

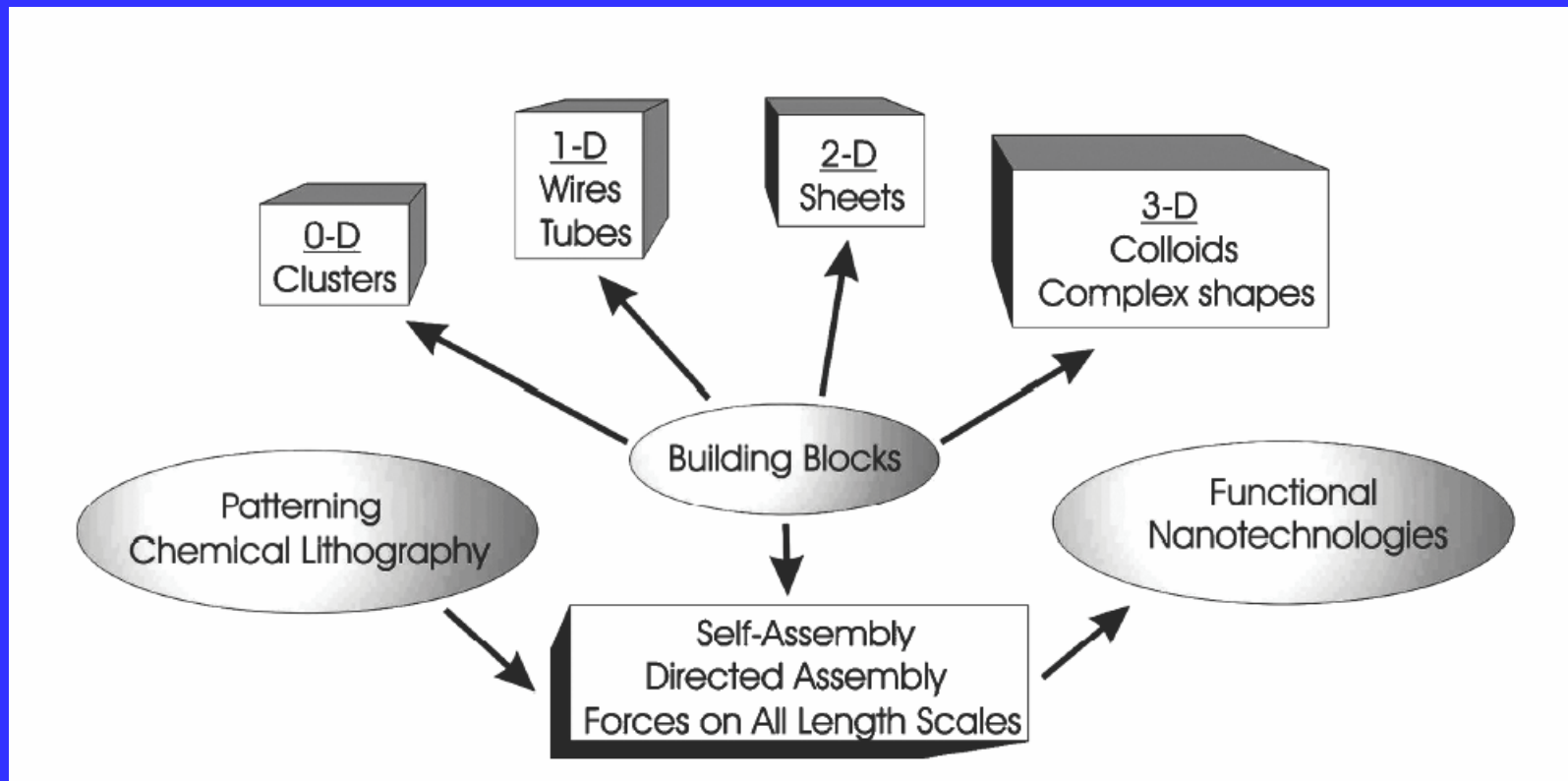
# ΒΑΣΙΚΕΣ ΑΡΧΕΣ ΤΗΣ NANOΧΗΜΕΙΑΣ

- Materials self-assembly
- “Large” and “small” nanomaterials
- Molecular vs. materials self-assembly
- Directing self-assembly
- Genealogy of self-assembling materials
- Porous solids
- Biomaterials-Lessons to be learned
- 2-D assemblies
- SAM's and soft lithography
- “Clever” clusters
- Nanowires
- Nanocolloids

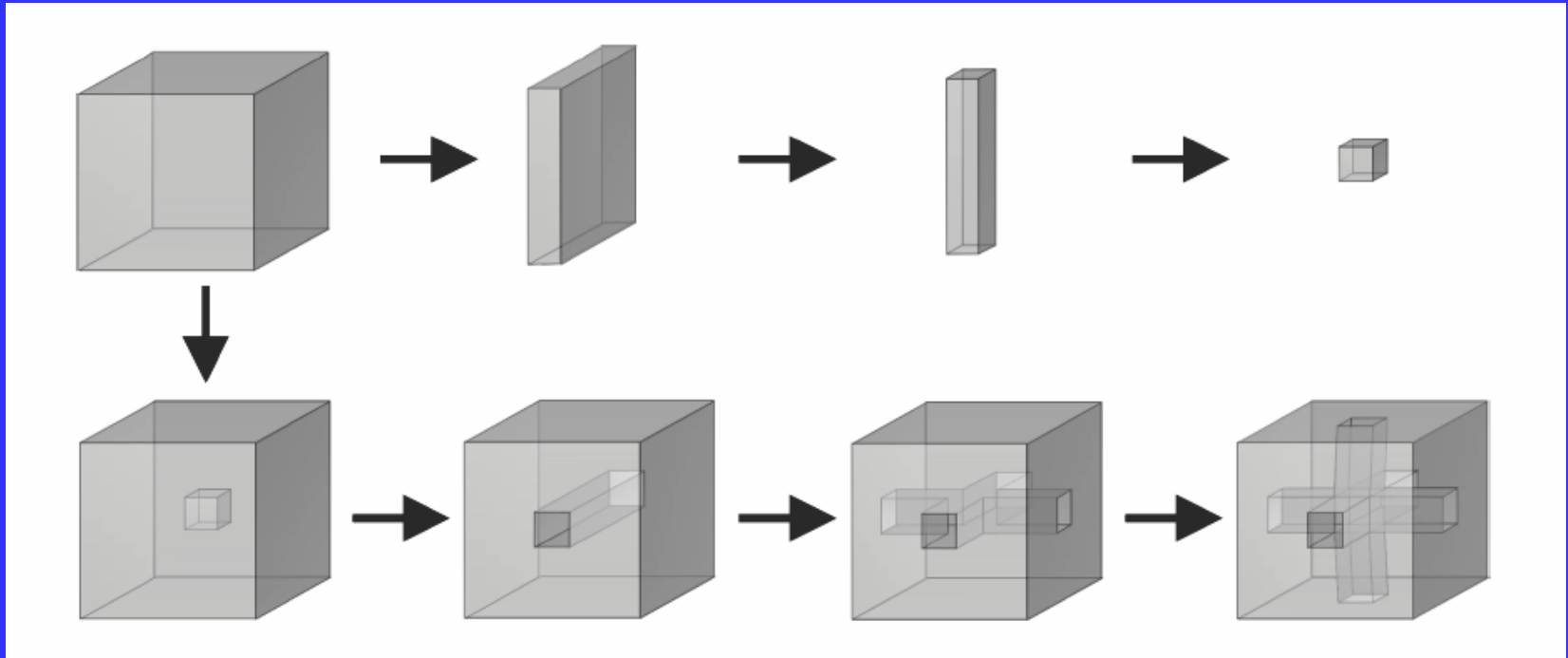
Nanochemistry : A Chemical Approach to Nanomaterials  
by G. Ozin, A. Arsenault

Royal Society of Chemistry; First edition (November 22, 2005)

