

Colors and Chemical Names (2)

Kentaro Sato

Continuing from the last article, let us keep going over more examples of elements and compounds named after their colors.

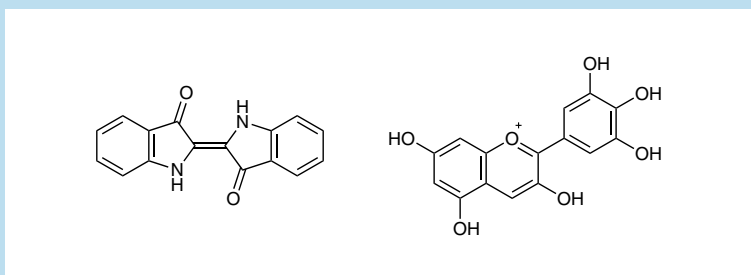
Blue

Two elements whose names are derived from the color of blue are indium (atomic number 49) and cesium (55). Indium was named after indigo based on the blue color of its emission spectrum, and cesium was named after the Latin *caesius*, which means sky blue, because it also showed blue emission spectrum.

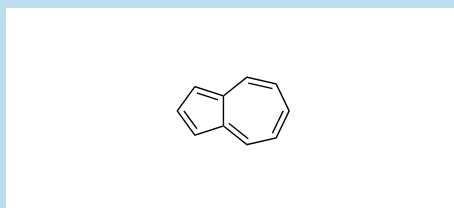
Though blue is the color of ocean and sky, it is for some reason a rare color in the biological world. The

rarity of blue is perhaps reflected in our traditional images such as bluebirds being a symbol of happiness and blue rose being a synonym of improbability. As for naturally occurring organic compounds having a bluish color, only a few are known. Indigo and delphinidin (the pigment of the Delphinium flowers) are well-known examples but there aren't too many others.

A famous hydrocarbon compound appearing blue is azulene, which is composed of fused five- and seven-membered aromatic rings and is an isomer of naphthalene. *Azul* means blue and is a part of such words as *Côte d'Azur* (the French Riviera) and the *Azzurri*, the nickname of Italian national football team.

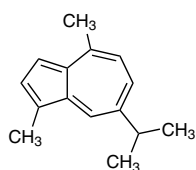


Indigo and delphinidin



Azulene

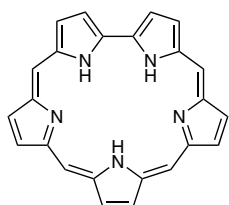
There are natural products possessing an azulene skeleton. For example, the unforgettably bright blue color of the mushroom species known as *rurihatsutake* or blue milk mushroom originates from azulene derivatives. Also, some essential flower oils turn bluish under high thermal conditions during distillation. This phenomenon is the result of dehydration and oxidation of certain terpenoids containing fused five- and seven-membered rings, producing aromatic compounds of the likes of guaiazulene. These compounds are known for their anti-inflammatory effects and are used as medicines even today. If you see any stomach medicines or mouthwash liquids colored blue, those products very likely contain an azulene derivative.



Guaiazulene

As for blue-colored minerals, sapphire would probably come to your mind first. Chemically speaking, sapphire is a crystal of aluminum oxide containing varied amounts of iron and titanium impurities. The name is derived from the Latin *sapphirus* or the Greek *sappheiros*, both of which correspond to blue.

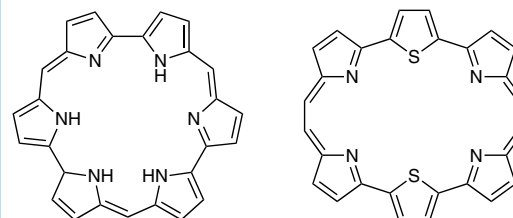
The total synthesis of vitamin B₁₂ led by the late R. B. Woodward was a monumental achievement in the history of organic synthesis that resulted in the development of various spin-off chemistries. One of the compounds synthesized as byproduct was the macrocyclic compound composed of five pyrrole units. This compound was named sapphyrin after its bright blue color and the same suffix to porphyrin. The synthesis of sapphyrin sparked the following development of macrocyclic porphyrinoid chemistry.



Sapphyrin

Many porphyrinoids were synthesized afterwards and were named after jewels, including rubyrin, which was introduced in the previous article. Besides rubyrin, there have been made assortment of jewels of organic synthesis

such as green-colored smaragdyrin (named after the Latin *smaragdus* meaning emerald) and ozaphyrin (based on the Emerald City from the Wizard of Oz), rose red-colored rosarin, orange-colored orangarin, turquoise-colored turcasarin, purple-colored amethyrin (named after amethyst), and bronze-colored bronzaphyrin.



