SCIENCE

Computers '95: Fluid Dynamics

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A Special Report

Efforts to understand the formation of stars, the motions of ocean and atmosphere that control our weather, and other fundamental processes on Earth and in space face a double challenge. Data on these phenomena are often sparse, and they are governed by complex fluid motions. Thus they are tailor-made for study with a computer. Thanks to increases in computing power and improvements in computational methods, great strides have been made recently in simulating and indeed understanding the underlying controls on fluid motion from Earth's core to the stars. In this special issue, four Articles by leading practitioners illustrate how the interplay of numerical simulations, theory, and observations has advanced understanding in key areas of geophysics and astrophysics.

The accompanying News stories look at some of the underpinnings of this effort. In studies of fluid dynamics, turbulence is the wild card, and efforts to simulate it and its complex effects on mass, momentum, and energy transfer have been frustrating. Barry Cipra looks at how mathematicians are trying to crack the problem with computational short cuts based on a richer understanding of turbulence. In spite of these advances, fluid-dynamics simulations are notoriously hungry for computer power, and two stories look at where that power will come from.

In the near term, as Robert Pool describes, a new generation of supercomputers is emerging that get their number-crunching muscle from mass-produced microprocessors—the same chips found in the most powerful workstations—rather than from the custom processors of earlier supercomputers. The result, for fluid-dynamics modelers and other users, may be the steep performance increases and price drops long enjoyed by users of desktop machines. But silicon microchips will run up against physical limits sooner or later, and when that happens, a new wave of computers, physically and conceptually different from current devices, will take their place, as James Glanz reports.

No issue on computers can ignore the Internet, which has transformed nearly every computer into a window on a wider world. Cyberspace, rich as it is, can be frustrating because it's an uncataloged archive, and Gary Taubes examines efforts to bring order to it by indexing its contents. Ultimately, Internet architects would like to make it as easy to hunt down information in cyberspace as it is in the on-line biomedical databases M. Mitchell Waldrop describes, which have changed the world for genome researchers.

–Brooks Hanson and Tim Appenzeller

An on-line version of this special section, which includes links to World Wide Web sites offering supplemental information, can be found in the "Beyond the Printed Page" section of *Science*'s home page (http://www.aaas.org/science/science.html).