(1917–1981)

JULE GREGORY CHARNEY

Pioneer of Atmospheric Dynamics

MIT professor Jule Charney was an international leader in the field of atmospheric science. His "quasi-geostrophic" equations allowed large-scale atmospheric circulations to be described mathematically and, using early computers, enabled him to produce the first numerical weather predictions. Throughout his career, Charney made fundamental contributions to the theories of weather systems, hydrodynamical instability, atmospheric wave propagation, hurricanes, drought, and atmospheric blocking, as well as ocean currents.

Credit: Courtesy MIT Museum

As an active founder of many meteorology-related organizations and initiatives, Charney encouraged scientific collaboration across disciplines and borders. After all, as he was quick to point out, the atmosphere is a single, global system.

"Jule Charney, more than any other living figure, has guided the postwar evolution of modern meteorology."

—The American Geophysical Union 1976 William Bowie Medal citation

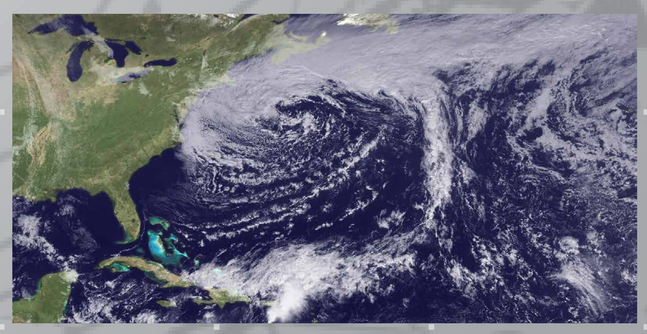
When applying to doctoral programs, Charney considered aeronautics, but ultimately enrolled in meteorology at the University of California at Los Angeles. He entered the field at an auspicious time. Research during World War II led to a surge of scientific and technological advances. Charney later noted that he was lucky to be mentored by pioneers Carl-Gustav Rossby, Jacob Bjerknes, and John von Neumann "at a young and impressionable age."

Credit: Courtesy of Nora Rosenbaum

$$\frac{\partial \zeta_g}{\partial t} = -\mathbf{v_g} \cdot \nabla \left(\zeta_g + f \right) + f_o \frac{\partial \omega}{\partial p}$$

$$\frac{\partial \vartheta}{\partial t} = -\mathbf{v_g} \cdot \nabla \vartheta - \omega N^2$$

The equations above make up the quasi-geostrophic theory of atmospheric motions introduced by Charney in a 1948 paper. This theory became the foundation of modern dynamical meteorology and oceanography.



Charney's doctoral research explained the origin of mid-latitude weather systems and the mechanism known as "baroclinic instability" that dictates their size, structure, and growth rate. With this insight, Charney had identified a ubiquitous phenomenon in all rotating, stratified fluids, including Earth's atmosphere and oceans, as well as other planetary atmospheres.

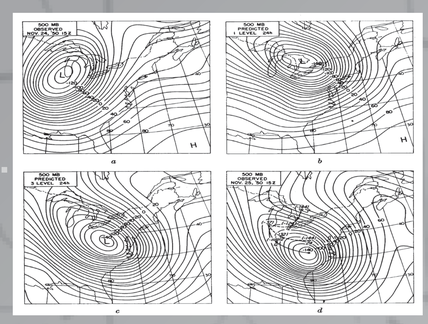
Credit: NOAA NESDIS Environmental Visualization Laboratory

During his quarter century at MIT, Charney mentored countless students and made profound, lasting impacts on the field through groundbreaking research on such diverse topics as the stability of atmospheric and oceanic flows, the formation and evolution of weather systems and hurricanes, oceanic boundary currents, how planetary waves extend up into the stratosphere, the formation of deserts, and how westerly winds can flip between zonal and wavy patterns.

Credit: katsrcool, CC BY 2.0

In the early 1950s, Charney led the theoretical meteorology group at the Institute for Advanced Study in New Jersey, demonstrating that computer-driven calculations using quasi-geostrophic theory could aid in weather forecasting. Charney (far left) poses next to future MIT colleague, Norman Phillips, along with G. Lewis, N. Gilbarg, and G.W. Platzman, against the backdrop of the institute's computer.

Credit: Photograph by Joseph Smagorinsky, courtesy AIP Emilio Segrè Visual Archives, gift of John M. Lewis



The work of Charney's group at the Institute for Advanced Study was the dawn of numerical weather prediction. In 1953, Charney produced the first computer-generated prediction of cyclogenesis.

