18 December 2006 By: Stefan Anitei, Science Editor

Blue Blood

Copper, not iron ...

What did the medieval Spanish nobles want to express when they were saying they had blue-blood?That they were some kind of snails?No, Spanish nobles wanted to say they are not of dark skinned origin like the invading Arabs, but white like Northern Europeans, with visible blue veins. Instead, snails are indeed blue-blooded! And not only snails, but all the mollusks (like clams, slugs, snails, squids, octopuses) and some arthropods: horseshoe crabs (which is rather a kind of marine scorpion) (photo), scorpions, some spiders, and decapod crustaceans (lobsters, true crabs, crayfishes). All these animals have in their blood respiratory proteins called hemocyanins. Like the hemoglobin, the other type of respiratory protein, which gives the red color of the blood in vertebrates, some worms, and some insect larvae, hemocyanins are metalloproteins, but instead of iron, their molecule contains copper atoms!When hemocyanin is not binded to oxygen, it's colorless, but oxygenation turns hemocyanin blue. Even if hemocyanin has the same function like hemoglobin, there are differences in its molecular structure and mechanism. Copper atoms are directly binded to protein while iron atoms are not in hemoglobin molecules. Hemocyanins' binding ability to oxygen is much lower than of the hemoglobin, about 25 %. (That's why the more advanced group of the vertebrates chose the evolutionary variant of hemoglobin). Hemocyanin oxygen-binding capacity is also affected by dissolve-salt ion levels and acidity. Hemocyanin molecule has a big size, that's why it is usually found free-floating in the blood, unlike hemoglobin, which must be stored in cells (red cells) because its small size would lead it to clog and damage blood-filtering organs such as the kidneys. The free-floating nature can allow for increased hemocyanin density over hemoglobin and increased oxygen carrying capacity, likewise free-floating hemocyanin can rise viscosity and multiply the energy expenditure needed to pump the blood.