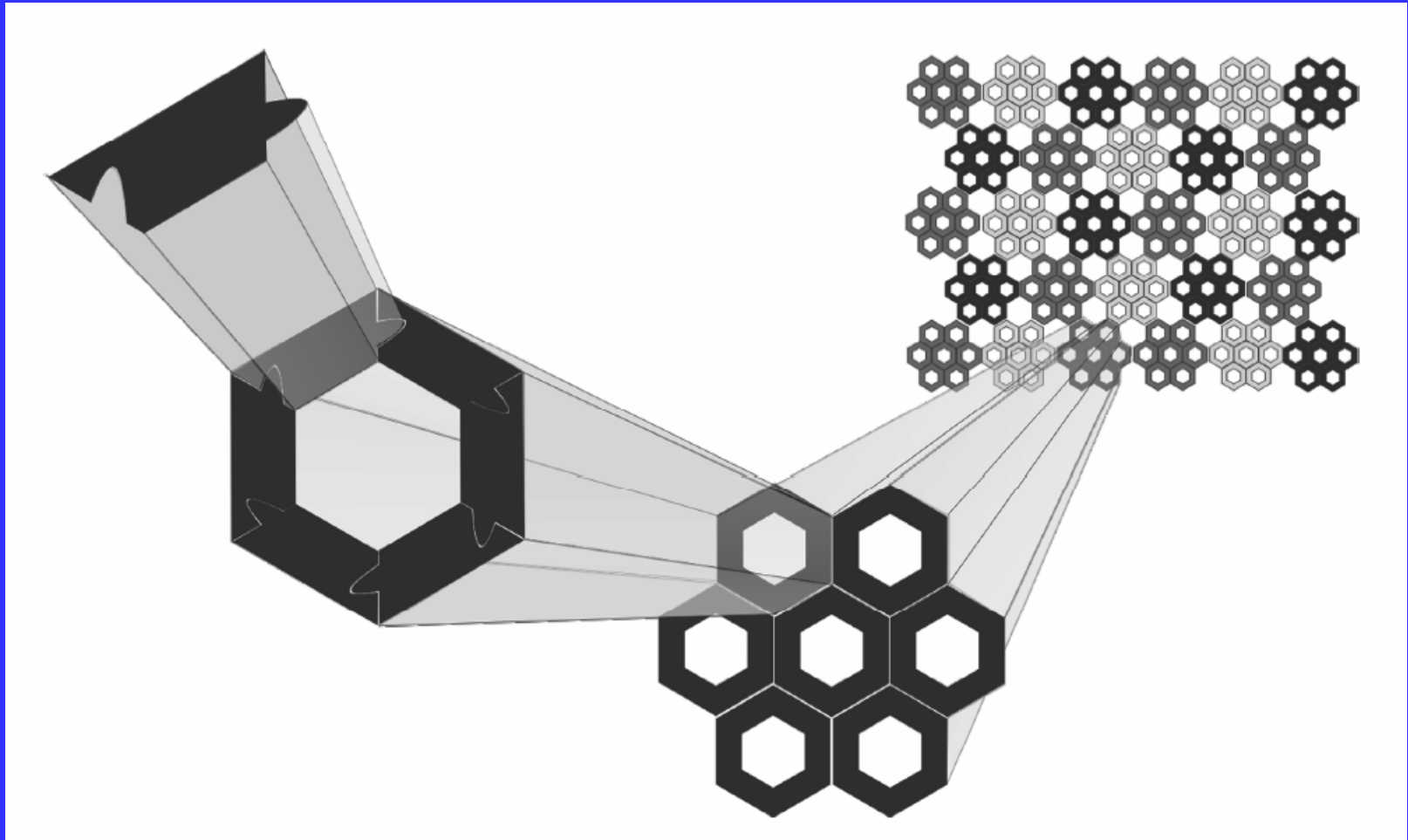
# Factors that must be considered when approaching the self-assembly of a nanoscale system



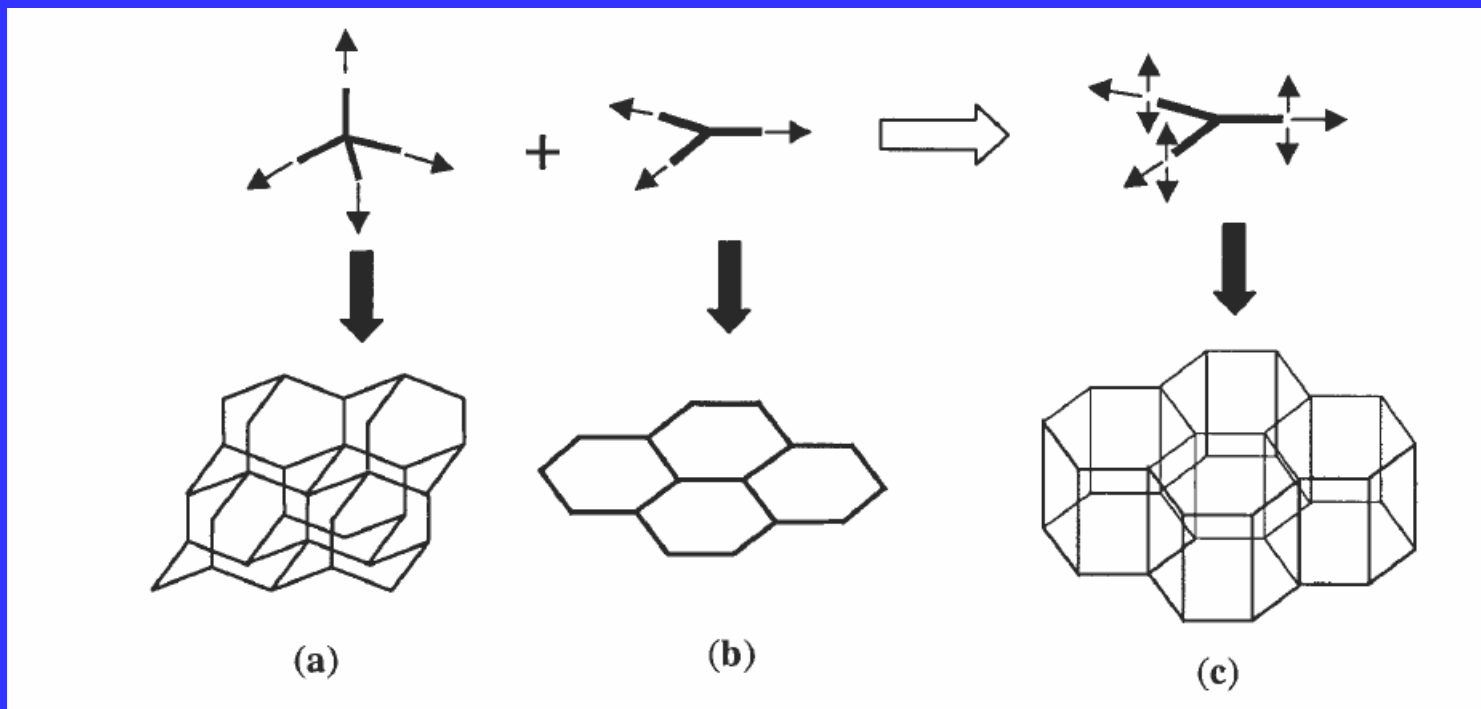
## Dividing matter to the nanoparticle and nanoporous state



**A hypothetical hierarchical system, exhibiting distinct building rules at different length scales**

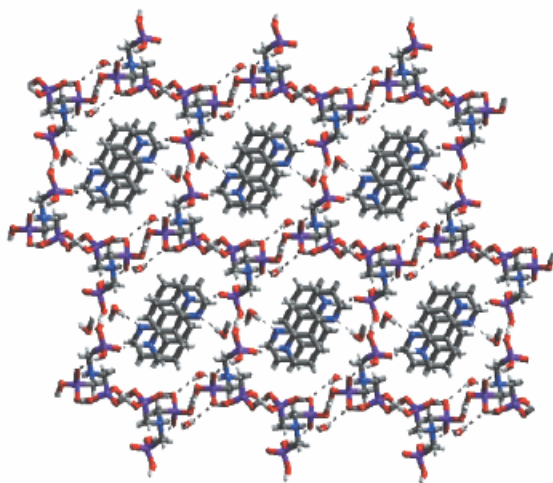


**3D (a) and two-dimensional (b) structures formed by self-assembly of tetrahedral and trigonal molecular building blocks**

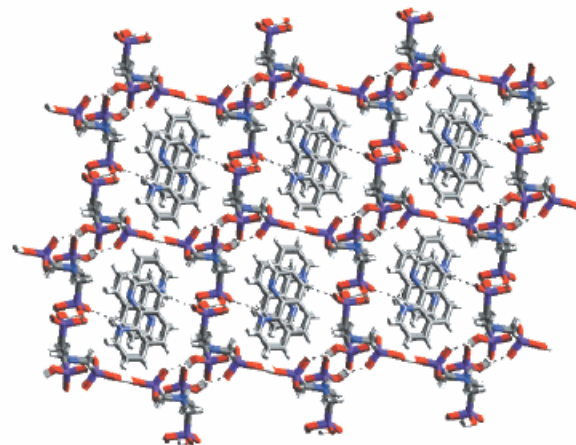


**Self-assembly of trigonal molecular building blocks with tetrahedrally shaped functional groups may lead to the formation of three-dimensional open hexagonal networks (c).**

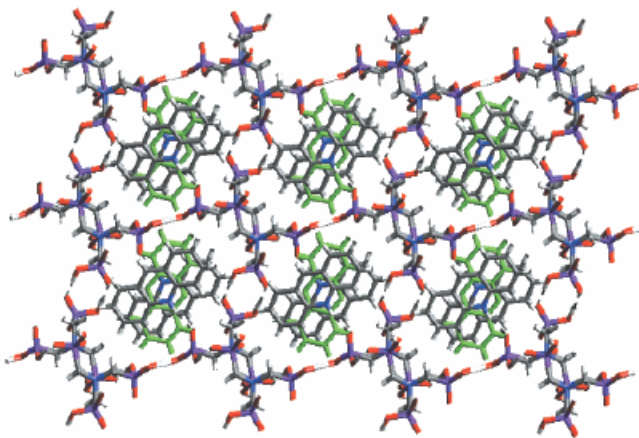
# Packing diagrams of three-dimensional hexagonal structures of molecular complexes of amines and phosphonates



