THE DANCE OF THE SOLIDS

by John Updike

EDITOR’S NOTE: These verses were composed after the writer had read the issue of SCIENTIFIC AMERICAN (September, 1967) devoted to materials. They appear in his forthcoming book Midpoint and Other Poems, and are reproduced with the generous permission of Alfred A. Knopf, Inc.

ARGUMENT: In stanzas associated with allegory the actual atomic structure of solids unfolds. Metals, Ceramics and Polymers. The conduction of heat, electricity and light through solids. Solidity emerges as being intricate, giddy, playful.

All things are Atoms: Earth and Water, Air And Fire, all, Democritus foretold. Swiss Paracelsus, in’s alchemic lair, Saw Sulfur, Salt, and Mercury unfold Amid Millennial hopes of faking Gold. Lavoisier dethroned Phlogiston; then Molecular Analysis made bold Forays into the gases: Hydrogen Stood naked in the dazzled sight of Learned Men.

The Solid State, however, kept its grains Of Microstructure coarsely veiled until X-ray diffraction pierced the Crystal Planes That roofed the giddy Dance, the taut Quadrille Where Silicon and Carbon Atoms will Link Valencies, four-figured, hand in hand With common Ions and Rare Earths to fill The lattices of Matter, Glass or Sand, With tiny Excitations, quantitatively grand.

The Metals, lustrous Monarchs of the Cave, Are ductile and conductive and opaque Because each Atom generously gave Its own Electrons to a mutual Stake, A Pool that acts as Bond. The Ions take The stacking shape of Spheres, and slip and flow When pressed or dented; thusly Metals make A better Paper Clip than a Window, Are vulnerable to Shear, and, heated, brightly glow.

Ceramic, muddy Queen of human Arts, First served as simple Stone. Feldspar supplied Crude Clay; and Rubies, Porcelain, and Quartz Came each to light. Aluminum Oxide Is typical—a Metal is allied With Oxygen ionically; no free Electrons form a lubricating tide, Hence, Empresslike, Ceramics tend to be Resistant, porous, brittle, and refractory.

Prince Glass, Ceramic’s son, though crystal-clear, Is no wise crystalline. The fond Voyeur And Narcissist alike devoutly peer Into Disorder, the Disorderer Being Covalent Bondings that prefer Prolonged Viscosity and spread loose nets Photons slip through. The average Polymer Enjoys a Glassy state, but cools, forgets To slump, and clouds in closely patterned Minuets.
The Polymers, those giant Molecules,  
Like Starch and Polyoxymethylene,  
Flesh out, as protein serfs and plastic fools,  
The Kingdom with Life’s Stuff. Our time has seen  
The synthesis of Polysoprene  
And many cross-linked Helixes unknown  
To Robert Hooke; but each primordial Bean  
Knew Cellulose by heart: Nature alone  
Of Collagen and Apatite compounded Bone.

What happens in these Lattices when Heat  
Transports Vibrations through a solid mass?  
\[ T = 3Nk \] is much too neat;  
A rigid Crystal’s not a fluid Gas.  
Debye in 1912 proposed Elastic Waves called phonons which obey Max Planck’s Great Quantum Law. Although amorphous Glass, Umklapp Switchbacks, and Isotopes play pranks Upon his Formulae, Debye deserves warm Thanks.

Electroconductivity depends  
On Free Electrons: in Germanium  
A touch of Arsenic liberates; in blends  
Like Nickel Oxide, Ohms thwart Current. From Pure Copper threads to wads of Chewing Gum Resistance varies hugely. Cold and Light As well as “doping” modify the sum Of Fermi Levels, Ion scatter, site Proximity, and other factors recondite.

Magnetic Atoms, such as Iron, keep  
Unpaired Electrons in their middle shell, Each one a spinning Magnet that would leap The Bloch Walls whereat antiparallel Domains converge. Diffuse Material Becomes Magnetic when another Field Aligns domains like Seaweed in a swell. How nicely microscopic forces yield, In Units growing Visible, the World we wield!

Textbooks and Heaven only are Ideal;  
Solidity is an imperfect state.  
Within the cracked and dislocated Real Nonstoichiometric crystals dominate. Stray Atoms sully and precipitate; Strange holes, excitons, wander loose; because Of Dangling Bonds, a chemical Substrate Corrodes and catalyzes—surface Flaws Help Epitaxial Growth to fix adsorptive claws.

White Sunlight, Newton saw, is not so pure;  
A Spectrum bared the Rainbow to his view. Each Element absorbs its signature: Go add a negative Electron to Potassium Chloride; it turns deep blue, As Chromium incarnadines Sapphire. Wavelengths, absorbed, are reemitted through Fluorescence, Phosphorescence, and the higher Intensities that deadly Laser Beams require.
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