

METEOROLOGY

Jet Stream Steers Weather

Bad weather often spills from the nose of the jet stream, fast-flowing river of air high in our atmosphere that gives added speed to west-to-east plane flights.

By ANN EWING

► WINTER STORMS ride on the jet stream's nose.

The jet stream is an invisible, 200-mile-per-hour current of air found streaking 10,000 to 40,000 feet above the earth's surface.

Often the stream itself completely circles the Northern Hemisphere. It takes on a wave-like pattern, the distance between crests covering thousands of miles.

High-flying airplanes get lifts on these west-to-east currents that cut hours from their arrival times when they are headed eastward.

The speediest stream yet found was reliably clocked at 275 miles per hour over a 30-mile distance. Scientists suspect that winds slightly over 300 miles an hour are possible.

Often associated with these swift-flowing rivers of air is clear air turbulence that tosses airplanes around without warning. Such unseen danger areas are becoming more and more important as man flies at the higher and higher altitudes where today's jets operate more efficiently.

Only since the end of the war have scientists been making an intensive study of these strange upper air currents so closely associated with the kind of weather you and I experience.

Some scientists believe the jet stream affects ground weather by governing air flow patterns in the lower atmosphere.

The jet stream's existence was first uncovered when World War II pilots returned from bombing flights over Japan with strange tales that meteorologists at first found hard to believe.

Their planes, the pilots said, would often

have a ground speed near zero approaching the target, a ground speed of about twice indicated air speed returning from the bombing run.

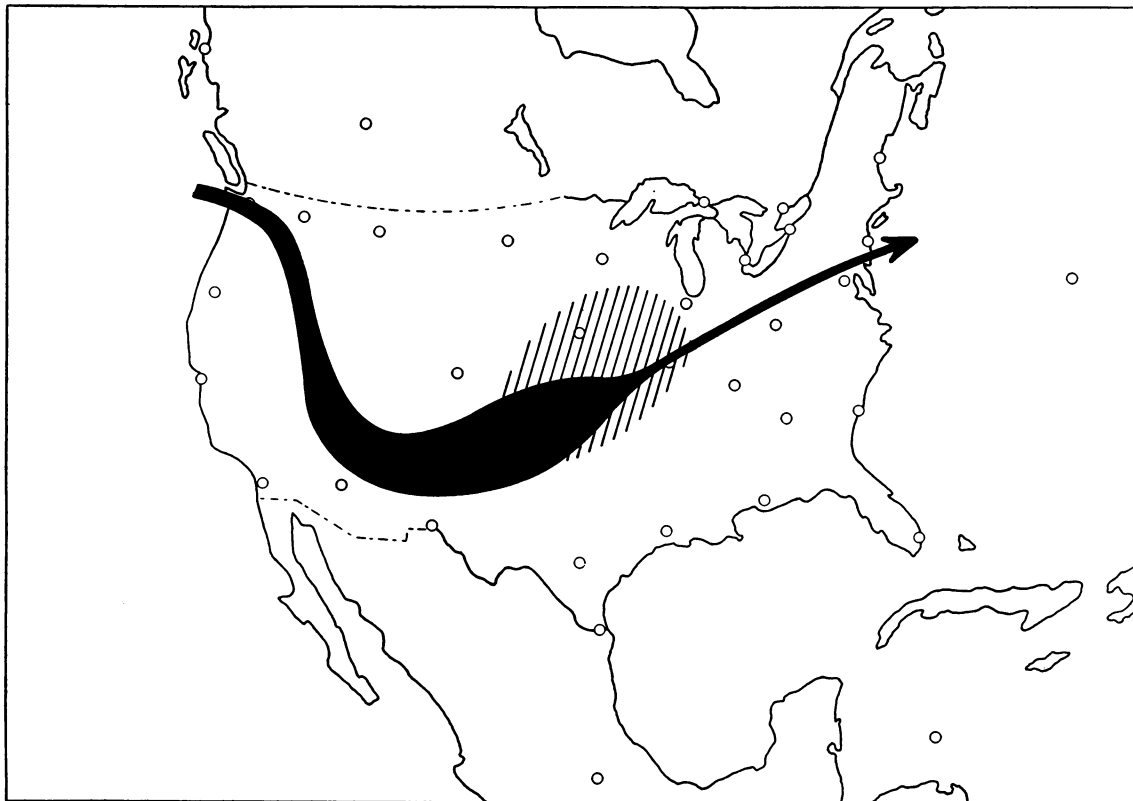
Now weathermen know that these pilots were bucking the jet stream when they were headed toward Japan. And now meteorologists for airlines, in so far as possible, route westbound high-level flights so as to avoid such strong head winds.

Usually, however, dispatchers from the airlines do not know exactly where the jet stream is. Its position can change rapidly from day to day.

To learn more about what causes the jet stream, why it takes the form it does and how to predict where it is going are among the big problems now facing meteorologists.

Answers to such questions would not only speed up high altitude flights, they would also assure more accurate predictions of tomorrow's weather as well as more accurate forecasts over longer periods.

Although there is a strong tie-in between jet streams and storms and rainfall on the earth's surface, many of the exact relationships are still to be established.



JET STREAM'S SILHOUETTE—Not a wild beast descending upon an unhappy country but a scientist's picture of the jet stream, this drawing shows how bad weather sits on the nose of this swift air current. The blacked-in area marks high-velocity concentration at the level of strongest wind, roughly 30,000 feet. Air in the jet shoots out forward through the nose and later loses its high speed.

However, Dr. Herbert Riehl, a University of Chicago meteorologist and specialist in jet stream studies, told SCIENCE SERVICE, "I have not yet seen a great winter storm formed in the middle latitudes without the jet stream as a starting mechanism."

