physical sciences

GEOPHYSICS

Meanders in Gulf Stream being charted

An area of the North Atlantic 55,000 miles square is being charted this summer by six scientists from the U.S. Naval Oceanographic Office. Their aim is to determine where the Gulf Stream suddenly begins to meander near Cape Cod, after having flowed up from Florida in a fairly well defined path.

In a combined air-sea operation, the oceanographers are investigating the volume of water transported by the meanders and the distribution of heat in the study area, which is about 200 miles south of Halifax, Nova Scotia. It is broad enough to cover several branches of the meandering Gulf Stream.

Two sets of readings, about three weeks apart, are being made with bathythermographs. The second readings will be compared with those taken on the first trip in order to plot any changes in the meanders. Airborne scientists are dropping expendable bathythermographs at 45-mile intervals between the ship's lanes which are predominately in a north-south direction.

The scientists plan to make preliminary analyses of their data while at sea.

CHEMISTRY

Evidence for helium 3 ion

During a study of the chemistry of helium ions in helium at gas pressures of from one to 30 torr at temperatures of from 300 to 76 degrees Kelvin, the existence of helium 3 ions was discovered.

There are three isotopes of helium: helium 3, helium 4 and helium 6. All have two protons in their nucleus and two outer electrons; each has, respectively, one, two and four neutrons. Helium 3 is widely used in low temperature research. [Helium I and helium II are not isotopes of the element, but refer to two liquid phases of helium 4, one the normal fluid and the other, the superfluid that appears at 2.2 degrees Kelvin.]

Dr. P. L. Patterson, who made the discovery at the Joint Institute for Laboratory Astrophysics in Boulder, Colo., reports in the April 15 JOURNAL OF CHEMICAL PHYSICS (just published) that the new ion species occurs at temperatures below 200 degrees Kelvin. Identification of He_3^+ was based on observations of its behavior under varied experimental conditions.

At 76 degrees Kelvin, the rate of formation of He_3^+ from He_2^+ is faster than the three-body formation of He_2^+ from He^+. Between 135 and 200 degrees Kelvin, ionized helium 2 and helium 3 are in equilibrium.

PLANETARY ASTRONOMY

Rough terrain on Venus

Three rugged sectors of Venus, extending over thousands of square miles of the planet's northern half, have been mapped by radar astronomers from California Institute of Technology's Jet Propulsion Laboratory.

Using the 210-foot antenna at Goldstone, Calif., which JPL operates for the National Aeronautics and Space Administration, Drs. Richard M. Goldstein and Shalav Zohar have mapped an area on Venus about the size of New England plus New York and Pennsylvania.

They found the most clearly defined area, called Beta, is roughly circular, with a diameter of 150 miles. The two other features, more irregular, appear almost as large on the radar map. Whether they are chains of mountains or extensive fields of boulders is not known, but there seems little doubt the areas are rough compared to the surrounding regions.

Details of the observations, made at a frequency of 2,388 megahertz, will be reported in a forthcoming issue of NATURE. The radar studies are conducted by JPL for NASA to increase knowledge of the planets (SN: 3/30, p. 309).

PHYSICAL CHEMISTRY

Laser measures fast reaction rates

Accurate observations of the fastest reactions that occur in solutions, at approximately a trillionth of a second, can now be made with a laser technique developed at Lawrence Radiation Laboratory.

Drs. Yin Yeh and Norris Keeler, with Edward Britton, have applied the method to study ionic reactions in solutions at chemical equilibrium. In such reactions, molecules lose electrons, breaking apart into ions; and ions acquire electrons, reforming into molecules.

Even though the solutions are in equilibrium, local chemical fluctuations are present, their magnitude depending on temperature and other factors. The laser beam is sent into the solution and its light is scattered by the molecules, then analyzed for the amount of Doppler broadening. The breadth of the line indicates the chemical reaction rate.

One advantage of the new technique is that the laser light does not itself affect the molecules under study. The method may be applicable to studies in living organisms of enzyme and other biological reactions.

It also promises to yield data now lacking on very rapid reactions.

QUANTUM MECHANICS

Finer fine structure

The Sommerfeld fine structure constant is not finely enough known. According to Drs. Harold Metcalf, J. R. Brandenberger and J. C. Baird of Brown University, the present 21 part-per-million discrepancy in the experimental value of the constant leads to intolerable ambiguities in the values of basic atomic phenomena.

The constant appears in expressions for the values of minute splitting of spectral lines caused by relativistic effects of electron motion. It involves the electron's charge, the Planck constant and the speed of light; it is, therefore, considered to be of basic significance.

The Brown group is trying for one part in a million accuracy and report preliminarily in the July 15 PHYSICAL REVIEW LETTERS a value of 1/137.0353, accurate to eight parts per million.

The four best values previously available are based on the Lamb experiments on atomic hydrogen, hydrogen maser experiments, the hyperfine structure of muonium and the Josephson effect. The Brown value is based on spectroscopic observations of atomic hydrogen.