A Vampire Story: Science, Folklore and Beyond

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(…) Throughout the vast shadowy world of ghosts and demons there is no figure so terrible, no figure so dreaded and abhorred, yet dignified with such fearful fascination, as the vampire, who is neither ghost nor demon, but yet who partakes the dark nature and possesses the mysterious and terrible qualities of both…
Rev. Montague Summers, "The Vampires in Europe", London 1929

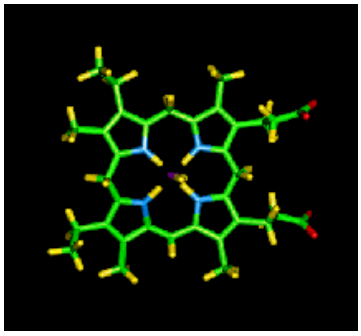
Pieter Brueghel – the allegoric Mad Meg (Dulle Griet); Oil on wood, the Museum Mayer Van den Bergh, Antwerp. The painting fascinates with hidden, mysterious meaning. The possible symbolism of the large woman is sometimes interpreted as a sign of violence, heresy, personification of an evil, a fearsome witch...

Every single bookstore at the 1733 Leipzig spring fair was selling books about vampires. The German readers' interest had been aroused by the events that had taken place first in Moravia and later in the Serbian territories recently re-conquered from the Turks in the 1720's. Since Serbia was governed by the Austrian military authority and any epidemics would have jeopardized the army's striking ability, the Viennese bureaucratic machinery required detailed reports about every suspicious case. It is thanks to this circumstance that we have got the first and relatively precise description of an age-old Serbian belief. According to the reports, in 1725 mysterious deaths occurred in one village. The inhabitants blamed

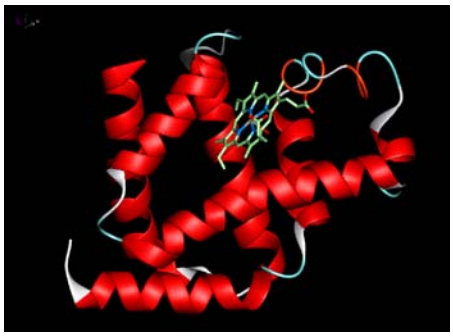
it on a man who had recently passed away. The report states that the village people dug the corpse out of its grave and pierced its heart with a sharply pointed stick. In 1730 a similar case was reported in another village where a soldier and his family died after eating mutton from a sheep that had been bitten by a vampire in the form of a snake. Fearing that the dead had become vampires themselves, the villagers exhumed and beheaded the corpses. During the winter of 1731–1732, an epidemic of cases was reported in a third village as well. The dispatched military physician first tried to convince the villagers that vampires did not exist and belief in them was a mere superstition...

The Witches' Sabbath by Hans Baldung Grien portraits a midnight meeting of witches, govering to practice their unusual craft and sorcery

Soon, however, all of Europe caught the vampire fever: Periodicals were competing with each other in describing the most macabre details and even the physicians that did not believe in the resurrected blood suckers joined the sharp debates on the subject in the columns of the Nuremberg professional journal *Commercium litterarium ad rei medicae et scientiae naturalis incrementum*. They all did, of course, agree that there were no such things as vampires and although the epidemic as to the had an unknown origin, it was by no means supernatural. The opinions, however, were sharply divided as to the causes of the apparent soundness of the exhumed corpses. The phenomenon came in hand for the believers in *iatromechanics*, *chemiartry* or *iatrochemistry* who explained all bodily functioning by mechanical or chemical processes, as just when their fortunes were fast shrinking, it spectacularly proved their teachings. Georg Ernest Stahl and his followers, who represented the vitalist-animalist school of medicine, rejected the notion that the human body resembles a hydraulic machine where it is the body fibers' contraction and dilation that assure the body fluids' flow and where the blood flow is the most important motion element. In Stahl's work titled *Theoria medica vera*, published in 1709, the "anima", the vital principle, inseparable from the physical body, was seen at work in matter controlling and directing its functioning. The animists had a hard time trying to explain how the vital processes could possibly go on even after death. Yet it was their line of thinking that became prevalent in the 18th century and, in accord with it, the medical debate concerning vampires died out as well...



The basic model of the heme olecule with the iron ion at the center position of the porphyrine structure. Heme is omplex red organic pigment forming the prosthetic groups found in most oxygen carrier proteins like hemoglobin pictured on the right panel



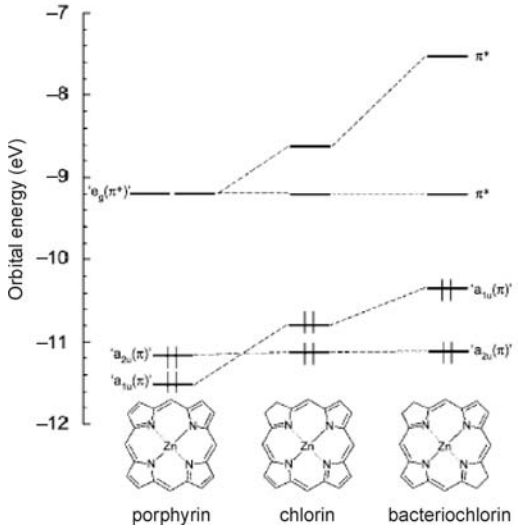
Hemoglobin is a crystallizable, conjugated protein consisting of an iron-containing pigment (heme) and simple protein, globin. In the lungs, it combines readily with oxygen to form a loose, unstable compound called oxyhemoglobin, in a process called oxygenation.

