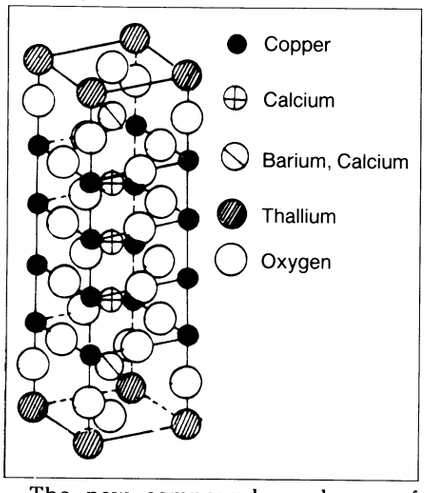
Layer upon layer to higher temperatures

With relatively little theoretical guidance, researchers have tested hundreds of combinations of chemical elements in their search for superconductivity at higher and higher temperatures. So far, all of the new superconductors contain copper and oxygen atoms arranged in layers sandwiched between layers of larger, heavier metal atoms.

The behavior of the newest class of superconductors — those containing the elements thallium or bismuth — seems to suggest a trend linking the temperature at which a material loses all electrical resistance with the number of copper oxide planes pressed between successive layers of thallium or bismuth atoms (SN: 4/2/88, p.213). The latest experimental results show that the trend holds for up to four consecutive copper oxide layers but not for five.

In the Sept. 2 SCIENCE, a group of researchers from Northeastern University in Boston describes the structure of a thallium-based compound containing four consecutive copper-oxygen layers within the material's basic structural unit, or unit cell. That material's superconducting transition temperature is 122 kelvins, or -240°F.



SCIENCE

The new compound, made up of thallium, barium, calcium, copper and oxygen, belongs to a family of materials in which each member contains a different number of consecutive copper oxide planes. As the number of planes increases from two to three to four, the transition temperatures go from 90 to 110 to 122 kelvins. The diagram above shows the arrangement of atoms in a unit cell of the 122-kelvin material.

A team of Japanese researchers at the Electrotechnical Laboratory in Ibaraki also has synthesized the same family of superconductors, obtaining almost identical transition temperatures. However, its preliminary results, as reported in the Aug. 11 NATURE, suggest the transition temperature for a compound having five consecutive copper oxide planes is probably less than 120 kelvins.

Even before the Japanese results became known, some theorists, who had predicted the transition temperature should rise as the number of copper oxide layers increased, were hedging their bets. They now suggest that the spacing between the copper oxide layers may be just as important as the number of layers in determining a material's transition temperature. The closeness of that spacing helps determine how strongly electrons bind together, or couple, to produce superconductivity. If the spacing between copper oxide layers goes up as the number of layers increases, then the transition temperature would at some point start to fall.

Confusing the situation further, scientists at the Materials Research Laboratories in Hsinchu, Taiwan, report traces of superconductivity in a thallium-based compound at temperatures as high as 162 kelvins. That compound also appears to have four consecutive copper oxide layers in its unit cell. The Taiwanese discovery is described in the Aug. 15 HIGH-T_c UPDATE, a newsletter monitoring recent superconductivity research results. However, no other group has yet succeeded in reproducing the Taiwanese findings. *— I. Peterson*

Dog virus seals fate of European seals

Over the last five months, harbor seals in the North and Baltic Seas have died in vast numbers from unknown causes. The deaths have occurred in Scandinavian, German and Dutch waters, and the British population of seals, the largest in Europe, now appears threatened. Although scientists have isolated two viruses from dead seals, they have been unable to establish a causal link to the fatal disease. Others have blamed persistent pollutants, such as PCBs or dioxins — which are known to affect immune response — in the deaths of an estimated 8,000 to 9,000 seals.

Now a Dutch research group says it has discovered the apparent cause: another virus, canine distemper virus (CDV) or a close relative. CDV belongs to the morbillivirus family, which includes the human measles virus. The work was led by Alfred D.M.E. Osterhaus of the Dutch National Institute of Public Health and Environmental Protection in Bilthoven and Elizabeth J. Vedder of the Seal Orphanage in Pieterburen.

Osterhaus and others initially isolated a herpesvirus from the lungs and other organs of 8 of 35 dead seals from the afflicted areas, and a picornavirus from the lungs of 20 of 22 seals investigated. In a letter in the July 28 NATURE, he proposed that one or both of these viruses "probably caused" the outbreak.

But when the scientists attempted to confirm the hypothesis with blood studies, they found "no correlation" between disease symptoms and a rise in antibody levels against either virus — although virus-neutralizing antibodies were present in the blood of the seals coming from afflicted waters. On this basis, and after failed efforts to immunize young seals in the orphanage, the scientists searched for other viruses.

Meanwhile, Swedish workers at the National Veterinary Institute in Uppsala observed that tissue damage in diseased seals resembled that in dogs with distemper, leading the Dutch to test for CDV. Of 23 wild seals brought to the orphanage and tested between July 3 and Aug. 8 — all apparently healthy and without CDV antibodies — 22 developed disease symptoms and CDV antibodies within 14 days, Osterhaus and Vedder report in the Sept. 1 NATURE. These and further blood studies on various seal populations — gray seals living in the orphanage during the outbreak who survived the disease, and harbor seals from Denmark and Germany at different stages of the disease — "clearly show" that the primary cause is CDV or a close relative, they say.

Further evidence implicating CDV comes from the similarity of the seal and canine symptoms: respiratory, gastrointestinal, skin and central nervous system ailments and secondary infections.

The Dutch scientists are trying to isolate the virus and develop a vaccine. A preventive vaccine for use in seal sanctuaries is urgently needed, though chances of protecting the wild harbor-seal population are remote, the researchers say. Osterhaus told SCIENCE NEWS he thinks the canine vaccine is "quite likely to be effective in seals," but "the use of live vaccines is not generally advisable in wild animals, because you don't know what it's going to do once it starts spreading in animal species."

Some speculation concerning the epidemic's origin centers on the virus' possible spread from dogs to harbor seals. There is also "some concern that overall ocean degradation may be playing an important role in the seal deaths in Europe," says Douglas B. Inkley of the National Wildlife Federation in Washington, D.C. "Exactly what the causes and links are is difficult to assess, but you have to look beyond the virus and ask what's making the seals susceptible. Widespread epidemics like this are not the norm." *— C. Eron*