The jet stream, he explains, can be likened to water under pressure in a hose. As water shoots out from the hose nozzle when it is turned on, so do high winds shoot out from the nose of the jet stream.

Although winds may be over 200 miles per hour in the jet, the nose will travel eastward at rates averaging 20 to 30 miles per hour, which is about the speed storms travel on the surface, so that the air in the jet shoots out through the nose and later loses its high speed.

Meteorologists do not yet know what causes the jet stream. They hope that extensive upper air soundings, both by radio-sonde balloons and by aircraft, will solve this problem.

First Airplane Survey

The first wide-scale airplane survey of the jet stream was made under the direction of Capt. F. A. Berry, the naval officer who supervised Project AROWA, which stands for Applied Research Operational Weather Analysis, a study supported by the Navy's Bureau of Aeronautics. In Project Jet Stream, Air Force scientists, with different kinds of aircraft, are now coordinating their efforts with the Navy study.

From these and previous flights, scientists have learned that a thin stream shoots forward from the jet stream's nose, and that this stream is usually 200 to 300 miles wide.

They have also found that the jet stream is usually centered at about 30,000 feet, that its average speed is 200 miles an hour, and that 50% of the strongest winds are found within 50 miles on either side of the jet stream's center.

A miniature picture of how jet streams form and change shape is being made, in the laboratory, under controlled conditions, by Dr. Dave Fultz, University of Chicago meteorologist, and by other scientists using similar methods.

They rotate water colored with dyes in a pan heated around the edges and cooled at the center. Aluminum powder sprinkled on top of the water shows the jet streams, with their patterns changing as the rotation and heating rates are varied.

Meteorologists are also following with great interest studies being made of the Gulf Stream, for they have discovered that there are many similarities between the fast-flowing rivers of air in the upper atmosphere and the major ocean currents.

As the jet stream does, so the Gulf Stream remains concentrated in a relatively narrow band over rather long distances. It also meanders much as the jet stream. Further, the flow rate of the Gulf Stream drops off very rapidly on either side of the fastest part of the current.

Upper atmosphere readings will help to solve the jet stream riddle, but such meas-

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BIBLIOGRAPHY OF MATERIAL ON ANIMAL EXPERIMENTATION—*Illinois Society for Medical Research* and the *National Society for Medical Research*, ISMR Bulletin No. 6, 8 p., paper, free upon request to publisher, 951 E. 58th St., Chicago 37, Ill. A selective bibliography including material from 1914 to August 15, 1954.

THE HEALTH OF REGIONVILLE: What the People Thought and Did About It—Earl Lomon Koos—*Columbia University Press*, 177 p., illus., \$3.25. This book is a study of popular attitudes toward sickness based on a survey made in a rural community of New York State.

JIVARO: Among the Headshrinkers of the Amazon—Bertrand Flornoy, with foreword by Brian Fawcett—*Library Publishers*, 224 p., illus., \$3.95. Telling of an expedition into the jungles of the Amazon to the Jivaro tribe and describing their techniques of human head-shrinking, a process heretofore unexplained.

MODERN CHEMICAL DISCOVERIES—Richard Clements—*Dutton*, 290 p., illus., \$5.00. The author, a British science writer, has endeavored to bring together in one volume all the most important chemical discoveries of the past 50 years.

RIGS AND RIGGING OF YACHTS—D. Phillips-Birt—*Adlard Coles (John de Graff)*, 207 p., illus., \$8.00. For yachtsmen, especially those planning a new rig.

SAILING AERODYNAMICS—John Morwood—*Philosophical Library*, 124 p., illus., \$7.50. Presenting the theory of sailing for the yachtsman.

SOIL—G. V. Jacks—*Philosophical Library*, 221 p., illus., \$5.00. To give farmers and students of agriculture an understanding of soil management.

TABLES OF INTEGRAL TRANSFORMS: Vol. II—Based, in part, on notes left by Harry Bateman and compiled by the Staff of the Bateman Manuscript Project—*McGraw-Hill*, 451 p., \$8.00. Containing tables of further integral transforms and integrals of higher transcendental functions.

THE VITAMINS: Chemistry, Physiology, Pathology, Vol. III—W. H. Sebrell Jr. and Robert

S. Harris, Eds.—*Academic*, 665 p., illus., \$15.00. The last book in a three volume reference work, containing the vitamins from p-aminobenzoic acid to the tocopherols, as well as new and unidentified growth factors.

Science News Letter, December 4, 1954

Jet Stream

Continued from p. 363

urements must come from all parts of the world. At present, they are made extensively only over certain portions of the Northern Hemisphere.

During the International Geophysical Year, scheduled for 1957-1958, scientists around the world will coordinate their efforts to measure such things as daily changes in the earth's magnetic field, formation of "northern lights," and variations in shortwave radio propagation conditions.

For weathermen, among the most fascinating data to be taken will be the upper air measurements.

The first suggestion of the existence of a narrow, high-velocity region in the upper atmosphere was made in 1933 by the late Prof. V. Bjerknes and his associates.

Their suggestion went unnoticed until 1944, when Dr. H. C. Willett of Massachusetts Institute of Technology published diagrams suggesting a "localized high velocity stream in the upper westerlies."

In 1946, three University of Chicago meteorologists, Dr. Carl-Gustaf Rossby, a Swedish-American meteorologist, Dr. Eric Palmén and Dr. Riehl, made a full-scale theoretical attack on the problem.

At that time, Dr. Rossby suggested that the pattern of flow high above the middle latitudes suggests the presence of "a broad stream meandering eastward around the hemisphere in wavelike patterns. The kinetic energy of this stream is concentrated in a narrow band of high wind speed embedded in a relatively quiescent surrounding atmosphere."

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