EXHIBIT IV

MAN-MADE STONES

[Extracts from the Bureau of Mines Handbook for 1950]

Making crystals almost exactly like those produced by nature is not new. Rubies and sapphires large enough for cutting and use in jewelry have already been made on a fairly large scale. Such synthetic gems are, to a large extent, duplications of the natural gems. They are the same chemically, structurally, and in outward appearance. They are not the same as "stones" used for inexpensive jewelry, which are usually colored glass or plastics.

Synthetic gems now in common production are used largely for industrial purposes. Hardness, the same special property which contributes to their value in jewelry, also makes them valuable in industry. The diamond, being hardest of all stones and the most imperishable, is in greatest demand, but thus far the sole source of all diamonds, whether industrial or gem, has been nature's supply, dug from the earth. Though they are often found in stream beds, they are seldom if ever water-worn.

Corundum (or "emery"), chemically alumina or aluminum oxide, is the next hardest material to diamond. When pure and transparent it too is highly prized for gem use and is called, according to its color, a sapphire, oriental ruby, amethyst, emerald, or topaz. Industrially it is excellent for abrasive use, especially for work on materials of high tensile strength, such as steel. Spinel, a magnesium-aluminum combination, is just below corundum in hardness.

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Both emery and spinel are manufactured commercially. The operation is essentially one of melting at extremely high temperatures the chemical compound of which the natural gem is composed, the melted mass being allowed to cool slowly so that it will crystallize in forms similar to nature. Later the large mass is cut for the gem market or for industrial uses. Chief production is in Germany, followed by France. The U.S., India, and Japan also share in the world market.

According to Kraus, Hunt, and Ramsdell's textbook, Mineralogy,

"In chemical composition and all physical properties, such as hardness, specific gravity, and indices of refraction, these synthetic gems are identical with those occurring in nature. Because of the presence of inclusions, tension cracks, and peculiar structure lines, cut synthetic gems can, in most instances, be easily distinguished from natural stones. In some cases, however, especially if the cut stones are about 1/2 carat or less in size, their synthetic character may be very difficult to determine."

Domestic synthetic corundum and spinel production amounts to several million carats each year. Of this, about 70 per cent is ruby-color synthetic corundum, 20 per cent blue spinel, and the rest corundum and spinel of other colors. Most of this material is used in educational ring stones, the buff-top, flat-back stones being the most popular.

During 1950, public acceptance of synthetic rutile (titania) increased to the point where it could be called commercially important. When first introduced, the jewelry trade did not respond, but as a result of interest in titania by the amateur lapidaries and direct-mail sales, public interest was created to a point where the jewelry trade is now willing to accept and promote this material.

Production has been largely on an experimental basis by the Linde Air Products Company and the National Lead Company. Prices for boules are about 50 cents per carat for colorless and 75 cents per carat for blue and red.

Synthetic emeralds are being made by the Chatham Research Laboratories in San Francisco. About 50,000 carats of rough crystals are produced annually, of which less than 10 per cent is gem quality. The retail price for top-quality synthetic emerald is $120 per carat and no flawless stones of more than 2 carats are known to have been made.

Because carbon, the basic element common to coal, graphite, and diamond, acts differently than the materials in sapphires and rubies when subjected to high temperatures, the conversion of carbon to diamond is not so easily accomplished.

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