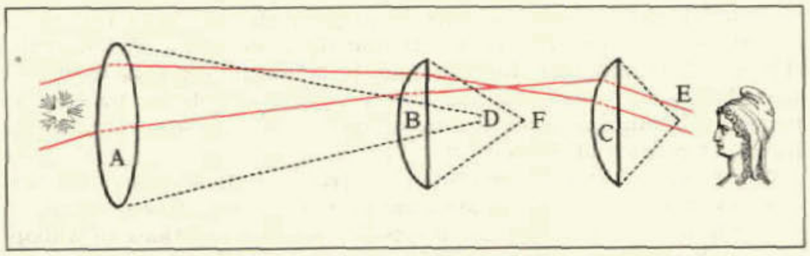
"The Development of Compound Eyepieces, 1640–1670" by Andrew van Hendel, in the *Journal of the History of Astronomy* (vol. 8, no. 1, 1977), Academic Publications, 156 5th Ave., New York, N.Y. 10010.

During the 17th century, the refracting telescope developed rapidly from Lippershey's all-purpose spyglass (1608) into a sophisticated astronomical instrument. In large measure this was due to the Huygenian eyepiece, named for Christian Huygens, the Dutch astronomer, physicist, and lensmaker, who is credited with its invention.

But Huygens, writes van Hendel, a Rice University historian, "did not invent the eyepiece *ex nihilo*." As early as 1644, a Capuchin monk, Schyrle of Rheita, used a modified telescope with additional lenses in his studies of Saturn, Jupiter, and Mars. A 1649 letter from Augsburg optician Johann Weisel also refers to what is clearly a compound eyepiece. Huygens studied a Weisel eyepiece in Antwerp in 1652.

Recurrent modifications in telescope construction during the period brought increased magnification, expansion of field of view, and alleviation of spherical and chromatic aberration (the former caused by lens shape, the latter by the lens's tendency to bend different wavelengths of light at different angles). Magnification increases with the ratio of the objective focus (AD, below) to the focus of the eye lens (CE). Telescopes thus grew longer to increase focal length. However, the greater the magnification, the smaller the field of view. Although the Keplerian telescope (1611, two convex lenses) yielded a larger field of view and a clearer, if inverted, image than the Galilean (1609, convex and concave), similar restrictions of field soon became apparent. Van Hendel speculates that it was the long telescope, necessitating addition of a field lens (B) to increase the scope, which led to development of the compound eyepiece.

But until he visited England, Huygens had worked primarily with




*Field lens (B) directs oblique beams to eye lens (C). Huygens was not aware that the optimum configuration for his eyepiece (BC) is a ratio of focal lengths (BF:CE) between 2:1 and 3:1, with separation equal to half BF + CE.*

smaller (12- to 23-foot) instruments. Not until 1661, when observing the transit of Mercury across the sun with Sir Paul Neile's 35-foot telescope, was he impressed with the need for the field lens.

In subsequent experiments of his own, Huygens improved the eyepiece, adopting the plano-convex lens (one side flat) for field and eye lenses, turning the flat side of each toward the eye, as Weisel had done 15 years before. Building on the work of his predecessors, by October of 1662 he had determined elements of the special relationship between field and eye lens, thus eliminating aspects of transverse chromatic aberration.

## *Is It Safe? Does It Work?*

"Vaccines and Social Responsibility: Here Are Some Answers. What Are the Questions?" by H. V. Wyatt, in *The Monist* (Jan. 1977), Box 402, La Salle, Ill. 61301.

In 1972, a U.S. court ordered the federal government to pay damages to a woman paralyzed by poliomyelitis as a result of "immunization" with Sabin oral vaccine in 1963. The court found the former Division of Biologics Standards of the National Institutes of Health negligent in releasing vaccine that had been determined—through tests on monkeys—to exceed the legal safety limit. Yet, the same vaccine has virtually eradicated polio in the United States. Introduction of new vaccines necessarily involves issues of safety versus efficacy. What balance should be struck between the two?

Scientists working on the polio vaccine program faced a moral dilemma, writes Wyatt, a microbiologist at the University of Bradford, England. If the Sabin vaccine were not used, polio would infect thousands and kill many; if it were introduced, almost all of these cases would be prevented. The vaccine itself, however, could cause some scattered injury. This latter consideration was overlooked in light of the "balance of good." Moreover, the vaccine had been widely tested in humans, and researchers were convinced the vaccine was safe, "regardless of what other doubts might be raised by animal or tissue culture experiments."

Clear bioethical decisions, says Wyatt, are plagued by a variety of uncertainties, including test results that differ in people and animals. Between 1957 and 1964, for example, tests on guinea pigs indicated that the Swedish polio vaccine had increased in potency by only 50 percent, although tests of the same vaccine on humans revealed an increased potency of 300 percent.

Wyatt warns that "overscrupulous fear" of the possible consequences to recipients may "preclude proper testing of new vaccines" for such diseases as malaria and syphilis. Adverse reactions to whooping cough vaccination, for example, recently stirred up controversy in Britain, despite the fact that deaths from the disease have been reduced from over 1,000 to about 10 annually.