tivity community last spring was not unlike that in the house of the Indian fisherman after he finds the "Pearl of the World" in the John Steinbeck story *The Pearl*: There was excitement at the discovery of superconductivity up to 90 K, concern about the properties of the new superconducting materials and apprehension about how long it would take to "engineer" the materials for various applications. There were debates about whether the line of research that had yielded 90-K superconductors had been adequately funded, and about the level of financial support this research now needed to quickly turn the new superconductors into technologically useful materials. And researchers were anxious to determine which, if any, of the many reports claiming critical temperatures for superconductivity higher than 200 K were creditable. Amid this commotion and confusion, hope and anxiety, the news from Caen reporting superconductivity up to 22 K in a new class of oxides, which did not contain any rare earth element, appeared to those few who did take notice of it as no more than a "small misshapen seed pearl."

Arthur Sleight (Du Pont Research) told us that he and his colleagues at Du Pont confirmed superconductivity in $Sr_2Bi_2Cu_2O_{7+y}$ soon after he heard Raveau talk about the Caen group's work at the American Chemical Society meeting in New Orleans last summer. Sleight, who is credited with the 1975 discovery of superconductivity in $BaPb_{1-x}Bi_xO_3$ at temperatures up to 13 K, said that he and his colleagues tried substituting barium for strontium in $Sr_2Bi_2Cu_2O_{7+y}$. But the barium-substituted compound was not a superconductor and, Sleight said, the Du Pont group did not study the bismuth system any further. At AT&T Bell Labs Bertram Batlogg and his colleagues discontinued work on $Sr_2Bi_2Cu_2O_{7+y}$ after verifying the Caen results, because the superconducting samples showed a very weak Meissner effect.

"We started to replace yttrium with bismuth already in May [1987]," Chu said. He added that his group's work on bismuth substitutions went ahead quite independently of the reports from Caen and that he had become convinced by November of the possibility of discovering superconductors having T_c as high as 80 K among bismuth-based oxides.

Sheng and Hermann found superconductivity first in the Tl-Ba-Cu-O system, in October. Their samples contained no calcium; their nominal compositions were $Tl_2Ba_2Cu_3O_{8+x}$ and $TlBaCu_3O_{5.5+x}$. The samples consisted of many components and showed zero resistance above 80 K. Because a university office took a long time to process the patent application, Sheng and Hermann announced this superconductor only on 22 January, the day the Tsukuba group announced the bismuth superconductors. And the Arkansas group added calcium to their samples and discovered superconductivity above 100 K in Tl-Ca-Ba-Cu-O soon after their announcement of the 80-K superconductor. The composition of the 80-K phase in the Tl-Ba-Cu-O system has not been determined, but preliminary x-ray diffraction studies show it to be different from that of the 90-K superconductor $RBa_2Cu_3O_{7-y}$.

The thrill of discovery

The developments in superconductivity this winter offer the thrill and excitement that inevitably accompany every discovery. These developments may also help unlock the secret of the entire class of cuprate superconductors or help discover new ones. Batlogg said, for example, that the coherence length, which is a measure of the separation between the two members of a Cooper pair, is the same, when measured normal to the copper–oxygen planes, in both the 90-K rare earth superconductor and the 85-K bismuth superconductor. Because the separation between successive copper–oxygen layers in the bismuth superconductor is between two and three times that in the 90-K superconductor, Batlogg infers from the measurement of the coherence length that superconductivity is confined to individual copper–oxygen layers.

It may be too early to assess whether the new superconductors will be easier to engineer for various applications. The discovery of the 125-K thallium superconductor may already be an important step in obtaining higher critical current densities at 77 K, the boiling point of nitrogen. The reason is that the critical current density, which measures the current that can be safely passed through a superconductor without causing a transition to the normal state, increases (when a superconductor is cooled below its T_c) as the $^3/_2$ power of the temperature difference from T_c. Thallium, however, is an extremely toxic metal. Thallium oxide is water soluble and also quite toxic. For this reason, AT&T Bell Labs has not yet decided whether to work extensively on the thallium system.

The two-dimensional mica-like structure of the 85-K bismuth superconductor might form better wires, many researchers hope. The new superconductors do not lose oxygen readily or react with moisture: Their superconducting properties are more stable than those of the 90-K rare earth superconductors.

—Anil Khurana ■

A Super Time to Renormalize

What incredibly superlative times these are! Modern advances in physics are beyond description, or so their names imply: We have discovered superconductors and superfluids, predicted supersymmetries and superstrings, observed supernovas, supergalaxies and superclusters; and we analyze them all on supercomputers. But where do we go from here? We avoided the dilemma for many years but technology has caught up with us at last. No words can describe our latest creations. The next-generation accelerator will have unprecedented size and efficiency, but we can only express its overwhelming capacity by repeating ourselves, as in an awestruck stutter: We call it the Superconducting Super Collider. The high-temperature superconductors discovered last year have been verbally elevated to their proper level only at the expense of the lower-temperature materials, which have been downgraded to "conventional superconductors." (Do I detect a contradiction in terms?)

This dilemma requires a truly delicate solution. How can we give proper credit to new discoveries without disparaging our current generation of superworks? We could follow the lead of America's advertisers, who frequently must introduce phenomenally improved products to the public, and speak of the "new improved superconductors." Or we might revert to childhood practices with "super-duper conductors." Unfortunately, both of these solutions carry us only to the next generation. (Would you consider "super-duper-gluper conductors"?) We might seek a more quantitative solution and allow exponential growth—super^{2}conductors. We could then permute the words in the name for the SSC without altering either the acronym or the meaning (it's commutative, I believe) to get a Super(Superconducting Collider), written as Super^{2}Conducting Collider. That leaves room, economics and politics aside, for the Super^{3}Conducting Collider. But exponential growth leads to infinities. So the best idea of all is to eliminate these infinities by renormalizing our terms and reverting to humble but descriptive adjectives. I think it's a super idea!

—Barbara Goss Levi