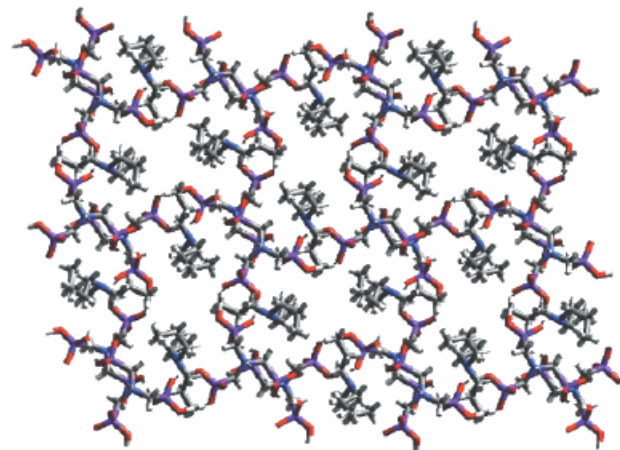
(a)



(b)



(c)



(d)

## Jean-Marie Lehn, pioneer of supramolecular chemistry

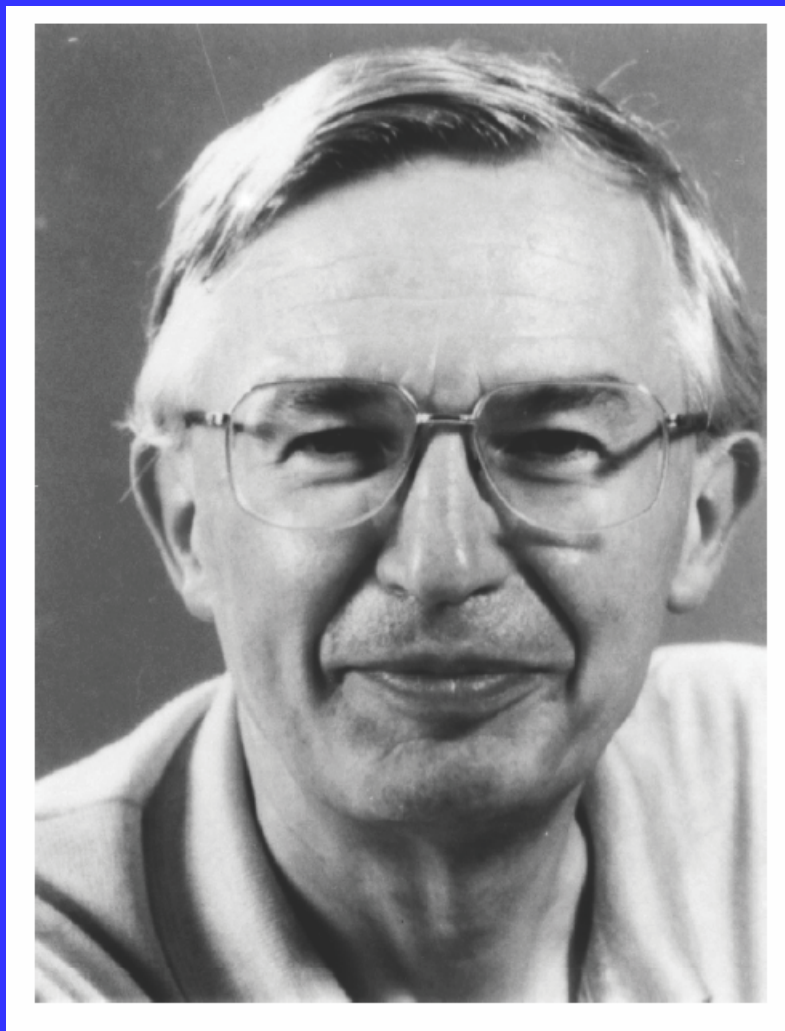
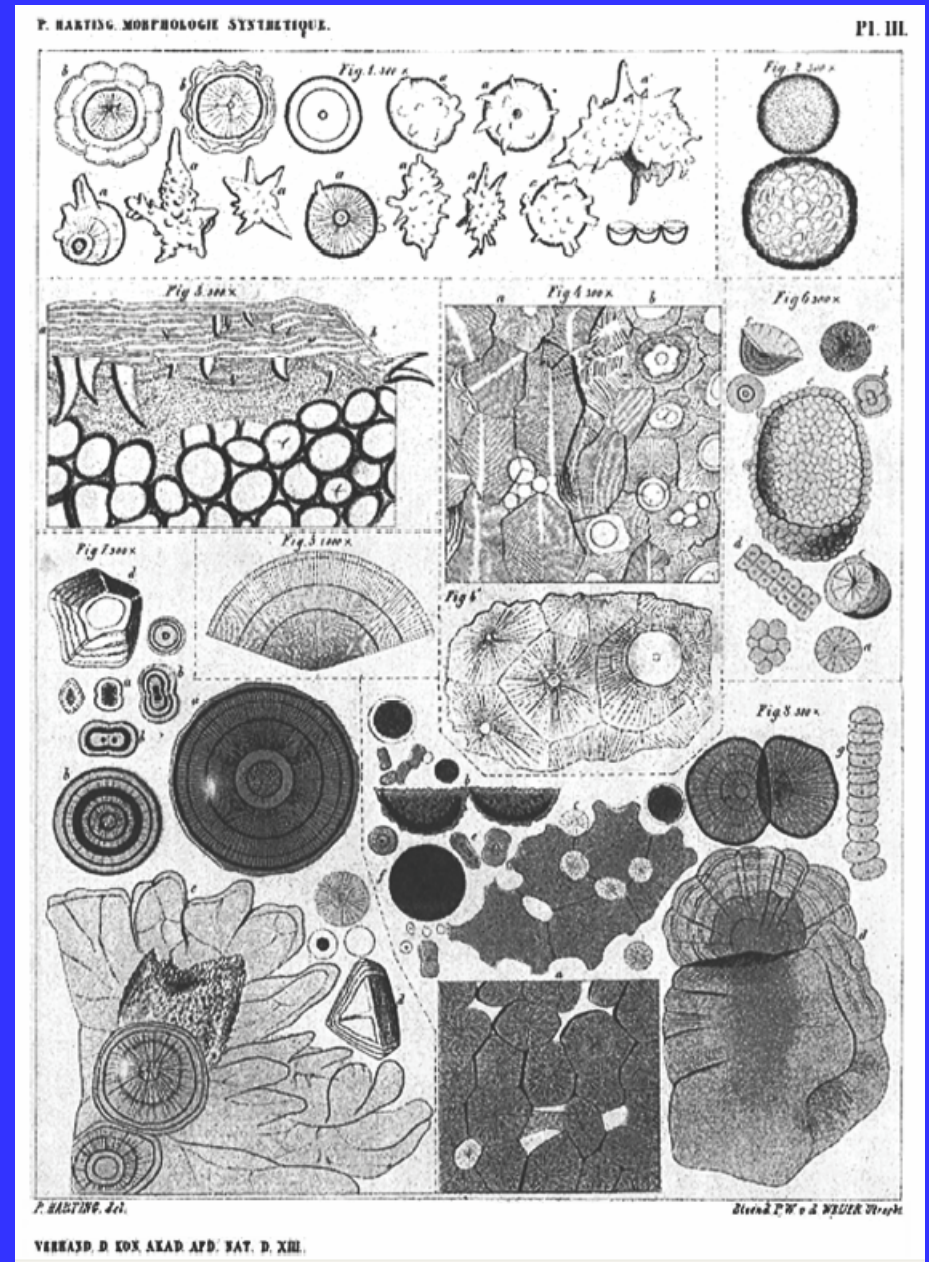