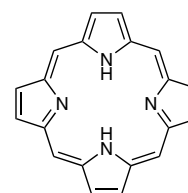
Rosarin and bronzaphyrin

Purple

Japan is a nation of scarce natural resources, but did you know that it is the largest producer of one particular element? It is iodine, which Japan actually produces a third of the total amount produced in the world. Most of the Japanese iodine are mined from the natural gas deposit in Kujukurihama in Chiba prefecture.

Iodine was first isolated in 1813 from the vapor produced by the acidic treatment of seaweed ash. The vapor had purple color, so the element was given the name after the Greek *ioeides*, which means violet. The Japanese name *youso* is a transliteration of iodine.

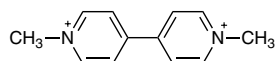
As mentioned so far, a wide variety of porphyrin derivatives have been synthesized that show beautiful colors. The original porphyrin itself is colored purple so dark that even a highly dilute solution of it is brightly colored. Accordingly, its name is derived from *porphyra*, the Greek term meaning purple.



Porphyrin

There is an organic compound called viologen whose name is derived from violet. The structure of viologen contains two *N*-methylpyridinium cations bonded at the 4 position of each other. The fact that it turns bright violet when it is reduced to form a radical cation led to its name. Upon reoxidation, the radical cation produces reactive

peroxides that are known to damage nearby compounds. Viologen and related compounds are used as pesticides (paraquat) for this property, but since it is also toxic to animals its use is banned or strictly restricted in some countries.

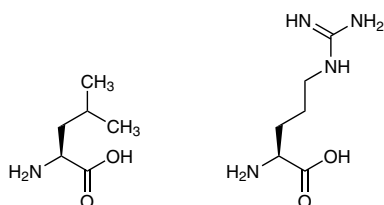


Viologen

White

Even though most organic compounds appear either white or colorless, some are known that have a name derived from the color of white. *Albus*, the Latin translation of white, is found in words such as album (which originally meant white message board). Egg white was similarly called *albumen* and the proteins it contained were named albumins.

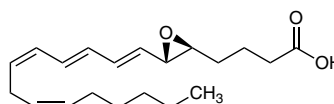
In a similar manner, one of the amino acids leucine was named after the Greek *leukos* that means white because it was first obtained as white crystals. Another amino acid arginine has similar naming background, as it was named after the Greek *argyros*, meaning silver, because it was first isolated in silvery crystalline form. It is also the origin of the atomic symbol of silver, Ag.



Leucine and arginine

The Greek *leukos* also became the origin of the name of white blood cells (leukocytes). Branching out from there,

names like leukotrienes and interleukins were assigned to relevant important biological substances. There are apparently many other examples containing the prefix *leuko* in the field of biology.



Leukotriene A4

Other colors

Some substances are named after them having a wide color variation instead of one specific color. For example, the name of iridium is based on Iris, the Greek goddess of the rainbow, since the salts of iridium complexes came in a variety of colors which reminded of a rainbow.

Chromium was named in similar fashion after the Greek *chroma*, meaning color, because again its salts showed diverse colors. There are a number of words containing *chroma*, including chromatography, chromism (the reversible change of color in response to externally applied stimulus), and chromosome.

We have gone over elements and compounds named after their colors. There should be certainly more examples that escaped my literature search but it only proves the close relationship and the long history between color and chemistry. Researches closely related to colors such as organic light-emitting diodes, chromisms, and phosphorescent reagents are now expanding their realms, therefore we can expect more of the compounds named after colors to come out in the future. Naming a new, hard-obtained compound is one of the biggest rewards for chemists. If you ever get a chance to be a godfather of a new compound, these old examples may be helpful as good references.

Introduction of the author :

Kentaro Sato

[Brief career history] He was born in Ibaraki, Japan, in 1970. 1995 M. Sc. Graduate School of Science and Engineering, Tokyo Institute of Technology. 1995-2007 Researcher in a pharmaceutical company. 2008-Present Freelance science writer. 2009-2012 Project assistant professor of the graduate school of Science, the University of Tokyo.

[Specialty] Organic chemistry

[Website] The Museum of Organic Chemistry <<http://www.org-chem.org/youki/MOC.html>>