Profile: Water Clusters

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Introduction

Clusters—also known as nanoparticles, nanocrystals, nanoclusters, and quantum dots—are increasingly attracting scientific and technical interest. They are arrays of matter that can be described as arrangements, patterns, or "molecular designs."

As we penetrate into the world of nanometers, we become aware of the physical variation possible in the molecular arrangement of elements within a single chemical formula, right down to the arrangement of particles in the atomic nucleus. *Science* has devoted a whole series of articles to this topic, presenting the current state of knowledge on the subject and prospects for the future [1, 4, 5, 7]. These articles deal with the structure, thermodynamics and topography of clusters [7], magnetic clusters in molecular formations [5], semiconductor crystals, nanocrystals, and quantum dots [1] and—of particular interest to medicine—water clusters [4]. A contribution by Ball et al provides new content that enlivens the perennial discussion of the interrelationships between structure and function [2].

Water clusters

If we disregard the possible applications of clusters in laser technology and in the production of nanocrystals, quantum dots, and superthin films and choose instead to concentrate on their significance in medicine, the results of research on water clusters are especially informative. Many physicists say that water, which is of decisive importance as a transmitter of information in material dilutions, has the "memory of an elephant." This ability to transmit information cannot be derived from the unitary chemical formula H_2O; rather, it

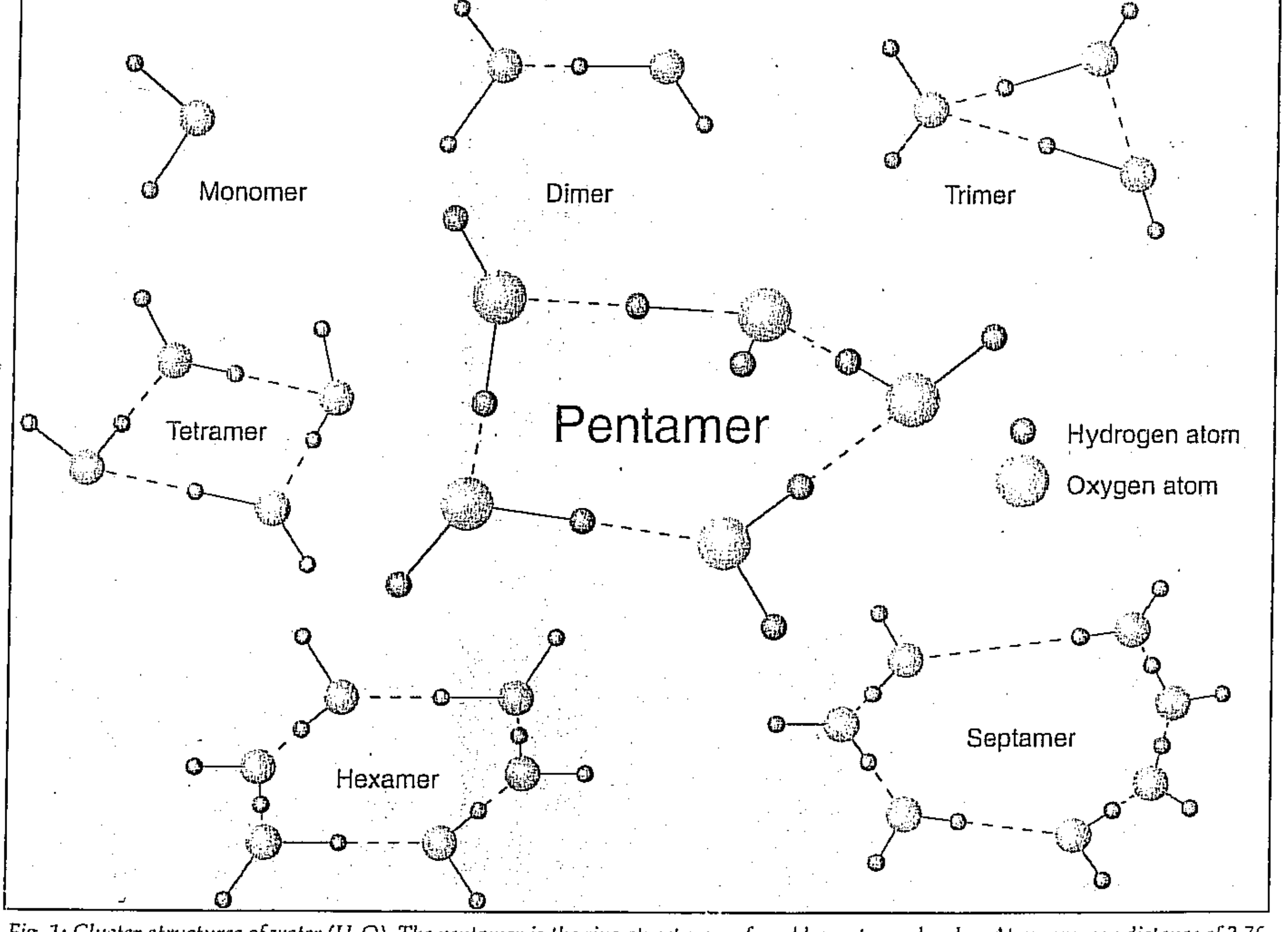

Fig. 1: Cluster structures of water (H_2O). The pentamer is the ring structure preferred by water molecules. At an average distance of 2.76 Å between oxygen atoms, there is a great deal of latitude in cluster formation. Each molecule in the cluster structure serves as both a donor and an acceptor of hydrogen bonds. The various angles suggest possible three-dimensional orientations and the degree of freedom.

results from water's multiplicity of cluster formations. Figure 1 illustrates this for monomers through septamers. In addition, within each cluster form there is still a substantial degree of latitude with regard to the arrangement of elemental structures, bond capacities, and surface energies. There is a correlation between temperature and cluster size only with regard to the distance between oxygen atoms. In liquid water at 4°C, this distance is 2.84 Å, while in ice at 223°K it is only 2.75 Å [3, 6]. As cluster size increases (dimer to pentamer), the distance between oxygen atoms decreases.

In solutions, water molecules tend to form pentagons and hexagons, with the pentagonal structure predominating 8:1. Pentagons seems to make closed surfaces possible. "Magic numbers" (numbers that demonstrate especially stable formations) of linkages between H+ and H_2O ions may be the basis for water's memory of dissolved substances. The cyclic water pentamer seems to be the fundamental structure in the hydration of biomolecules. Rings of six and seven point to increasing hydrophilicity. Water seems to surround dissolved hydrophobes with polyhedral structures in order to minimize disruption of the tetrahedral network.

Significance for homeopathy

Much of cluster research is still theory, but the facts and the models that concur are enough to permit the characterization of clusters as carriers of information. This applies especially to dissolved medications in which the dissolved substance forces the solvent to form clusters. The key to the biological efficacy of high dilutions in homeopathy may lie in this cluster-forming ability of solutions. Through contact with the dissolved substance, its "information" is transmitted even when molecules of that substance are no longer statistically present in the solution.

References

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