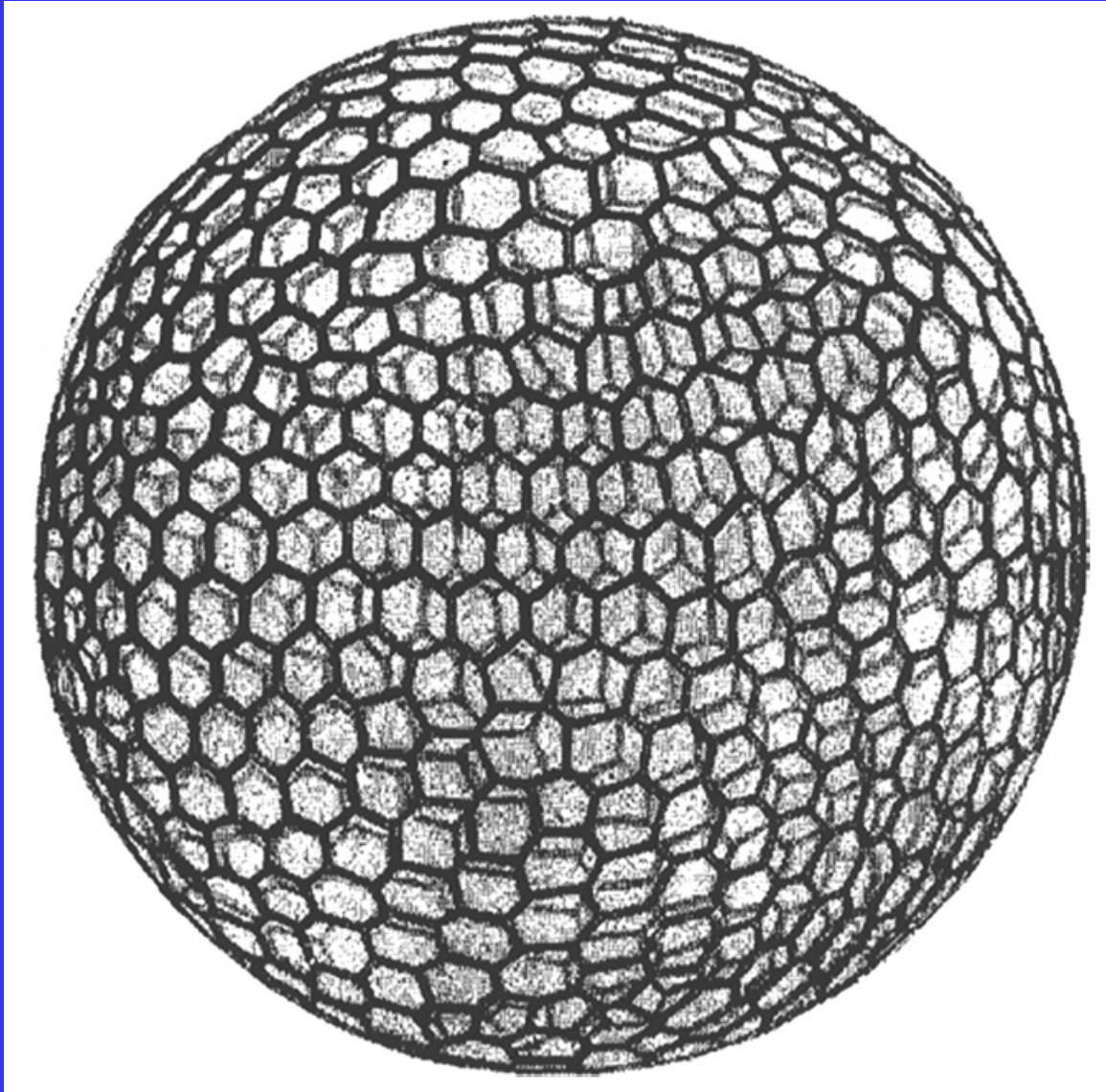


Image of synthetic morphologies  
produced by Pieter Harting,  
hand-drawn by himself in 1872

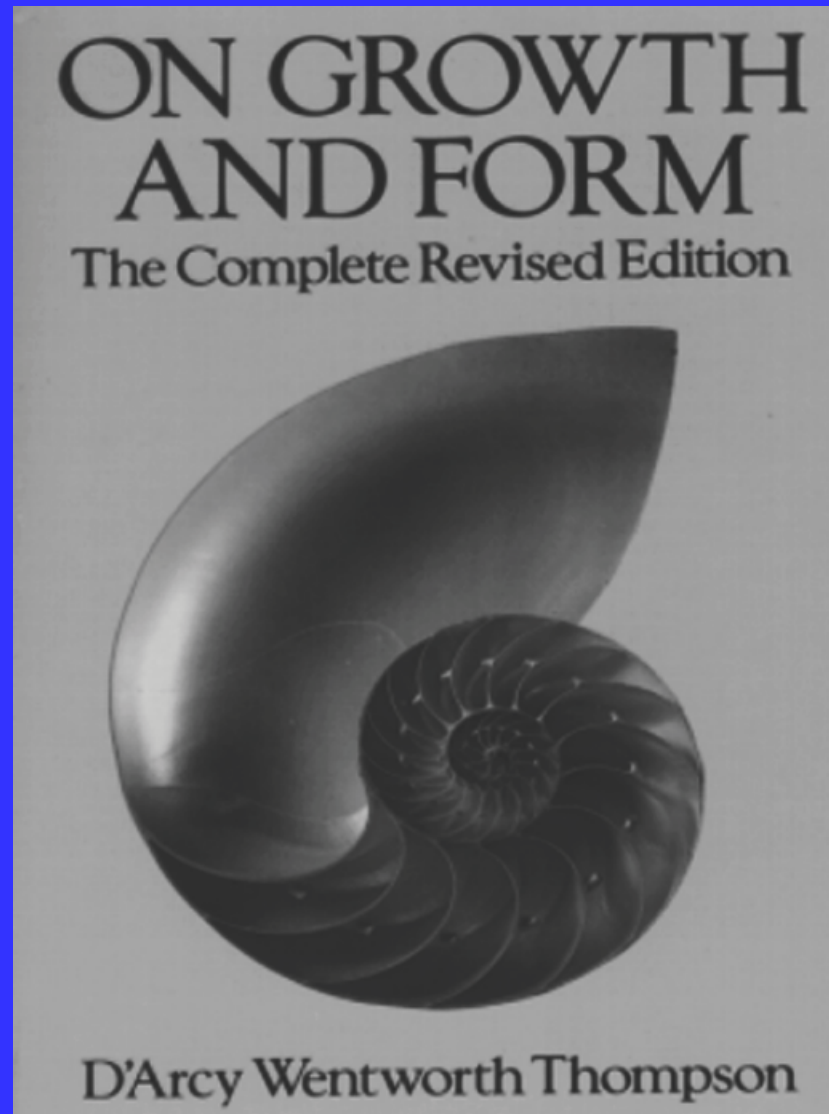




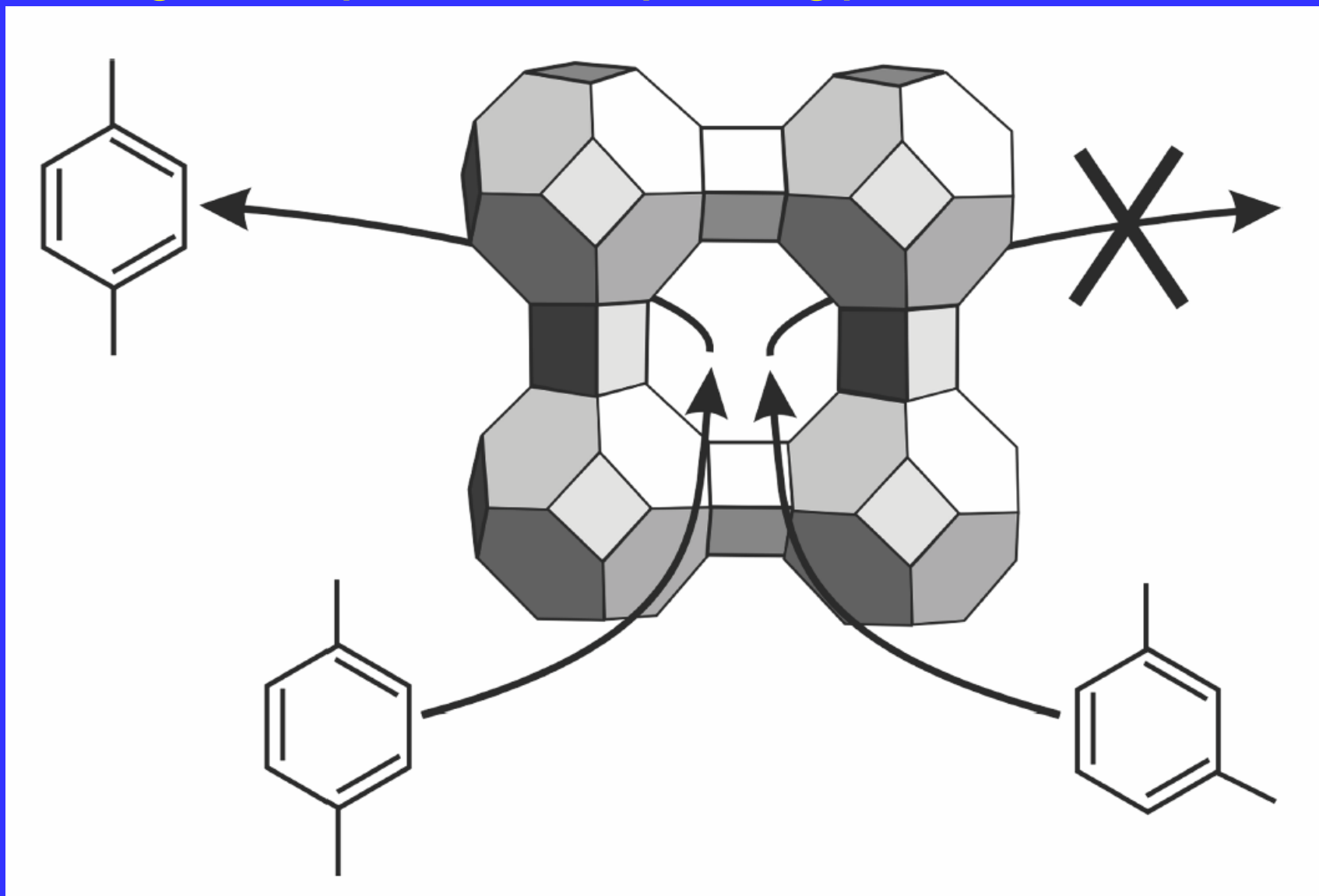
# Sketch of a radiolarian discovered by Ernst Haeckel



