Physical Sciences Notes

ORGANIC CHEMISTRY

Cancer-Causing Radical

Detection of a highly active chemical agent may help explain why tobacco smoke is more cancer-causing than the elements that make it up. The agent only appears at temperatures above 197 degrees C.

The agent detected is called a free carbon radical, a type of chemical structure in which a carbon atom is bound to only three other atoms in a molecule, instead of the usual four.

Free radicals generally last a very short time because they react quickly with other chemicals and elements. One way to spot their existence is by measuring their peculiar pattern of electron spin, which is different from other materials.

While measuring electron spin resonance in a number of compounds, Dr. W. F. Forbes of the University of Waterloo, Ontario, and Dr. J. C. Robinson of the University of Rochester, N.Y., discovered that free radicals were formed when the materials were heated.

One of the compounds tested was 3,4-benzpyrene, a known cancer-causing agent, and one of the components of tobacco smoke.

Drs. Forbes and Robinson suggested that the free radical formed by heating the agent might increase its cancer-causing power. This might explain why tobacco smoke that has been heated is a stronger cancer-causing agent than the unheated 3,4-benzpyrene, which is one of its components. The results were reported in the April 1 NATURE.

ACOUSTICS

Ultrasound Tames Burner Noise

Gas burners can be quieted by adding sound, a British research team reports.

By sending ultrasonic impulses across the tip of a gas nozzle, they were able to cut the sound output of the burner. Relatively small amounts of energy in the ultrasonic tranducer gave a six decibel lessening in the sound output, according to F. E. J. Briffa and R. A. E. Fursey of the Central Laboratories, Shell Research, Ltd. (NATURE, April 1).

The ultrasound waves cause vortices in the flame, shortening and broadening it.

GEOCHRONOLOGY

Earth's Age: 6 Billion Years Plus

The earth is at least six billion years old, Dr. V. I. Baranov of the U.S.S.R. Academy of Sciences has concluded after surveying the results of age determinations made on the basis of the decay of radioactive elements.

Determinations of absolute age from radioactive decay depend essentially on a comparison of the isotopes present when the object was in its original state and at the end of the time interval being measured.

An upper limit on earth's age is given by the ratio of heavy chemical elements, such as uranium 235 and 238, and by the time required for radiogenic lead isotopes to accumulate in earth's crust.

The isotopic composition of the lead in the earth's crust limits the lifetime of terrestrial material to about five billion years, a figure substantiated by extensive experimental data. Nevertheless, Dr. Baranov's survey has shown, this limiting estimate "can by no means be considered definitely established."

Dr. Baranov believes that the five-billion-year figure is valid only if the lead in the earth's crust has not become mixed with lead from deep within the earth that is responsible for the mean chemical composition of the earth as a whole.

Recent reports of an age for earth of more than six billion years are therefore quite possible, Dr. Baranov reports in SOVIET ASTRONOMY for March-April, a translation of the ASTRONOMICAL JOURNAL of the Academy of Sciences of the U.S.S.R. published by the American Institute of Physics in New York.

MAGNETISM

Spin Waves Detected in Sodium

"Spin waves" have been detected in potassium and sodium for the first time, thereby confirming a theory suggested 10 years ago by a Russian scientist. Dr. Lev Landau proposed then that the phenomenon was not restricted to magnetic materials, although experimental evidence proving he was right had previously been lacking.

The spin waves are generated when a thin slab of metallic sodium or potassium is placed in two magnetic fields, one steady and uniform, the other varying rapidly.

According to the theory of spin waves, the applied, rapidly varying magnetic field shifts the orientation of the electron spins in the vicinity of the metal's surface. The spin disturbance then propagates as a wave into the bulk of the metal via the collective motion of the electrons, with a velocity of about one-thousandth the speed of light.

The scientists who conducted the research believe the importance of their work lies in the excellent agreement between theory and experiment. The theoretical basis for the observations is described by Drs. Philip M. Platzman and Peter A. Wolff of Bell Telephone Laboratories, Murray Hill, N. J. The experimental verification was made by Dr. Sheldon Schultz and Gerald Dunifer of the University of California at San Diego.

CRYOGENICS

Coexistence Near Zero Kelvin

Superconductivity and ferromagnetism, two characteristics previously thought incompatible, can coexist in the same material at temperatures near absolute zero, research with alloys of indium and two rare earth metals, gadolinium and lanthanum, have shown.

A superconducting material is repelled by a magnet because the magnetic field lines are expelled from its interior. This repulsion is exactly contrary to the behavior of ferromagnets, which attract magnetic field lines.

Since the two characteristics are diametrically opposed, it was thought unlikely that both phenomena could occur at the same time in the same material. The studies showing that both could occur were made by Prof. Ronald D. Parks and two of his graduate students at the University of Rochester, Jack E. Crow and Robert P. Guertin.

Crow told the American Physical Society meeting in Chicago that the Rochester team conducted their experiments because detailed theoretical studies of the interactions between electrons and atoms had led scientists to believe the two phenomena might coexist.