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SOME FEATURES OF THE LATEST DECADE OF EXPERIMENTAL RESEARCH ON TURBULENCE

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SUMMARY

Photography, though older, has recently joined the hot-wire and laser-doppler anemometers as a serious tool in turbulent flow studies. It illuminates the renewed emphasis on searching for repeated characteristic local flow patterns (called "coherent structures" or "organised structures") within the turbulent motion. It appears that each traditional turbulent shear flow may include one or more of such fluid dynamic paradigms. In the plane free shear layer, for example, the most common pattern is a nearly periodic row of co-rotating plane vortices. In the fully turbulent parts of boundary layers and in round jets, the characteristic patterns are different, and they occur at more irregular intervals.

In homogeneous turbulence research, statistical properties continue to dominate, although (randomly occurring) characteristic flow patterns have occasionally been considered during the past thirty years. There is still interest in the long-recognised tendency of the turbulent fine-structure to be confined to spatially limited random regions of fluid. Some theoretical researchers have confused this spatial "spottiness" with the notion of temporal "intermittency".

Randomness is still recognised as a major feature of turbulence. Furthermore, "local isotropy" is alive and well in the velocity field at large enough Reynolds numbers. It may not, however, be valid for temperature and concentration fields being convected by locally isotropic turbulence. In fact, there is growing evidence that even in fully isotropic mixing, the statistical history of the scalar field being mixed may reflect its initial conditions for times much longer than the integral time scale of the turbulence.

With the advent of large, fast computers, Navier-Stokes numerical experiments are adding a new dimension to turbulent flow research. They have been used chiefly to infer statistical properties, but their greatest contribution may come from detailed inspection of flow events locally in space and time. Computer speed and size limitations have restricted the computed flows to modest Reynolds numbers, e.g. for isotropic turbulence, the equivalent of that generated by a 1 cm mesh grid in a wind tunnel air flow of a few metres/sec.

Numerical Navier-Stokes experiments also allow explicit "measurement" of static pressure fluctuations, an achievement whose success in the laboratory is still uncertain.

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