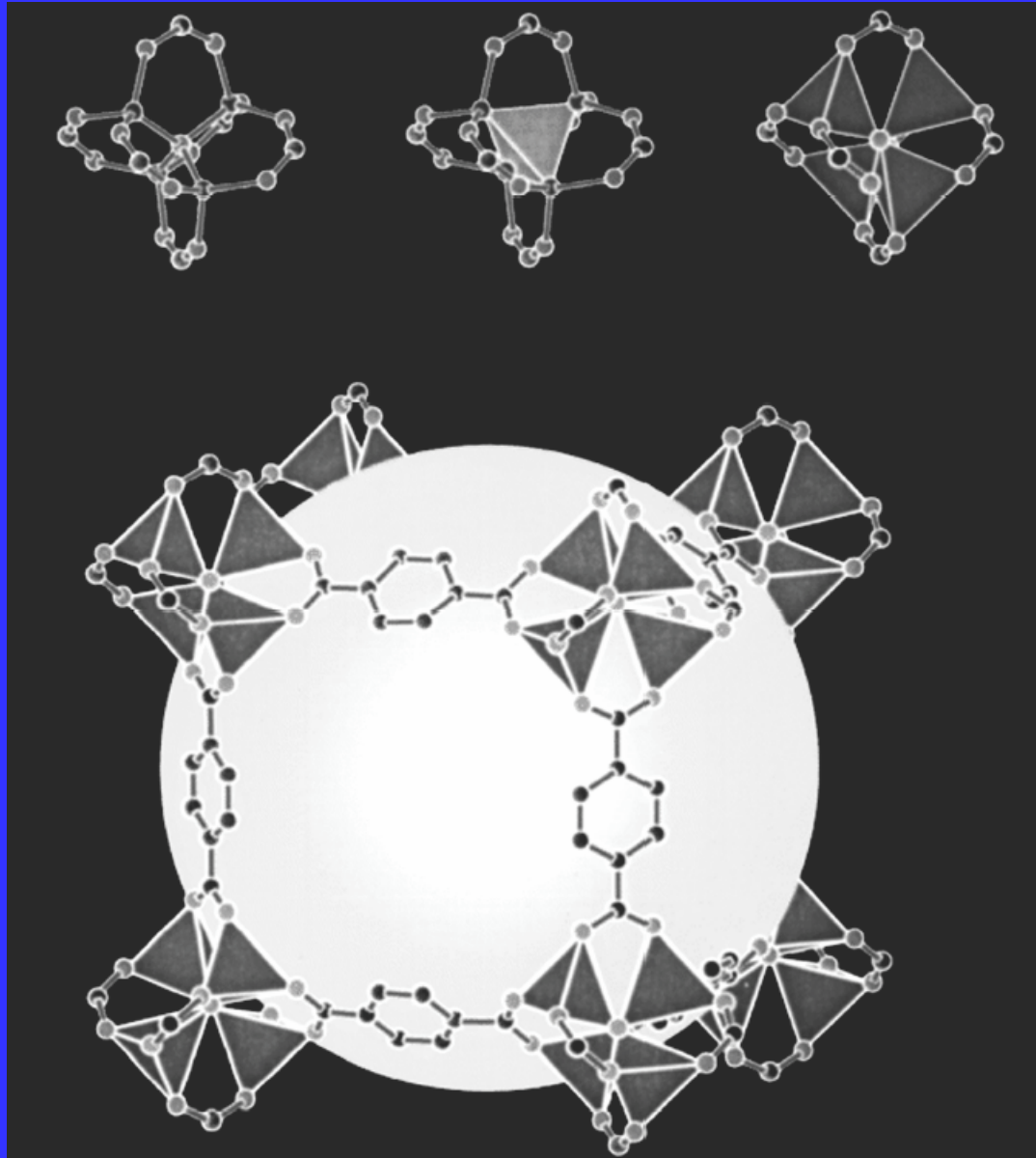
On growth and form, the ground-breaking text by D.W. Thompson



**A zeolite's crystalline aluminosilicate framework assembles around an organic template molecule providing pores after its removal.**