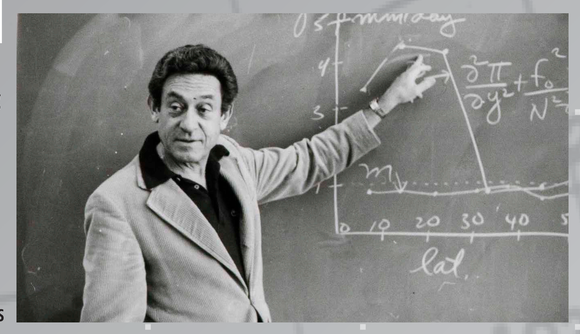
Credit: Charney, J. G. (1954) Numerical Prediction of Cyclogenesis, *PNAS*

Charismatic and open-minded, Charney had a knack for bringing people together. Soon after he joined MIT as a professor in 1956, he created and advertised an informal series of talks on geophysical fluid dynamics. The talks would continue for 22 years, attracting experts from around New England in the fields of meteorology, oceanography, geophysics, and applied mathematics. Above, Henry Stommel's announcement for one of the fortnightly seminars started by Charney.

Credit: Courtesy of J. Young

Charney played a key role in the establishment of many critical weather-related initiatives, such as the Global Atmospheric Research Program, an observational program improving numerical weather prediction, and the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory. One of Charney's last contributions was a pioneering study on the connection between CO_2 and climate change, conducted for the National Academy of Sciences.

Credit: Courtesy MIT Museum



"The motion of large-scale atmospheric disturbances is governed by the laws of conservation of potential temperature and absolute potential vorticity, and by the conditions that the horizontal velocity be quasi-geostrophic and the pressure quasi-hydrostatic."

—From "On the Scale of Atmospheric Motions" (1948) *Geofysiske Publikasjoner*

Background image credit: Charney, J. G. (1954) Numerical Prediction of Cyclogenesis, *PNAS*

1910

1917: Born January 1 to Russian immigrants Ely Charney and Stella Littman, tailors in the garment industry, Charney spent most of his early life in California.

1920

1928: Carl-Gustaf Rossby founded the country's first meteorology program at MIT in Course XVI Aeronautics and Astronautics.

1930

1931: MIT meteorologists instrumented a monoplane and performed six months of daily flights from East Boston (now Logan) Airport.

1938: Earned a bachelor's degree in mathematics and physics from UCLA, where he also received a master's in mathematics in 1940.

1940

1940: Radar Lab formed.

1941: Dept of Meteorology created as Course XIV led by Sverre Petterssen.

1942–69: Henry Houghton chaired the department.

1946: Course number changed to XIX.

1946: Received his Ph.D. at UCLA for "Dynamics of Long Waves in a Baroclinic Westerly Current."

1946: Worked at U. Chicago with Carl-Gustav Rossby.

1947–48: Published papers on baroclinic instability and quasi-geostrophic theory.

1948: Joined the IAS to explore the feasibility of numerical weather prediction.

1950

1954: Helped create the Joint Numerical Weather Prediction Unit, a collaboration between the U.S. Weather Bureau, Air Force, and Navy.

1955: Helped establish NOAA's Geophysical Fluid Dynamics Laboratory.

1956: Joined MIT as a professor of meteorology and director of the Atmospheric and Ocean Dynamics Project.

1957: Meteorology moved from the School of Engineering to the School of Science.

1960

1961–62: Published papers governing flow stability and planetary wave propagation.

1963: Awarded the Symons Gold Medal of the Royal Meteorological Society.

1964: Received the AMS Carl-Gustaf Rossby Research Medal. Elected to the National Academy of Sciences

1966: Appointed the first Alfred P. Sloan Professor of Meteorology at MIT.

1964: Meteorology moved from Building 24 to the Cecil and Ida Green Building, 54.

1968: Joint Program in oceanography created between MIT and the Woods Hole Oceanographic Institution.

1970

1971–73: Published papers on "geostrophic turbulence" and "desertification."

1976: Awarded the Bowie Medal of the AGU for "contributions to fundamental geophysics and for unselfish cooperation in research."

1979: The "Charney Report" linked CO_2 emissions and climate change.

1970–74: Norman Phillips chaired the department.

1974–77: Jule Charney chaired the department.

1977–81: Edward Lorenz chaired the department.

1980

1981: Even while battling cancer, Charney produced important research, co-authoring articles on monsoons and the oceanic equivalents of atmospheric weather systems.

1981: Died June 16, Boston, MA.

1981–1983: Chaired by Peter Stone.

1983: Merged with Course XII to become the present Department of Earth, Atmospheric and Planetary Sciences (EAPS, XII). The Center for Meteorology and Physical Oceanography established.

1990

1997: The Center for Meteorology and Physical Oceanography changed its name to the Program in Atmospheres, Oceans and Climate (PAOC).

2000

2010

2011: The Lorenz Center opened in EAPS.