bulence until this point in the course. The reason for this is simply that a theory for turbulent flows is still to be developed. Therefore my goal in treating turbulent flows is to introduce some of the language used in correlating turbulence measurements and in characterizing the turbulent field. The increased apparent shear stress in turbulent flows is explained in terms of the momentum transport caused by the fluctuating velocity field. The concepts of eddy viscosity and mixing length are introduced. They are found not to be as useful for turbulent flows as were molecular viscosity and mean free path for laminar flows because the scale of the turbulent motion responsible for transport is of the same order as the dimensions of the field. A general discussion is given on the character of fully developed velocity profiles and, in particular, on the roles of fluid viscosity and of the viscous sublayer. The variation of the average velocity and the eddy viscosity with location is correlated through dimensional analysis and the "law of the wall", the "velocity defect law", and the "overlap law". It is then shown how the definition of eddy conductivities for heat transfer are useful in explaining measurements and in particular the effect of Prandtl number on temperature profiles. The interpretation of fully developed velocity profiles and Cole's "law of the wake" are used to develop predictive methods for general turbulent boundary layer flows. Taylor's treatment of point source diffusion in homogeneous turbulent fields is presented as one of the few successful theories in turbulence. It is used to explain the gross aspects of turbulent mixing and to interpret the observed variation of eddy conductivities. Statistical methods for describing turbulent flows are discussed and in particular the concepts of correlation, scale, and spectrum are introduced. A very brief summary is given of theoretical attempts to deal with turbulence through the use of the concept of isotropy and the definition of a turbulence structure.

COMPRESSIBLE FLOWS

The last topic in the outline is a one-dimensional treatment of compressible flows. It is usually presented after the material on perfect fluid theory but appears here in my outline because in recent offerings of the course I have deleted it. Most of this material with the exception of that on finite amplitude waves and shock tubes are more properly treated in undergraduate courses.

OTHER APPROACHES?

I should conclude this article by saying that the course that I have discussed is only one way, and not necessarily the best way, of introducing graduate students in chemical engineering to basic concepts in fluid dynamics. My own introduction to and interest in fluid dynamics developed from a course in reactor design.

FLUID MECHANICS COURSE OUTLINE

1. Basic Equations
2. Unidirectional Viscous Flows
3. Non-Newtonian Fluids
4. Equations of Motion for a Viscous Fluid
5. Constitutive Relations
6. Creeping Flow Approximation
7. Perfect Fluid Theory
8. Boundary Layer Theory
9. Turbulence
10. One-Dimensional Compressible Flows

ChE news

The following item on CACHE was submitted by Professor Warren D. Seider, University of Pennsylvania, Philadelphia, Pennsylvania 19104.

The CACHE (Computer Aids for Chemical Engineering Education) Committee has been organized to coordinate the development of computing systems for use in chemical engineering education. The committee includes twenty educators from sixteen universities. The principal goal of the CACHE Committee is to accelerate the integration of computing into the chemical engineering curriculum by sustained inter-university cooperation in the preparation of curriculum and course outlines and in the specification and creation of computing systems.

The CACHE Committee's curriculum subcommittee has organized a session for the AICHE Annual Meeting in Washington, D.C., entitled "Computers in Chemical Engineering Education." The session will emphasize topics relating to short and long range plans for the integration of computers into the curriculum. Ten members of the CACHE Committee will participate in the panel discussion after brief presentations.