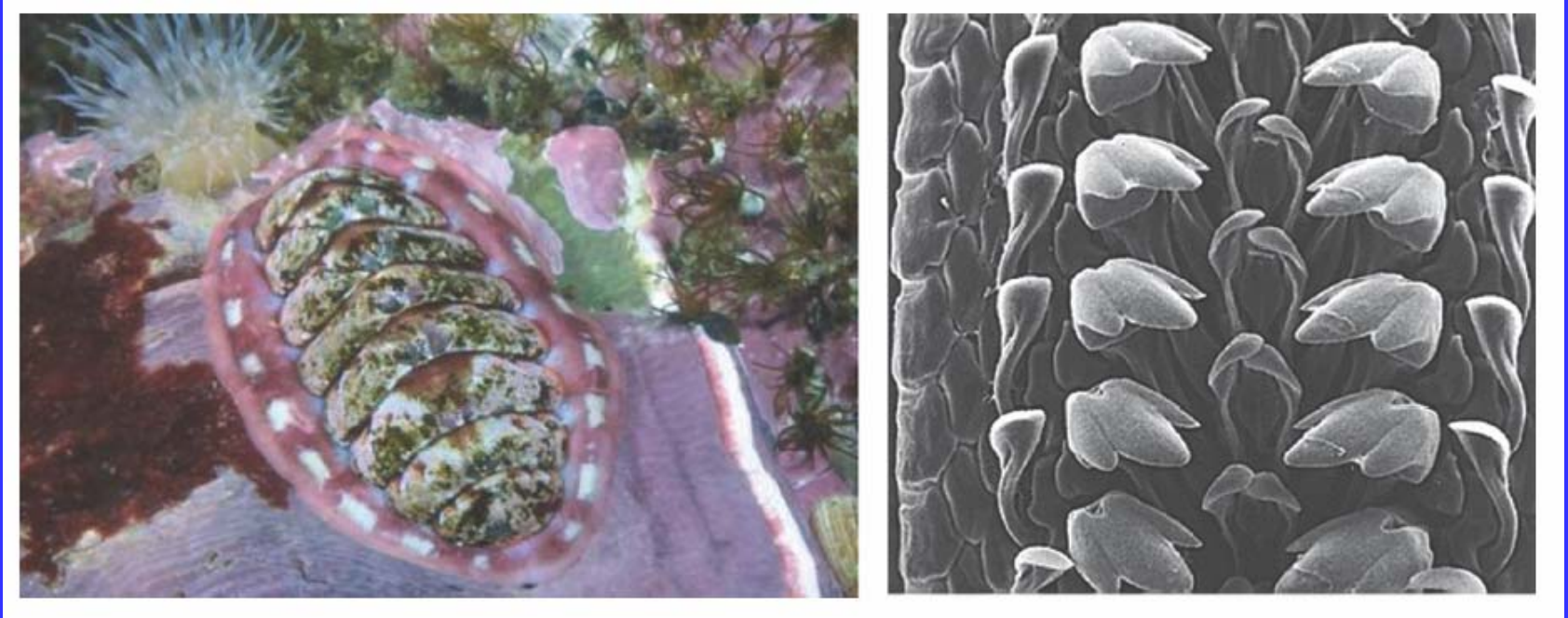


**Porous solids formed by assembly of Zn tetrahedra and dicarboxylates can have very large accessible surface areas**



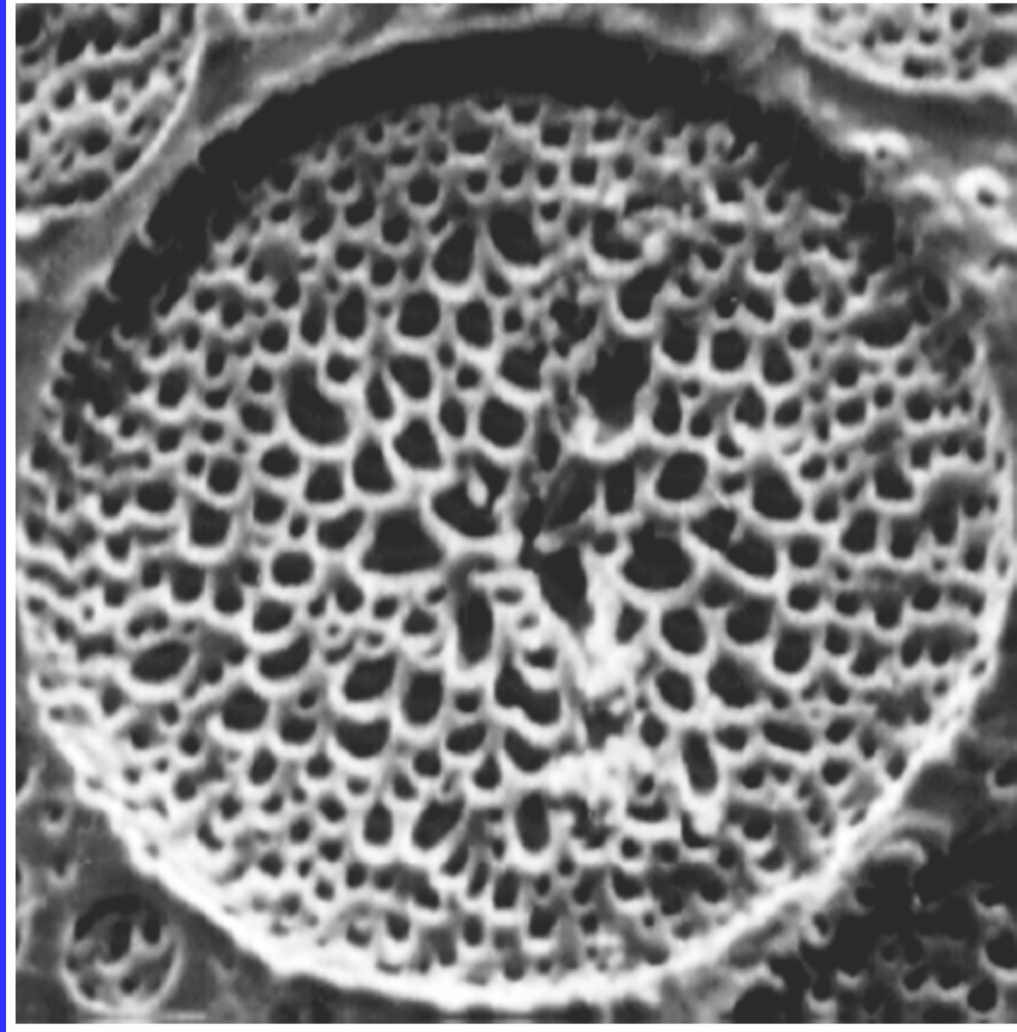


**The chiton, left, a primitive marine mollusk.**



**Chiton radula, right, composed of biomineralized iron oxide, are hard enough to scrape algae-covered rocks**

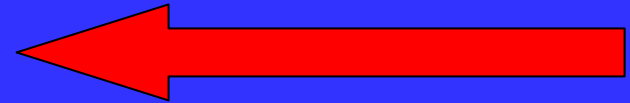
## Synthetic morphology resembling biomineralized systems



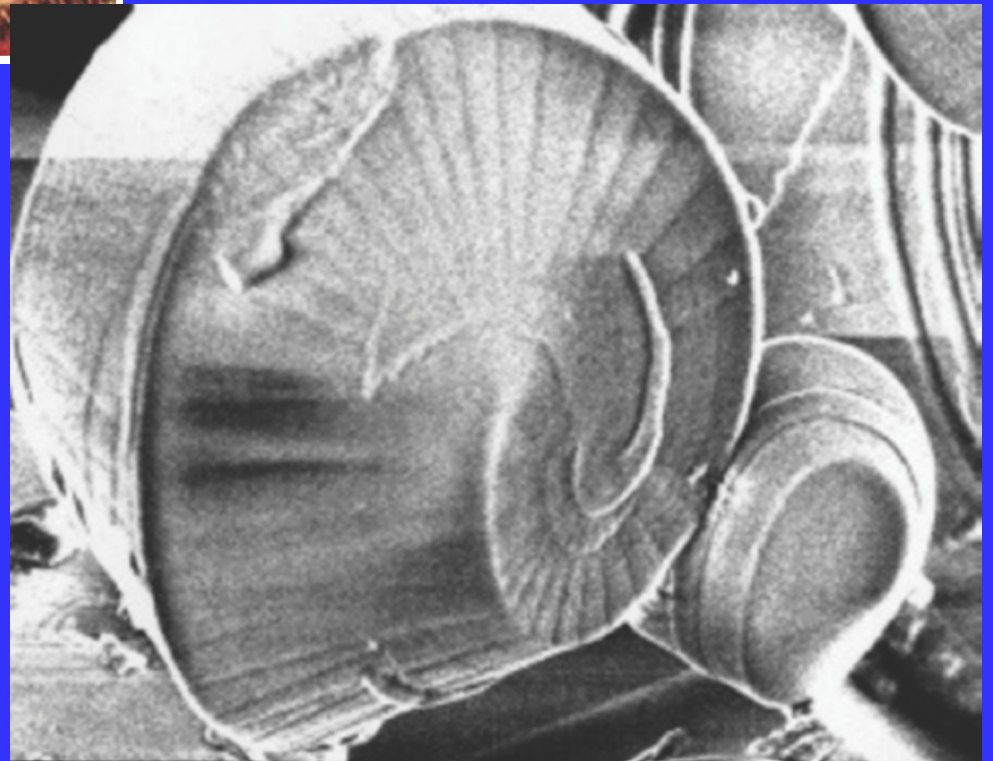
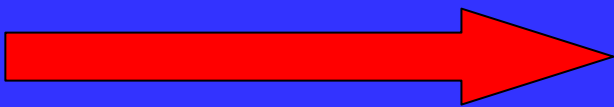




