While it wasn't a traditional transparent glass, the new material had the same helter-skelter atomic arrangement as ordinary window glass. The Professor and his research assistants, R.H. Willen and W. Klement, called their discovery Metallic Glass.

At first the metallurgical community wasn't impressed. While the Duwez team had made a profound discovery in materials technology, most metals researchers thought the process had no practical use. For one thing, only very small amounts of the material could be produced. For another, the first materials produced did not have obvious applications. But 10 years later, experts would call the advent of these wonder metals "one of the most exciting events in the annals of materials science and engineering."

This change in perspective was largely attributable to another set of discoveries by Duwez and his collaborators between 1967 and 1970. What they found was that alloys containing the metal iron could also be made into metallic glasses.

That these new materials exhibited novel and unexpected magnetic properties was recognized immediately by industry. It was also soon recognized that such metallic glasses, like traditional glasses, were exceptionally strong. Some were more than twice as strong as commercial high-strength steels. However, unlike traditional glasses, they were not nearly as brittle so that they could be formed into useful shapes.

The great strength and other unusual properties of metallic glasses have to do with their atomic structure. Ordinarily, the atoms in solid metals are neatly arranged in patterns to form small crystals. These crystals and the boundaries between them strongly influence the strength, resistance to corrosion, and other properties of items made of metal. The metallic glass is like frozen liquid. As such, its properties are very different from those of an ordinary metal prepared by slow cooling. When metals are melted, their atoms, like those in ordinary window glass, have no regular arrangement, but as the metal cools and hardens, its atoms become regularly ordered within the crystals.

What Professor Duwez and his team had done was to find a way to cool the liquid metal before its atoms had time to return to their regular positions. In an instant the glass-like, irregular placement of the atoms was "frozen" and a new kind of material had been made.

Other investigators discovered ways to increase the rate of production, and important commercial applications were found. Over 1,000 transformers built with metallic glass cores by General Electric were shipped in late 1985 and early 1986 to over 90 utilities as part of a 2-year field trial. In recent years, American, Japanese, and German companies have developed commercial production methods for metallic glasses with the goal of using this new material as a replacement for the traditional materials used in transformer cores and similar electrical devices associated with power distribution networks. Power losses in metallic glass core transformers are 60 to 70 percent less than in conventional core equipment.

Other examples of the application of metallic glasses include a flexible, metallic glass magnetic security strip which is fastened to merchandise in department stores. Pacific Northwest Laboratory has developed metallic glass coatings for pipes and vessels that resist corrosion by salt solutions and concentrated acids.

The recent discovery at Caltech that metallic glass can also be made if certain metals, such as gold and lanthanum, are deposited in alternating thin layers and heated, has opened the possibility that conventional powder metallurgical methods, such as those used in the manufacture of many commercial aluminum alloys for aircraft, may be used in producing these new materials.

Dr. Duwez' marvelous substance continues to find new applications in a technological world needing strong, energy efficient metals. Currently, 500 tons of metallic glasses are produced in the United States each year with plans afoot to increase this to 500,000 tons in the very near future—a considerable advance in the years since they were first created by Professor Duwez in quantities weighing only a fraction of an ounce.

ION IMPLANTATION

At the dawn of the Bronze Age 5,000 years ago, man discovered that copper mixed with tin could overcome the shortcomings of stone tools. Thus began mankind's relentless search to combine the elements of the earth in new and improved ways to better serve his needs.

This search took an unusual turn in the 1950's with the advent of a potentially powerful technol-