Jule G. Charney

Born January 1, 191 7, California; died June 16, 1981, Boston, Mass.; with John von Neumann, first introduced the electronic computer into weather prediction in 1950.

Education: PhD 1946.

Professional Experience: leader, Meteorology Group, Princeton, 1948-1956; Alfred P. Sloan Professor of Meteorology at the Massachusetts Institute of Technology, 1956-1981.

Jule Gregory Charney, Alfred P. Sloan Professor of Meteorology at the Massachusetts Institute of Technology, died June 16, 1981, at the Sidney Farber Cancer Institute. He was the leading world figure in meteorology ever since he and John von Neumann first introduced the electronic computer into weather prediction in 1950.

Charney was born on January 1, 1917, in California, to Russian immigrants. His original graduate studies at UCLA were in mathematics, but he changed to meteorology in about 1942. The basic principle of numerical weather forecasting is to express the physical laws of atmospheric hydrodynamics and thermodynamics that can be numerically solved by the computer as a step-wise marching process in time.

As a concept this was not new in 1950—it had been outlined in some detail 30 years earlier by the Englishman Lewis F. Richardson (1922). Richardson's test calculation done “by hand,” under difficult frontline conditions in World War I, gave very erroneous results, however.

As early as May 1946, von Neumann had envisaged meteorology as a major component of his newly formed Electronic Computer Project at the Institute for Advanced Study (Goldstine 1972; Platzman 1979). Charney's 1946 doctoral thesis had suggested to him that the large-scale circulations in the atmosphere could only be analyzed in a physically appealing and mathematically tractable way, if certain specific approximations were used to distinguish those circulations from sound waves and gravity waves of higher frequency (Charney 1947). After being exposed to von Neumann's hopes for numerical meteorology in an August 1946 meeting (Platzman 1979), Charney spent most of the following year in Oslo. There he extended his ideas and arrived at the “quasi-geostrophic prediction equations” (Charney 1948). These equations predicted only the slow large-scale motions and were free of the sensitivity to high-frequency motion that had plagued Richardson.

On Charney's return he joined von Neumann at Princeton as leader of the Meteorology Group. He then set about answering a series of critical technical questions such as: How important are friction and heating? From how large an atmospheric volume must one have data in order to make a 24-hour forecast for the US? What is the simplest formulation that might have some predictive skill?

The first computations were made in 1950 with the ENIAC and were gratifyingly successful (Charney, Fjörtoft, and von Neumann 1950; Platzman 1979). Similar research was quickly started in other countries, and more elaborate and accurate formulations were used at Princeton as soon as the new IAS computer was ready in 1952 (Goldstine 1972).

With Charney's help, the US Weather Bureau, Air Force, and Navy established in 1954 a joint Numerical Weather Prediction Unit in Suitland, Maryland, for routine daily prediction of large-scale atmospheric flow patterns and weather. The Weather Bureau, also with intellectual encouragement from Charney, soon started a specifically research-oriented group, the Geophysical Fluid Dynamics Laboratory, to use computers for basic atmospheric and oceanic research. Nowadays, computers are used for weather prediction at the 1- to 4-day range in all of the larger industrial nations and many smaller countries. This success has revolutionized other types of meteorological research as well, by emphasizing both the possibility and the responsibility to see that the consequences of hypotheses about the atmosphere are examined quantitatively. The computer has to a marked extent become for meteorologists the equivalent of the laboratory for physicists and chemists.

It must be admitted that these developments would have occurred eventually in the absence of Charney's personal insight. After all, Princeton was not the only center of computer development in the late 1940s, and Charney's quasi-geostrophic equations were being developed independently at that time in England, Norway, and the Soviet Union. It is very doubtful, however, that the first meteorological use of electronic computers would have been as successful elsewhere as it was under Charney and von Neumann. Their immediate success was a profound stimulus to the postwar development of atmospheric science.

In 1956 Charney left IAS to become professor of meteorology at MIT. A stream of major contributions in dynamic meteorology and oceanography came from him in the ensuing 25 years, including studies of the generation of the Gulf Stream, vertical propagation of hydrodynamic energy in the atmosphere, large-scale wave instability, formation of hurricanes, and hydrodynamic effects on desert climate. In the mid-1960s his clear view of the atmosphere as a single physical system, expressed in a report of the National Academy of Sciences (Charney et al., 1966), led to the extraordinary international effort in 1979 known as the Global Weather Experiment. Charney communicated his infectious enthusiasm for understanding the atmosphere and ocean to many students and collaborators, but his inspiring insights will be difficult to match.[1]

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[1] From Phillips 1981.

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UPDATES

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