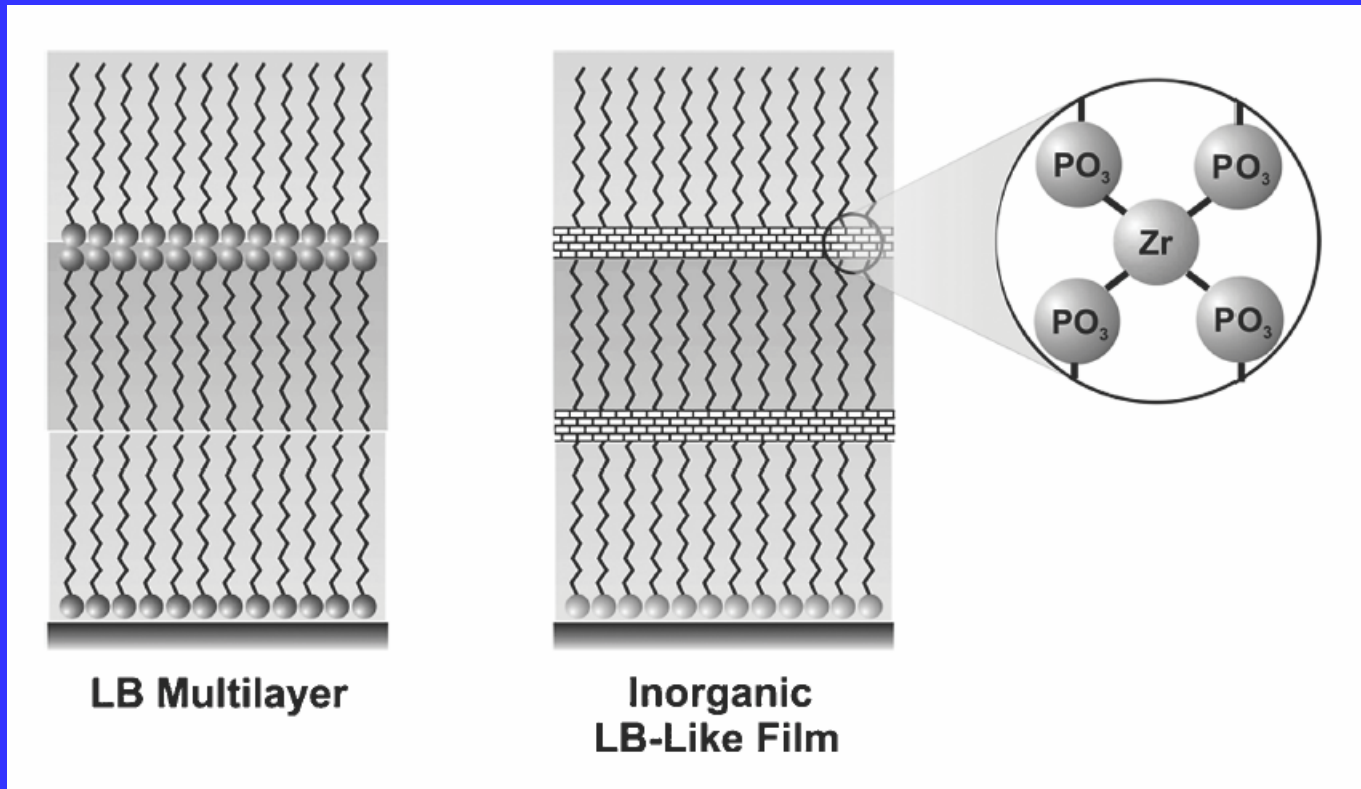
«ΦΥΣΙΚΑ» ΚΟΧΥΛΙΑ



«ΤΕΧΝΗΤΑ» ΚΟΧΥΛΙΑ

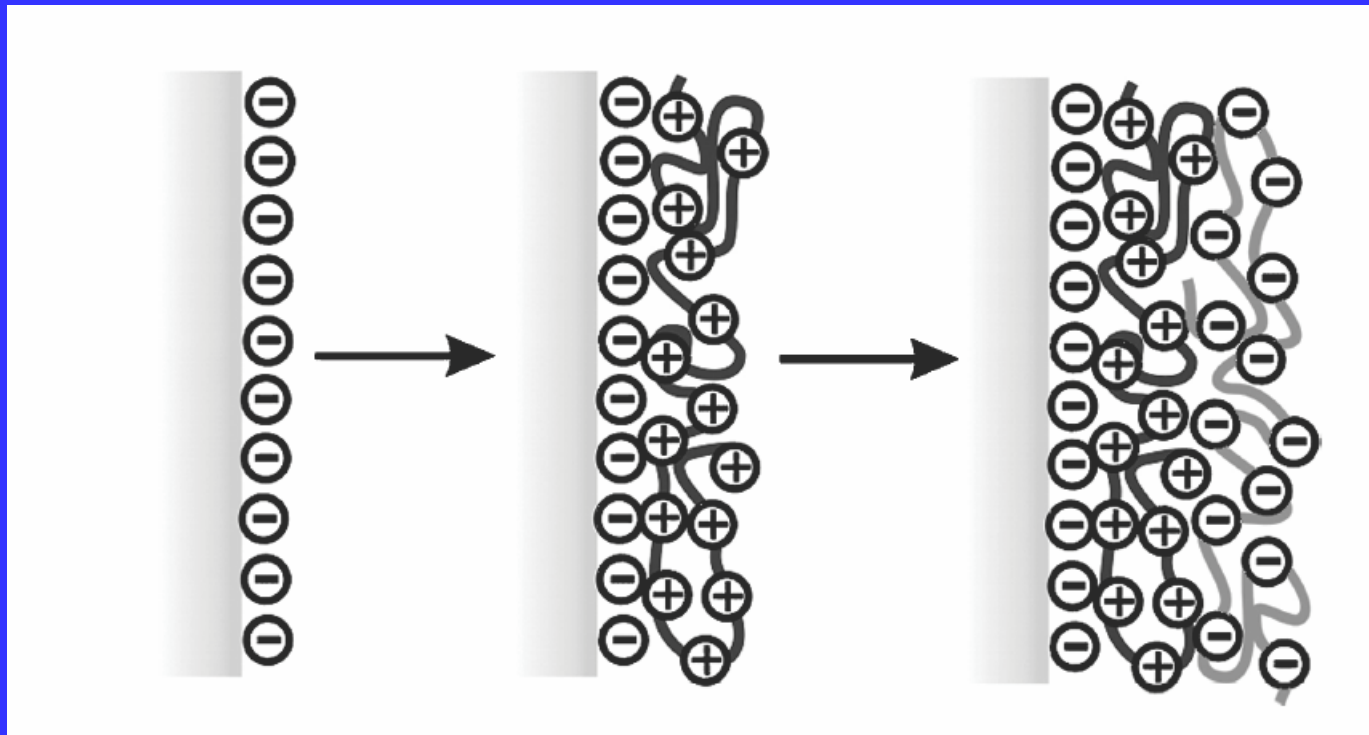


Langmuir–Blodgett films are formed through the repetitive transfer of amphiphile monolayers, left

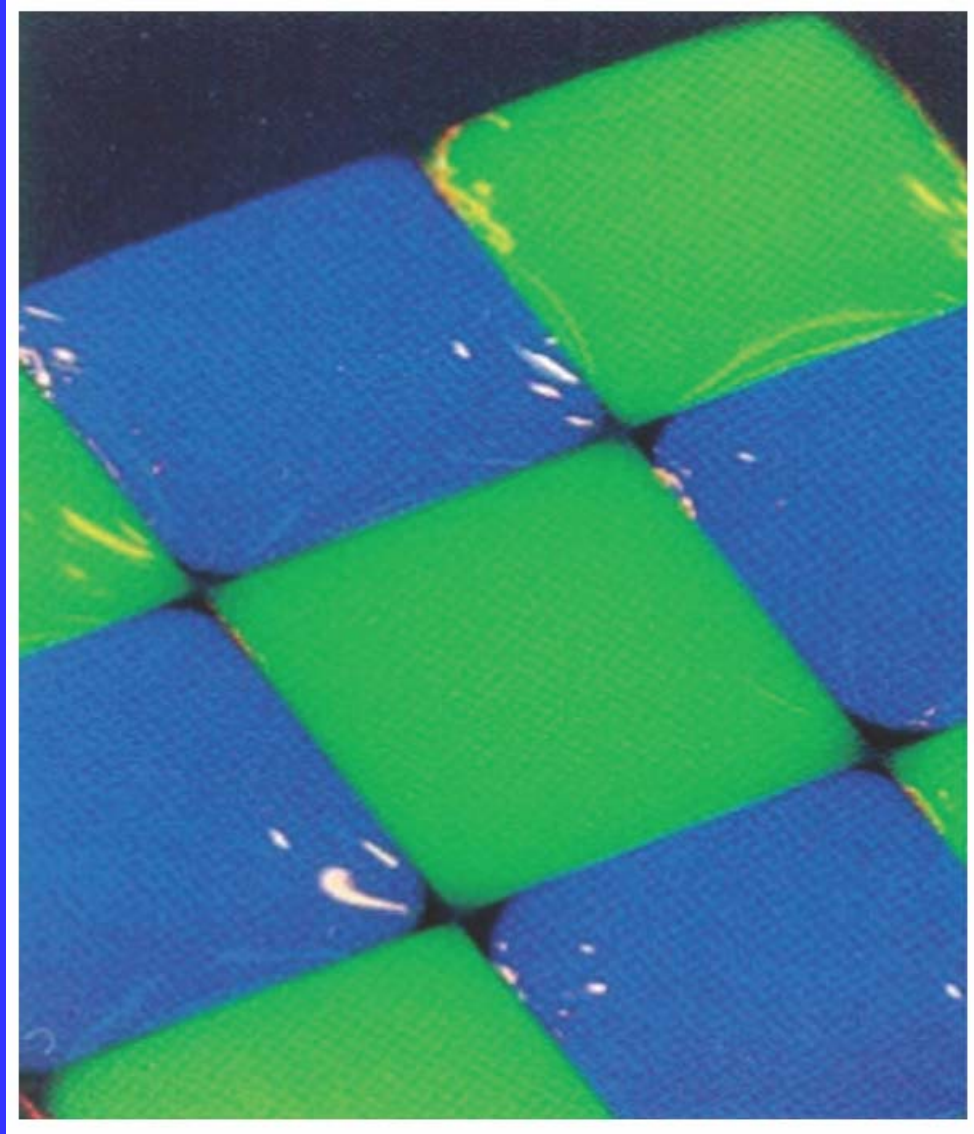


Inorganic LB-like films can be synthesized from diphosphonates and metal ions, right

**Iterative formation of layer-by-layer electrostatic multilayers by alternately dipping in solutions of polycations and polyanions**

