ACS MEETING

SCIENCE NEWS of the week

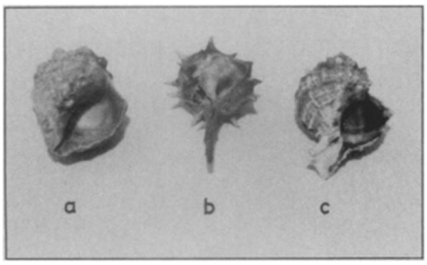
Blue-Purple Dye of Antiquity Reborn

The Lord also spoke to Moses, saying, "Speak to the sons of Israel, and tell them that they shall make for themselves tassels on the corners of their garments, and they shall put on the tassel of each corner a cord of blue. And it shall be a tassel for you to look at and remember all the commandments of the Lord..."

—Numbers 15:37-39 (NAS)

The fulfillment of God's instructions to Moses regarding the coloring of ritual prayer shawls hit a snag about 1,500 years ago, when the secret of how to make the prescribed blue dye somehow faded away. Now, however, an Israeli biochemist, by piecing together chemical, historical and archaeological evidence, reports he has rediscovered the ancient blue-purple dye — an achievement that could lead to a revival of an ancient Jewish practice and the birth of a new industry.

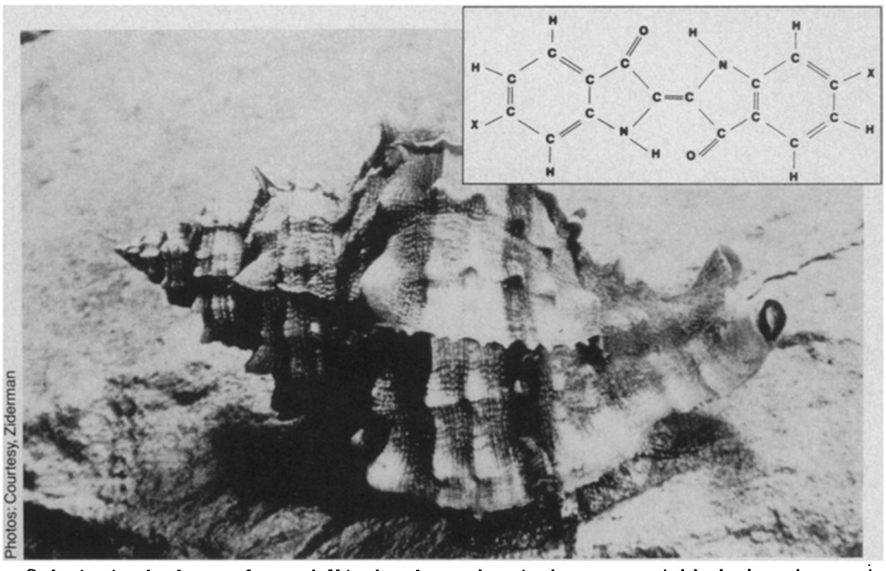
Irving Ziderman of the Israel Fiber Institute in Jerusalem identified a shellfish still found along Mediterranean shores as the source of the key ingredient in hyacinthine purple, known in biblical Hebrew as "tekhelet."



Sea snail sources of purple dyes.

"This commandment has not been observed since the seventh century," says Ziderman. Rediscovery of the authentic dye has been "awaited expectantly in synagogues throughout the world," he says. He described his findings last week in Philadelphia at the meeting of the American Chemical Society.

Although the animal source and even the color of tekhelet have been lost for centuries, the Bible, the Talmud and Mesopotamian trade records are rich with references to the dye, beginning about 3,600 years ago. Along with "kermes," a scarlet or crimson gleaned from the insect residents of certain oaks, and "Tyrian purple," a reddish shade derived from a sea snail, tekhelet brought wealth to its Phoenician manufacturers, who supplied sovereigns, as well as synagogues, with regally colored woolens. Although the use of kermes persisted to modern times, the Phoenicians' purple dye industry collapsed in the seventh century — probably more from the pressure of invading Arabs than from the depletion of raw material, Ziderman suggests.



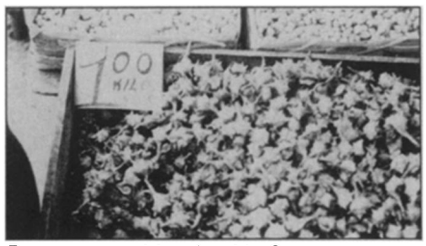
Photos: Courtesy, Ziderman

Substituting hydrogen for each X in the above chemical structure yields the key chromatic compound of pure indigo, whereas a bromine substitution gives Tyrian purple. The banded dye-murex mixes both compounds in a mucus gland to produce an important purple dye of antiquity.

Without an actual sample of dyed cloth to use as a reference, subsequent scripture translators identified the prescribed color as anything from purple to green to indigo or even yellow. While most English Bibles render the translation as blue, Martin Luther thought the Greek term "hyakinthos" suggested the color of a local flower by that name and he translated the word as "gelb" (yellow). By comparing the descriptions of early forgeries to some lesser-known Hebrew references to tekhelet, Ziderman was able to positively identify the desired dye as blue-purple. But which animal produced it?

Modern studies, particularly in the last decade, identified pure Tyrian purple as a brominated form of indigotin, the color-producing compound in indigo dye. Two related species of sea snail, the spiny dye-murex and the rock shell, were found to secrete a colorless mucus that, once exposed to sunlight and air, becomes yellow, then green and finally purple. The bromine gives Tyrian purple its reddish tinge. By adding indigo derived from plants to the snail extract, one can create a bluer shade (as some early forgers undoubtedly did), but talmudic references specifically indicated that the elusive tekhelet was to be an uncontaminated extract from shellfish.

Ziderman found the solution to his conundrum in a cousin to one source of Tyrian purple. Unlike its spiny relative, the banded dye-murex secretes a mucus that contains essentially a 50:50 mix of plain and brominated indigotin. The resulting color: the blue-purple of antiquity. Biologists have confirmed that the lifestyle of the banded dye-murex fits with purported seasonal rarity of the mollusks used to make tekhelet. The creatures burrow into the coastal seabed in the summer, emerging to the sand surface in the cold season. Winter storms further limit shell fishing to early fall and spring.



Dye source sold as food in Crete.

The converging evidence "gives us complete confidence" that the long-sought tekhelet has been found, Ziderman told SCIENCE NEWS. The banded dye-murex can still be found along the coasts of Israel and Lebanon, and is sold by the kilo for food in Cretan markets. But before the dye can again be commercially produced, methods must be developed to breed the snails on a larger scale, a challenge several marine biologists in Haifa are already beginning to explore, the scientist says. In addition, the actual dyeing process — "one of the great industrial secrets of the ancient world" — has yet to be detailed. "But at least in principle," Ziderman says, "that should not be difficult." —*D. Franklin*