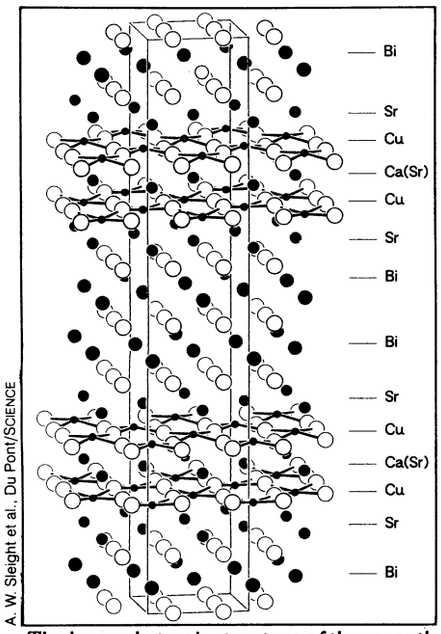
A Superconducting Banquet From the Periodic Table

Chemical intuition and an intimate knowledge of the periodic table of chemical elements have again led to the discovery of what may be another new class of superconducting ceramics. By substituting the toxic element thallium for a rare earth metal such as lanthanum and by adding a pinch of calcium, researchers at the University of Arkansas in Fayetteville have synthesized a material that begins to lose its resistance to electrical current at 123 kelvins, or −238°F, and becomes fully superconducting at 106 K. This surpasses the best results yet achieved with bismuth-containing superconductors (SN: 2/20/88, p.116).



A. W. Sleight et al., Du Pont/SCIENCE

The layered atomic structure of the recently discovered bismuth-strontium-calcium-copper oxide superconductor contains double sheets of copper and oxygen atoms. In the illustration, metal atoms are shaded; oxygen atoms appear as open circles. Only bonds between copper and oxygen atoms are shown.

The new thallium superconductors are "extremely easy to prepare," says Allen M. Hermann, who along with Z.Z. Sheng made the discovery. "It takes only about five minutes to make one of these materials." The simplicity of the process allowed researchers in Japan and at the University of Houston and Du Pont to confirm the discovery promptly. The Arkansas results will appear in the March 10 NATURE.

The recipe involves compressing a mixture of finely powdered barium copper oxide, thallium oxide and calcium oxide into a pellet. Heating the pellet for five minutes in an oxygen-supplied furnace at 900°C melts the mixture. Upon cooling in air, the material shows the properties characteristic of a superconductor.

Whether the thallium compound is a new type of superconductor isn't clear yet. Paul C.W. Chu of the University of Houston suspects that the thallium compounds are similar to the recently discovered bismuth superconductors. However, Hermann and Sheng say they have identified two different superconducting phases within their material. One of the phases seems to have an atomic structure with a pattern of three adjacent copper-oxygen planes. This contrasts with the bismuth structure (see illustration), which contains pairs of copper-oxygen planes.

The bismuth structure was recently worked out by a team of researchers at the Du Pont Experimental Station in Wilmington, Del., and appears in the Feb. 26 SCIENCE. Chu and his colleagues, who fabricated a similar bismuth superconductor, also determined the compound's structure, and their results match the Du Pont findings.

The recent discoveries show that there's plenty of room within the periodic table for more variations on the basic superconductor recipes now known. So far, says Chu, raising the temperature at which superconductivity begins has meant building increasingly complicated, layered atomic structures.

Says Hermann, "My feeling is that there's a whole, rich class of materials out there, all based on copper-oxygen planes." *— I. Peterson*

Endometriosis drug effective in trials

An experimental drug is showing promise against endometriosis, a common and painful disease of the female reproductive system that is frequently associated with infertility. In what is reported to be the largest, most carefully controlled study of its kind, the drug — a synthetic molecule taken as a nasal spray — proved as effective as the only currently approved treatment and was reported to cause significantly fewer side effects.

Affecting as many as 1 in 15 women of reproductive age, endometriosis occurs when tissue from the uterine lining migrates to other parts of the body, usually in the vicinity of the reproductive tract, and begins to grow. These islands of tissue remain responsive to monthly releases of reproductive hormones, which can cause a painful inflammatory response. Treatment has revolved around suppressing secretion of the female hormone estrogen.

Only one drug, danazol, made by New York City-based Sterling Drug Co., is approved for treatment of endometriosis in the United States. But danazol is a derivative of the male hormone testosterone and has a number of undesirable side effects, including voice lowering, increased growth of body hair, liver damage and a shift in blood lipid levels similar to those associated with cardiovascular disease. For women who cannot tolerate danazol, the only effective intervention is surgical removal of the ovaries.

The new drug, nafarelin, made by Syntex Research in Palo Alto, Calif., belongs to a class of synthetic compounds called gonadotropin-releasing hormone (GnRH) agonists. These chemicals resemble naturally occurring GnRH, which normally stimulates pituitary secretion of reproductive hormones. They differ from natural GnRH, however, in that they bind more readily to pituitary receptors and are less easily broken down by regulatory enzymes. Scientists have found that these tenacious analogues confuse hormonal regulatory controls so that estrogen production is suppressed.

The latest research was led by Milan R. Henzl, head of Reproductive Medicine at Syntex and an assistant clinical professor at the University of California at San Francisco, and was performed at 20 research centers in the United States and abroad. It involved double-blind comparisons of nafarelin and danazol in 213 women over a six-month span, using a standardized measure of endometriosis severity that included periodic examination of endometrial masses by laparoscopy. The study, which appears in the Feb. 25 NEW ENGLAND JOURNAL OF MEDICINE, shows that more than 80 percent of the patients in both groups had significant reduction of endometriosis, with nafarelin causing far fewer side effects.

"Nafarelin has a very straightforward action," says Henzl, "but it's a new class of compounds and we still must be quite cautious about it." Previous studies have shown that GnRH agonists cause some loss of bone mass, although the loss appears to be reversible. Other side effects include hot flashes and decreased libido. *— R. Weiss*