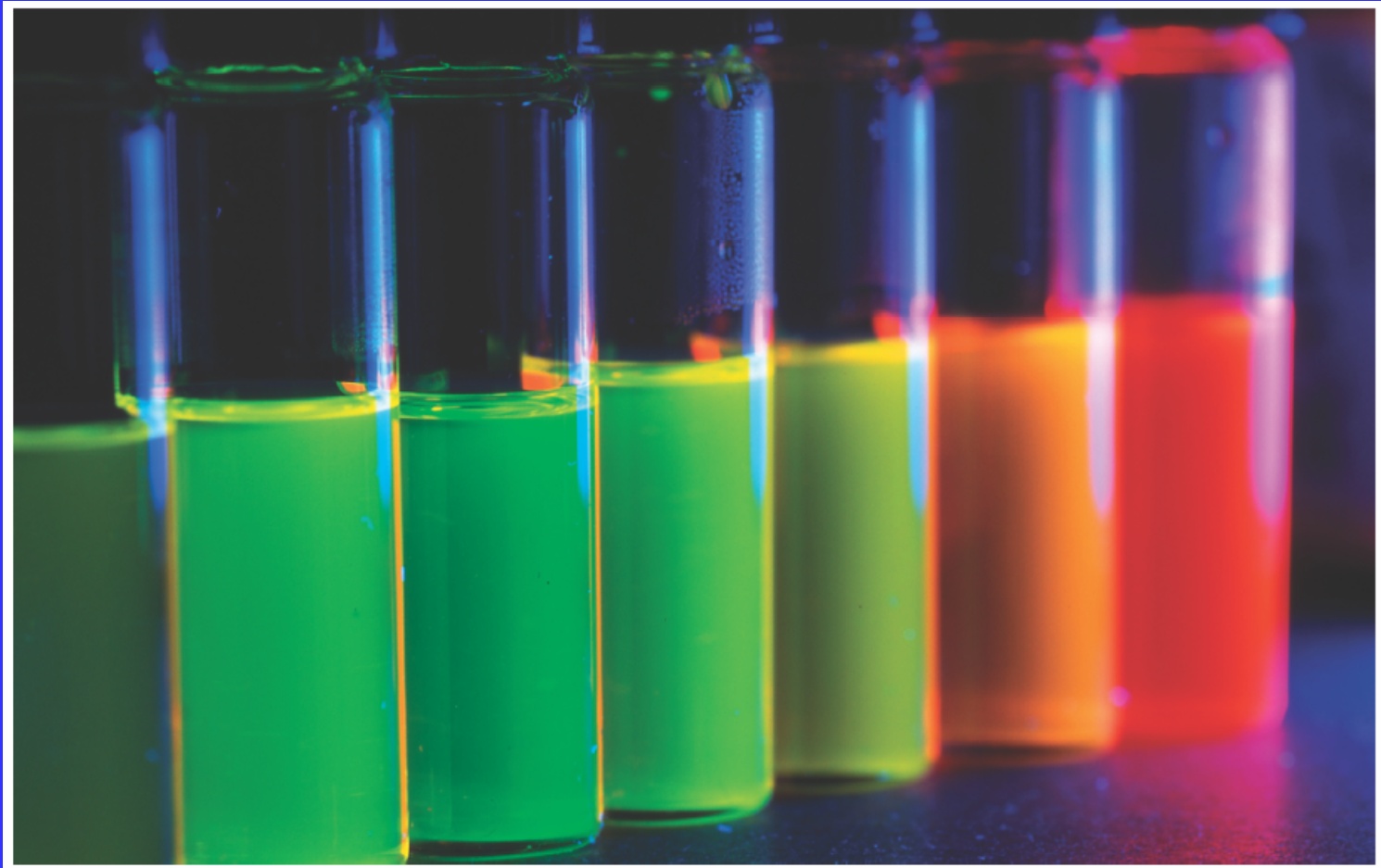


## Square drops of water through soft lithography

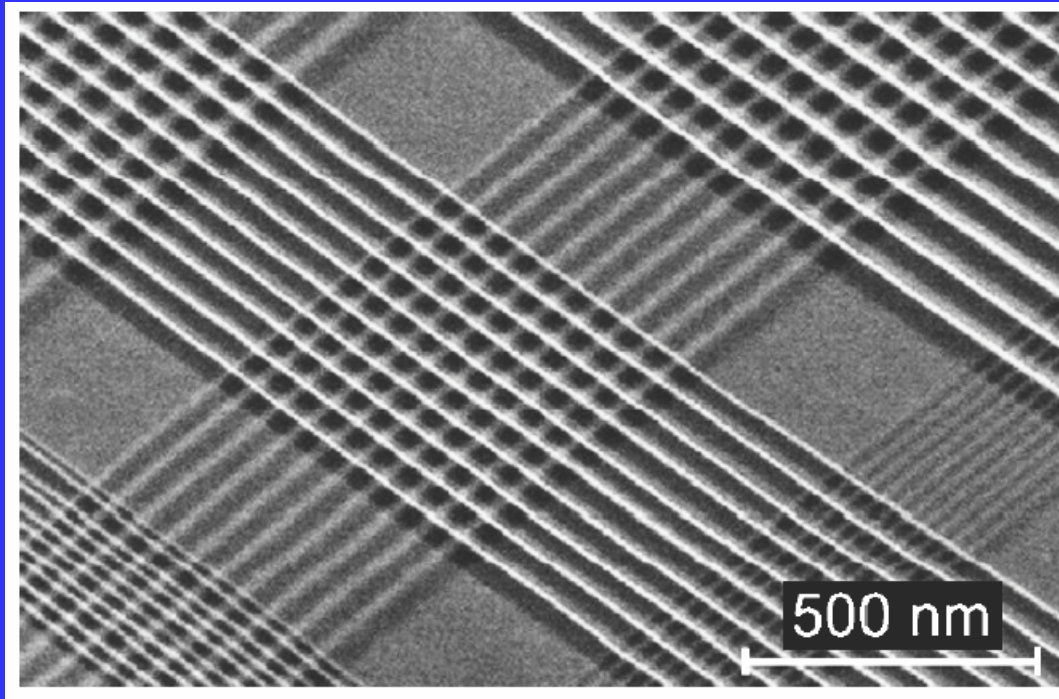




**Solutions of CdSe nanoparticles of different sizes under UV light,  
Showing size-dependent emission properties**

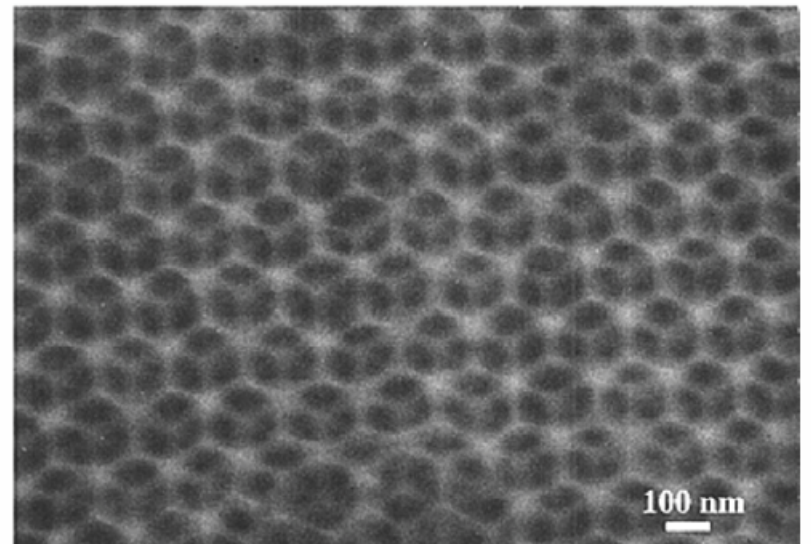
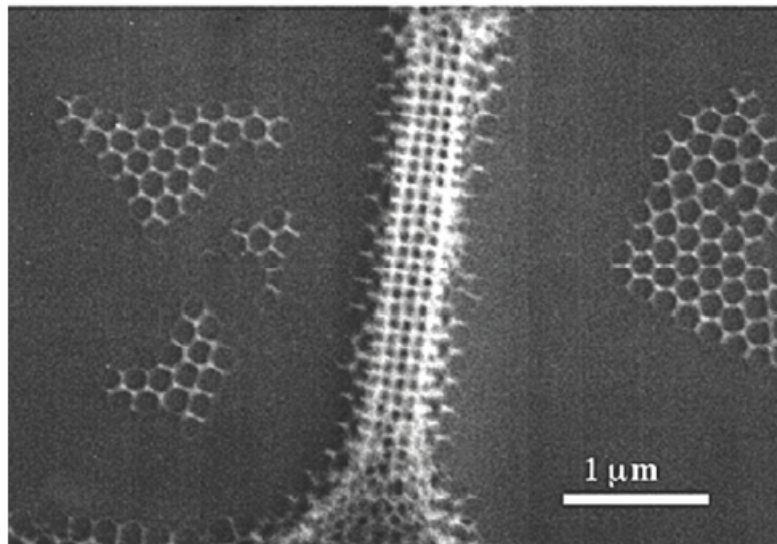
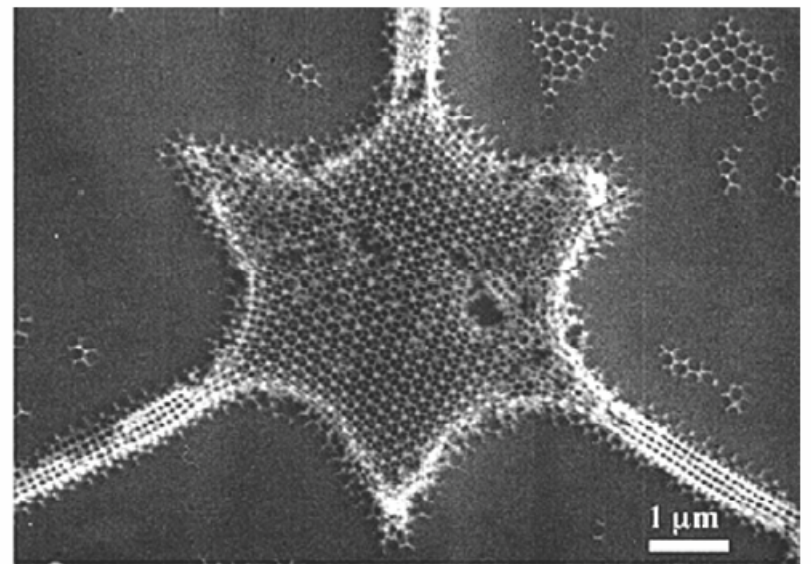
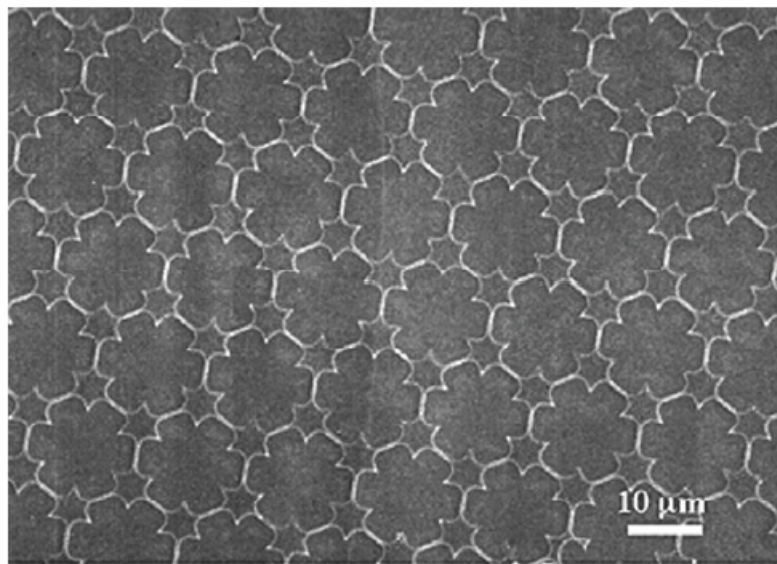


# Ultra-small pitch wire arrays made by superlattice templating





# Hierarchically ordered oxide through a combination of microchannel, microsphere, and block-copolymer templating



**Microstructure of siliceous diatom, *Cymbella Mexicana*, observed by microscopy**

