

The Dangers of Abstraction

By JOEL E. COHEN

Mathematics is a Dr. Jekyll and a Mr. Hyde. Computers, the visible instruments of mathematics, are all around us. Yet stories of the remoteness of mathematics and of mathematicians are legion. For example, C.N. Yang, a Nobel laureate in physics, once explained the difference between a physics book and a mathematics book. A physics book is one you can't read after the first page. A mathematics book is one you can't read after the first sentence.

Not all mathematicians think their subject is so remote. In 1983, in their first book, "The Mathematical Experience," Philip J. Davis and Reuben Hersh humanized mathematics as an activity of passionate, fallible men and women. The book told what it feels like to do and love mathematics. It won the 1983 American Book Award in Science. Properly understood, mathematics, the fearsome Mr. Hyde, became a lovable uncle.

In a new book, "Descartes' Dream: The World According to Mathematics" (Harcourt Brace Jovanovich, 321 pages, \$19.95), Messrs. Davis, professor of applied mathematics at Brown University, and Hersh, professor of mathematics at the University of New Mexico, report on the practical Dr. Jekyll: the mathematics of business and industry, medicine and law, government and war.

In business, for example, mathematics helps design the bodies of autos and aircraft to reduce air turbulence, helps schedule manufacturing, analyzes the failures of parts, suggests how to inventory spares, optimizes distribution to points of sale, helps set finance charges for credit sales and so on. Mathematics continues to contribute to the growth of national productivity in almost every sphere of life in technologically advanced countries.

Descartes and Leibniz dreamed in the 17th century that all human actions could be guided by mathematical reasoning. They would be amazed to see how much of their dream is true today.

Unlike Descartes and Leibniz, but like many humanists of the past and present, Messrs. Davis and Hersh fear that mathematics has penetrated our lives too far. Their fear derives from the secret of mathematics' success, abstraction.

Mathematics replaces complex processes or situations with symbols and simplified rules for manipulating those symbols. The symbols and the rules ignore everything about the real world except what is essential to the mathematician's or scientist's purpose. Scientists use mathematical abstractions to figure out the consequences of their assumptions. They can also test their assumptions by comparing mathematically derived consequences with observable reality. The symbolic abstractions that replaced falling bodies, planets, chemicals and chromosomes have given people astounding power.

When the purpose of the abstraction is to deal with people, however, there are potential dangers. "The final intent of the ap-

plication of mathematics to people," the authors write, "is to be able to compare two individuals or groups of individuals, to be able to arrive at a precise and definitive opinion as to which is taller, smarter, richer, healthier, happier, more prolific, which is entitled to more goods and more prestige, and ultimately, when this weapon of thought is pushed to its logical limits and cruelly turned around, which is the most useless and hence the most disposable . . . Whenever we use computerization to proceed from formulas and algorithms to policy and to actions affecting humans, we stand open to good and to evil on a massive scale."

Messrs. Davis and Hersh suggest that "advanced mathematization, through ab-

Bookshelf

"Descartes' Dream: The World According to Mathematics"

*By Philip J. Davis
and Reuben Hersh*

straction and subsequent loss of meaning, played a role" in the Holocaust. "It is no accident that the great evils of the period 1933-1945 were perpetrated in a country that was the world leader in theoretical science and mathematics . . . Numbers, tattooed on the arms of the victims, reduced them to the level of branded cattle." Beneath the bedside manner of the mathematical Dr. Jekyll lurks a Faust.

This mathematical self-flagellation is absurd. Replacing individuals and groups by abstractions is an older and deeper part of human experience than mathematics. The Chosen People fight the Amalekites. Armies distinguish enemies and allies, privates and generals. The law recognizes classes of creditors, stockholders and debtors. Hospitals, universities, corporations and unions all deal with people abstractly.

The problem lies not in using mathematics to approximate features of people, as the authors suggest, but in using the inadequate mathematics of falling bodies, planets, chemicals and chromosomes to approximate people poorly. Here I betray my optimism and sympathy for Descartes' dream.

The computer, drudge extraordinaire, is as happy storing 10 million numbers to characterize Johnny Jones, second grader, as it is storing only his IQ. The challenge is to choose the numbers wisely and to comprehend them. Once the human population outgrew the face-to-face group of a few dozen individuals, there was no escaping the masks we put over others' faces. With better mathematics and better instruments of mathematics, we can try to give those masks human features.

This is Mathematics Awareness Week. The new book by Messrs. Davis and Hersh could be just your number. Even if it's half wrong, it's at least half right, and that's better than most books on the subject.

Mr. Cohen is professor of populations at Rockefeller University.