Hemoglobin is the protein that is carried by red cells. It picks up oxygen in lungs and delivers it to peripheral tissues to maintain viability of cells

It was not till late XX century when the vampires' story became "scientifically" intriguing again. Hypothesis brought up by chemists and clinicians studying blood disorders was that vampires, those dreaded beasts of folklore and superstition, may have been nothing more than people suffering from a rare (one case in every 200 000 people) class of genetic diseases called *porphyria*. Congenital erythropoietic porphyria (porphyria originates from the ancient Greek word *porphura*, meaning purple) accused for being most likely responsible for the vampiric myth is the disease related to an inherited disorder of heme metabolism.

The molecule of heme is a prosthetic group to many important proteins like eg. hemoglobin which carries oxygen in our blood stream. Heme, whose chemical structure is responsible for the red color of blood is built of a porphyrin block: the very same molecule which in a slightly diverse form occurs in chlorophylls and bacteriochlorophylls – biological pigments involved in photosynthesis. A porphyrin consists of four pyrrole rings joined by methenyl groups. The ligand is a dianion whose negative charge can be countered by two protons usually localized on two opposite nitrogens, or by divalent metal (Fe for heme and Mg for chlorophyll) resulting in a neutral molecule. Biologically functional porphyrins include various peripheral substituents and are naturally embedded in a protein matrix (like heme in the hemoglobin) that provides a unique micro-environment for their physical properties and biological function. This structure is a main motive controlling

electronic properties of porphyrins, their optical and redox features, reactivities, rates of electron transfer or spin density profiles.



Energy level diagram calculated for the two highest occupied and two lowest unoccupied molecular orbitals (HOMO – 1, HOMO and LUMO, LUMO + 1) for a porphyrin (P), a chlorin (C) and for a bacteriochlorin (BC). These determine the optical spectra of the chromophores (Gouterman et. al. 1963). Note that the energy gap between the HOMO and LUMO decreases in the order P, C and BC and explains the red-shift of the lowest absorption band of the chromophores which is a HOMO to LUMO transition (adapted from Chang et al. 1081)

The ubiquitous roles of porphyrins in bioenergetics have prompted many experimental and theoretical studies that seek to fully understand and mimic their function by synthesis of new materials of dedicated catalytic and photochemical functions. A good example is the interest in using porphyrins in photodynamic therapy where porphyrin photosensitized generation of singlet oxygen is used to attack tumours. On the other hand, the deficient synthesis of heme in humans suffering from porphyria results in overproduction and accumulation of porphyrins whose burden on the organism can be detected e.g. by a strong red fluorescence of teeth (erythrodontia) or unusual sensitivity of skin to light (cutaneous photosensitivity). Exposure to even mild sunlight can disfigure the skin, cause the nose and fingers to fall off, and make the lips and gums so taut that the teeth, although no larger than ordinary, look like they are jutting out in a menacing, animal-like manner.

Couldn't then the porphyria have been responsible for a vampire tale – especially since the disease is hereditary? A person that is affected by porphyria

can seem very scary to the average observer seeing the victim's teeth and nails to gain a fluorescent glow. These traits could perhaps explain the fact that many vampire stories described the vampires as giving off a greenish glow. Humans suffering from the disease are likely to be deformed also in other ways, usually in the facial area. In most cases of porphyria, blood or heme transfusions can supply some relief from the symptoms, and this is still the mainstay of treatment. Interestingly, the heme pigment is robust enough to survive digestion, and is absorbed from the intestine. This means that, in principle, the symptoms of porphyria would be relieved by drinking blood – another possible link with the vampire stories. Chemical studies offer also an explanation of why vampires, or porphyria victims, might well have been afraid of garlic, in accord with existing mythology... Garlic (Allium Sativum) is known to contain a chemical (dialkyl disulphide) that can enhance the symptoms of the disease.

The only portrayal of actual porphyria in the arts is in the play and movie "The Madness of King George", about England's King George III, who had just lost the colonies in America when he was beset with "madness". Some historians hypothesize that he suffered from acute intermittent porphyria. In this form of porphyria, the liver is affected rather than the erythrocytes, and although the victim's skin is not typically photosensitive, the condition is characterized by strong neurologic disorders. In King George's time, his bizarre behaviour and wild outbursts were treated as insanity. It was not until late 70s when a new hypothesis has been formulated after two psychiatrists had revisited king's medical records and noticed a key symptom; dark red urine – a classic and unmistakable sign of a rare blood disorder – porphyria.

As speculated by biochemists, not only humans whose blood contains hemoglobin, but also plants that use the green porphyrin, chlorophyll, to absorb light energy can suffer from the conditions similar to porphyria. Plants make chlorophyll via a pathway very similar to that for heme production in animals. Mutations in the gene for the final step in this pathway lead to a buildup of porphyrins in the leaves. On exposure to sunlight the leaves blister and die. Botanical vampire myth is, however, much less enshrined in legends and not so popular in the history of art.

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