A deficiency in *dihydropteridine reductase* or any of the enzymes of BH₄ synthesis leads to hyperphenylalaninemia, and decreased synthesis of catecholamines and serotonin.
L-Homocysteine

Cystathionine β-synthase

L-Serine

H₂O

Cystathionine
A Urine from a patient with alkaptonuria

1 The specimen on the left, which has been standing for fifteen minutes, shows some darkening at the surface, due to the oxidation of homogentisic acid.

2 After two hours, the urine is entirely black.

B Vertebrae from a patient with alkaptonuria

Dense, black pigment deposited on the intervertebral disks of the vertebrae.