PRELIMINARY DATA

## Chemists and cancer

*Dr. Li: Findings suggest dangers.*

X-ray technicians have a higher incidence of death from cancer than other occupational groups; miners more than anyone else die from tuberculosis and psychiatrists have the highest rate of suicide. High mortality rates peculiar to an occupation are nothing new. Scientists as a group are long-lived but no one has dissected the general category to see if the members of one discipline are more prone to a disease or early death than others.

**The first step** toward such a study—this one specifically for chemists—has been made by a physician at the National Cancer Institute. The closest thing to a precedent for Dr. Frederick P. Li's study was a survey by the U.S. Public Health Service in 1950, in which causes of death for professional and nonprofessional groups—chemists included—were tabulated, but only a small number of chemists' deaths was studied.

Dr. Li specifically selected chemists because of evidence indicating cancer following heavy occupational exposure to chemicals. His exploratory study was designed to determine if causes of death among chemists differed from the mortality of comparable professional groups.

After reviewing a 20-year period (1948-67), Dr. Li concludes that chemists have a higher proportion of deaths from cancers of the lymph nodes and the pancreas than normal.

Dr. Li bases his findings on studies of the death certificates of chemists listed in the obituary column of CHEMICAL & ENGINEERING NEWS, a publication of the American Chemical Society. He obtained the death certificates of about 3,500 ACS members from their states of residence. By comparing the number of deaths from a specific cause to the total number of deaths, he obtained a percentage of the frequency of death for a specific cause. He then compared his results with published data on the percentages of death from specific causes among other professional groups. There were 61 deaths from cancer of the lymph nodes among chemists, versus 34 expected deaths. For the pancreas, the figures were 36 deaths compared to 22 expected.

"These findings, based on unavoidably imperfect data, suggest that chemical carcinogens may have a role in the origins of lymphoid and pancreatic cancers, but further studies are needed to assess the magnitude of this hazard and to identify the causative agents," Dr. Li says.

**Unfortunately,** better statistical data on the mortality of chemists do not appear readily available. A problem is heterogeneity. If chemists were a uniform group, statistical studies would be easy. But because they work in many different areas, with many different chemicals, it is difficult to come up with generalized answers.

For example, in Dr. Li's sample, although the large majority was composed of practicing chemists at the time of death, there were some who were chemical engineers and some who were administrators.

"It's difficult to identify groups of chemists with similar exposure to specific chemicals," Dr. Li adds. "If such data were available, I would be interested in looking at it."

MOLECULAR ASTRONOMY

## Water, silicates and diamond

Interstellar space was once considered the definition of a perfect vacuum. Over the years, however, it has shown itself full of various kinds of matter of increasing chemical complexity (SN: 8/17, p. 167). The latest entries are water, silicates and diamond.

The transition from the physics of interstellar space to a chemistry of interstellar space has been a gradual one. First, astronomers found clouds of dust and atomic gases in the regions between the stars. A few years ago chemical radicals began to be found. These are combinations of atoms such as OH, CN, or CH that form parts of ordinary compounds. In isolation they can exist by themselves, but when brought into contact with appropriate substances they react to form stable compounds. OH and H make water, for example.

**Whether** or not radicals can be called molecules seems to be largely a matter of taste, but observations of the last few months have turned up definite, unambiguous molecules of stable compounds.

Ammonia was the first to appear

(SN: 12/28, p. 639). Clouds of it were seen in the direction of the galactic center by a University of California group including Drs. A. C. Cheung, D. M. Rank, C. H. Townes, D. D. Thornton and W. J. Welch.

Now the same group reports in the Feb. 15 NATURE that while looking for more ammonia, they not only found it but found water as well. The water appeared in three directions: those of the Orion nebula, the object called Sagittarius B2 and the object called W49.

**The water,** like the ammonia, is identified by its characteristic emissions in the microwave radio spectrum. "The radiation found is attributed to $H_2O$ because its frequency coincides very closely to that found for $H_2O$ in the laboratory, and no other known atomic or molecular species can explain the observations," say the astronomers.

Molecular spectra are complex, however, and in the case of Sagittarius B2, where ammonia was found as well as water, the question may arise whether the water-identifying wavelength might not be attributed to the ammonia instead. Dr. Cheung and his associates argue that it would be extremely difficult for the ammonia to be excited in the way necessary for it to produce the disputed wavelength with the observed brightness. Therefore the wavelength is most likely to come from water, they say.

Furthermore, they point out, strong water emission comes from the Orion nebula, where no ammonia is seen.

**Silicate** compounds seem to appear in the region around the star 119 Tauri. The infrared spectrum of this star as it reaches the earth shows absorption at 9.7 and 10.6 microns. These absorptions, say Drs. R. F. Knacke and J. E. Gaustad of the University of California at Berkeley and F. C. Gillett and W. A. Stein of the University of California at San Diego, could be made by a cloud of silicate material, a combination of either iron or magnesium with silicon trioxide.

Dr. Knacke and his associates surmise that such compounds might have been formed inside the star, a cool supergiant in which various compounds are known to exist, and then blown into space by some disturbance.

Dr. Gaustad and Dr. William C. Saslaw suggest that the interstellar dust grains may be diamond crystals. The classical models for the dust, usually ice or ice-coated graphite, do not fit all the modern observations, they say. Carbon in the form of diamond would.

But there is a major objection: Diamond normally forms only under heavy pressure, a condition opposite to those in interstellar space. Under pressureless conditions carbon would be expected to crystallize in other forms.

To deal with the objection, Drs. Gaustad and Saslaw point out that a diamond crystal has many more points at which carbon atoms could stick than graphite does. In the conditions of random collisions in interstellar space, they say, this means that diamond crystals would have a better chance of growing than graphite. Thus diamond might grow under interstellar conditions even if it were thermodynamically unstable and after a certain lifetime changed to some other form.

To determine whether the dust is certainly diamond, say Drs. Gaustad and Saslaw, it will be necessary to make detailed studies of ultraviolet absorption by the dust and of the mechanisms of diamond formation under unusual conditions.

SEALAB

## Board of Inquiry

With evidence consisting of a coroner's report and a small empty can, the Navy last week prepared to name a board of inquiry into the death of Sealab III aquanaut Berry L. Cannon (SN: 3/1, p. 210).

**In the coroner's** examination Cannon's blood was found to contain excess amounts of carbon dioxide. This, Navy doctors say, could have given the diver convulsions in "a matter of minutes" and caused fibrillations of the ventricles of his heart. Additional evidence of $CO_2$ poisoning was the discovery that one of the Sealab diving units had an empty Baralyme air-purification canister. These are supposed to remove carbon dioxide as breathing mixtures are recycled. But because the diving units are not marked for each aquanaut, it will be up to the board of inquiry to determine if the empty canister was indeed Cannon's.

After months of delays due to gas leaks and mechanical problems, the climactic stage of the Sealab program was finally about to get underway, when Cannon's tragic and sudden death on Feb. 17 brought things to an abrupt halt. But for the tragedy, nine-man teams of aquanauts that week would have begun living in 12-day shifts, 620 feet down in the Pacific off San Clemente Island. Last week, however, the habitat and most of its crew were to be returned to the California mainland to wait out the investigation.

Meanwhile, project officials hope to get approval to resume testing of Sealab's experimental diving system, including the elevator-like personnel transfer capsules, decompression chambers on the deck of the surface support ship and the divers' own equipment, but without the habitat, while the inquiry is still in progress. ◇