News of Science

Storing Molecular Fragments

The National Bureau of Standards has developed a technique for capturing and storing large numbers of highly reactive molecular fragments at temperatures near absolute zero. In this method, unstable atoms and free radicals, known to exist but momentarily in flames and hot gases, are produced in an electric discharge, frozen into immobility, and trapped in solid form. Because these atoms are frozen in the excited state, they can be conveniently studied by optical spectroscopy.

In experiments to date, the bureau has produced solids containing atomic nitrogen and oxygen, and possibly atomic hydrogen and an unstable hydroxy (OH) molecule. These solids have very unusual properties, emitting bright glows, blue "flames," and colored flashes of light. When warmed 20 or 30 degrees, they combine very actively, releasing large quantities of stored energy, principally as heat. Possible fields of application for this new method include studies in solid state physics and basic chemistry, in which the trapped atoms could be used as powerful probes into the solids containing them. From a study of their properties, information could be obtained about the arrangement of the atoms and molecules in the solid and about the forces acting on them. The mechanism of atomic diffusion and of reactions between atoms and molecules also could be studied.

The technique has the advantage that the free radicals are stored in highly excited states as a result of the electric discharge, making it possible to study and analyze them by spectroscopic techniques. Also, because the radicals are collected at much lower temperatures than in previous methods, they can be stored longer in the uncombined form.

In this method, gases containing molecules of nitrogen, hydrogen, oxygen, or water are first passed through a high-frequency electric discharge, then frozen very suddenly at 4.2°K, just a few degrees above absolute zero.

The discharge is maintained in a waveguide resonator by a 2,450-Mc power supply. From the resonator, a glass tube leads the resulting molecular fragments into an evacuated metal vessel containing a cold surface in contact with a liquid helium bath. To prevent solidification of the discharge products at temperatures above 4.2°K, the gases are carried to the cold surface through a passageway that is kept near room temperature by contact with warm helium gas. When the gases reach the cold surface, they freeze into solid form there.

Because the free radicals produced by this method can be kept unchanged for many hours, a more detailed study of their properties has been possible than in previous work. For example, during the discharge through nitrogen the condensed solid emits a bright green glow, which tends to become yellow at high flow rates. The spectra obtained from this glow show that the structure of the solid condensed from the discharge differs from that of ordinary solid nitrogen. In fact, each atom of the condensed nitrogen forms a very loosely bound complex with some neighboring molecule, and this complex has properties that differ from those of the separate atom and molecule. The evidence shows that the complex is a definite unit. By analyzing its spectra, the forces holding it together can be studied.

Public School Growth

The Department of Health, Education, and Welfare has recently completed a study of the growth of the public school system in the continental United States (48 states and the District of Columbia) in the bienniums from 1951–52 to 1953–54. The total school population was at an all-time high, but secondary school enrollments were below the peaks reached in the 1930's. During the biennium from 1 July 1951 to 1 July 1953 the school-age population (ages 5 to 17 years inclusive) increased by 3.2 million (an increase of 10.1 percent) to reach 34.5 million. At the same time enrollments in the public schools increased from 26.6 million in 1951 to 28.8 million in 1953, an increase of 8.6 percent.

The total instructional staff increased by 86,000 to reach 1.098 million. Expenditures for public elementary and secondary schools amounted to $6.833 million in 1953–54, a rise of 19.7 percent over the $5.753 million spent in 1951–52. The total educational cost for 1953–54, when expenses for summer schools, community colleges, adult education, and so on are included, amounted to $9.092 million. Of this total $2.055 million went for capital outlay, a record high.

The report analysed salaries as follows:

"The average annual salary of the total instructional staff (supervisors, principals, teachers, etc.) was $3,825 in 1953–54 as compared with $3,450 in 1951–52, a rise of 10.9 percent; however, when adjusted to reflect the decrease in the purchasing power of the dollar, the average salary increased by 8.4 percent during the 2-year period. During the same period, the personal income (in 1953–54 dollars) per member of the labor force rose from $4,073 to $4,245, an increase of 4.2 percent. That instructional staff salaries still lag behind the gains made by the total labor force is indicated by the fact that during the period 1940–1954, the personal income of the labor force increased 62.3 percent compared with an increase of 37.8 percent in instructional staff salaries. A State-by-State analysis of instructional staff salaries in 1953–54 reveals that in 1 State the average salary was less than $2,000, in 12 States between $2,000 and $3,000, in 20 States between $3,000 and $4,000, and in 15 States the average was over $4,000."

International Cancer Statistics

Facts concerning cancer of the digestive organs and peritoneum are to be found in a statistical publication issued by the World Health Organization on the mortality from such malignant neoplasms in 26 countries since the beginning of the century. Mortality from cancer of the digestive organs is higher in men than in women.

Stomach cancer is responsible for the majority of cancer deaths in both sexes, immediately followed by cancer of the large intestine and the rectum. In England in 1953, 44.5 percent of all cancer deaths were caused by cancer of the digestive organs; in Spain, 48.9 percent; in France, 50.1 percent; in Italy, 54.6 percent; in Sweden, 52.7 percent; in Switzerland, 50.6 percent; in Canada, 46.7 percent; in Chile, 62.6 percent; in the United States, 39 percent; in Uruguay, 54.6 percent; and in Japan, 73.3 percent.

A remarkable increase in cancer deaths since the beginning of the 20th century is clearly shown in the statistical tables of the WHO report. Among the many possible causes of this rise is the aging of the population. Because cancer starts mainly around middle age, the fact that people live longer means that more of them may be struck by this disease. Fur-