physical sciences

Localized and transferable chemical bonds

Chemical bonds are established by the exchange of outer or valence electrons between the atoms that are bound together. In the application of wave mechanics to chemistry, wave equations or orbitals that describe the behavior of the valence electrons are calculated to aid understanding of the chemical processes.

It would be a great help if the orbitals calculated for a particular kind of bond in simple molecules (which are easier to calculate) could be transferred to more complex ones. This could be done if the bonds are localized, that is, if their configurations depend only on the atoms they join and not on the structure of the rest of the molecule.

In the Nov. 22 PHYSICAL REVIEW LETTERS, Peter Eisenberger and W. C. Marra of Bell Telephone Laboratories report on experiments in which X-rays were subject to Compton scattering by the electrons of CH_4, C_2H_4 and C_2H_6. The experiments yielded profiles of scattered gamma rays for the C-H, C-C and C = C bonds that could be used to predict the scattering profiles of C_3H_6, C_6H_6, C_6H_{12}, C_6H_{14} and C_8H_{10}. The result, they say, indicates that the bonds are indeed localized and transferable.

A prediction about Mars dust storms

The storm that has raised huge clouds of dust in the atmosphere of the planet Mars started in September (SN: 10/9/71, p. 245). By the time Mariner 9 went into orbit around Mars, the clouds covered most of the planet's surface. They have given the National Aeronautics and Space Administration a good deal of worry.

R. A. Wells of the University of California at Berkeley makes a prediction about how long the storm will last. In International Astronomical Union Circular No. 2372 (Nov. 29) he writes that a statistical analysis of Martian yellow-cloud occurrences over the past century shows that the maximum occurs about 77 days after Martian perihelion. He stresses the uncertainty of making predictions but says that the current maximum should have occurred about Nov. 23 and that comparison with the observed date of onset suggests that the activity could be considerably reduced by Jan. 31.

Gravity waves and black holes

Since Joseph Weber discovered gravitational waves, theorists have been trying to figure out what sort of events could be the sources of what he observes. Of the numerous suggestions put forth, black holes (SN: 12/26/70, p. 480) are favored by many because their strong gravitational fields are easiest to imagine giving out the strong signals Weber receives.

In the Nov. 22 PHYSICAL REVIEW LETTERS, Marc Davis and Remo Ruffini of Princeton University, William H. Press of California Institute of Technology and Richard H. Price of the University of Utah report the calculation of the spectrum of the burst of gravitational waves that would be emitted as a body falls into a nonrotating black hole. The total energy emitted, they find, would be 0.0104 of the rest energy of the infalling body multiplied by the ratio of the mass of the infalling body to the mass of the black hole. This is four to six times previous estimates.

earth sciences

Seeding with silver bromide

Silver iodide is the most commonly used agent for cloud seeding. When a cloud containing supercooled water droplets is seeded, the silver iodide acts as a nucleus for freezing. One explanation offered for its ability to initiate freezing is that its crystal structure is similar to that of ice. However, in order for water to freeze in the presence of silver iodide the water must be at a temperature of minus 2.5 degrees C., possibly because the individual cells of the silver iodide crystal lattice are slightly larger than those of ice.

Bernard Vonnegut and Henry Chessin of the State University of New York at Albany found that when bromine atoms were chemically substituted for iodine atoms in the crystal structure, the result was a lattice cell closer in size to that of ice. The researchers further report, in the Nov. 26 SCIENCE, that when about 30 percent of the iodine atoms in silver iodide are replaced by bromine atoms, the amount of supercooling required to produce freezing is reduced, so that the water need only be a degree or so below zero.

Effects of dumping at sea

Congress is currently working on a bill to regulate dumping of wastes off U.S. coasts. The House passed the bill and on Nov. 24 the Senate approved it, with amendments. The bill now goes to a conference committee to iron out the differences. Meanwhile, new evidence indicates the problem may be more serious than heretofore believed.

It has been assumed that wastes dumped well away from land stay in the same area, but Donald Swift of the National Oceanic and Atmospheric Administration's Miami laboratories has made observations that dispute this assumption. As part of NOAA's Manned Undersea Science and Technology programs, Swift explored the continental shelf off New Jersey by minisub.

He found that shelf topography is shaped by underwater currents during storms. Storm currents may build underwater ridges up to 30 feet high. Currents during fair weather appear to have little effect. One implication of Swift's findings is that wastes dumped on the shelf might be carried for many miles, affecting large areas of the sea bottom.

The little continental pieces

The pre-drift fit for the major continents has been fairly well established. What remains is to fit in the smaller fragments.

J. R. Griffiths of the University of Tasmania has interpreted bathymetric maps and data on crustal thicknesses to reassemble the continental fragments of the southwest Pacific. New Zealand is a small part of a large plateau, and the Queensland Plateau off Australia as well as the Lord Howe Rise and Norfolk Ridge, he writes in the Nov. 26 NATURE, are all composed of continental crust. The Norfolk Ridge probably represents the eastern margin of Gondwanaland.

Beginning with a fit of Antarctica and Australia, Griffiths would place the Campbell Plateau against West Antarctica, close the basin between Lord Howe Rise and Norfolk Ridge, with the Lord Howe Rise against eastern Australia. This reconstruction, he says, does not require that new transcurrent faults be postulated.