

PROTEIN SYNTHESIS AND “FINE TUNING”

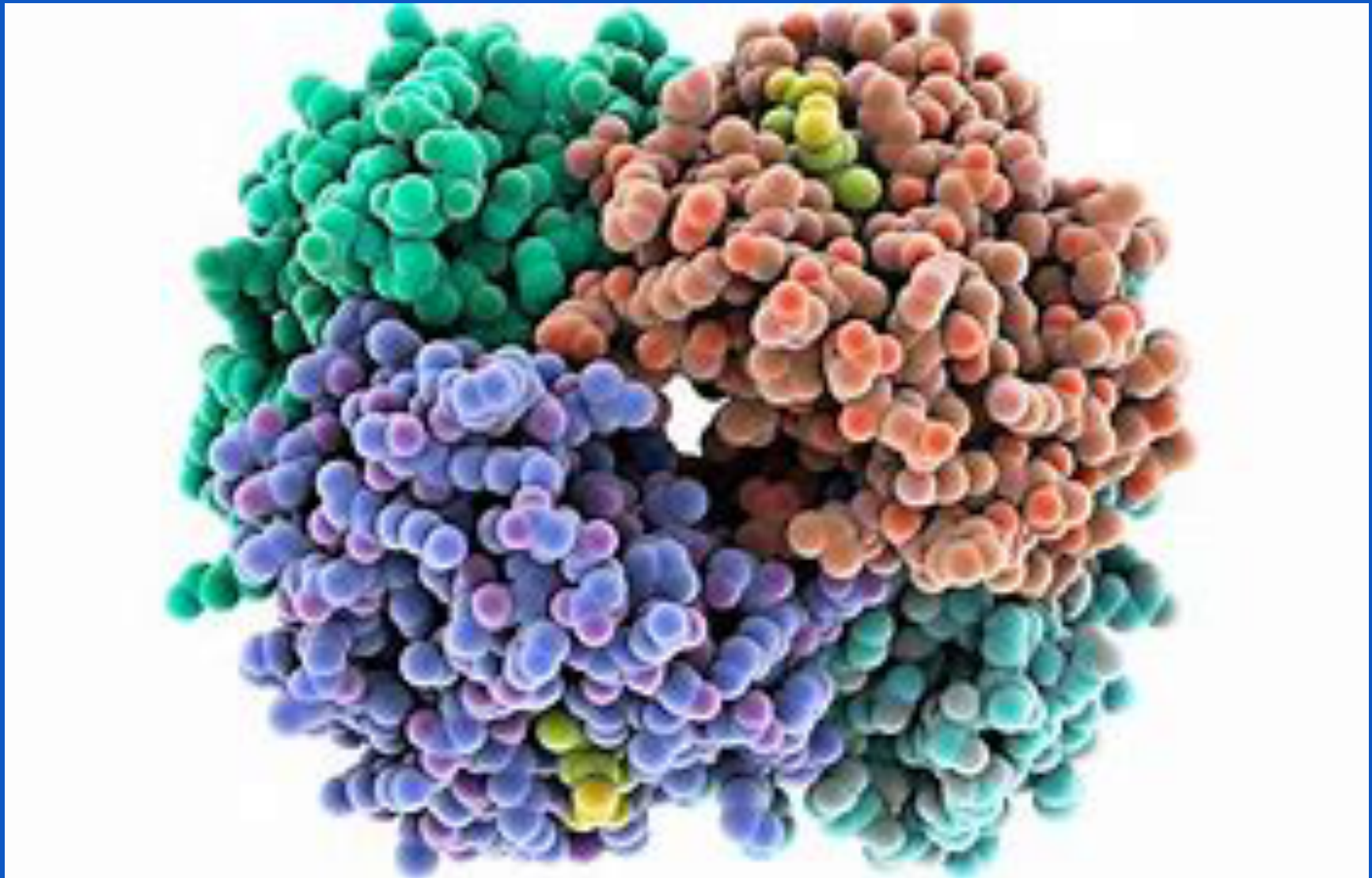
Paradigms for the discrete degrees
of Divine influx

**Swedenborg
Scientific
Association**



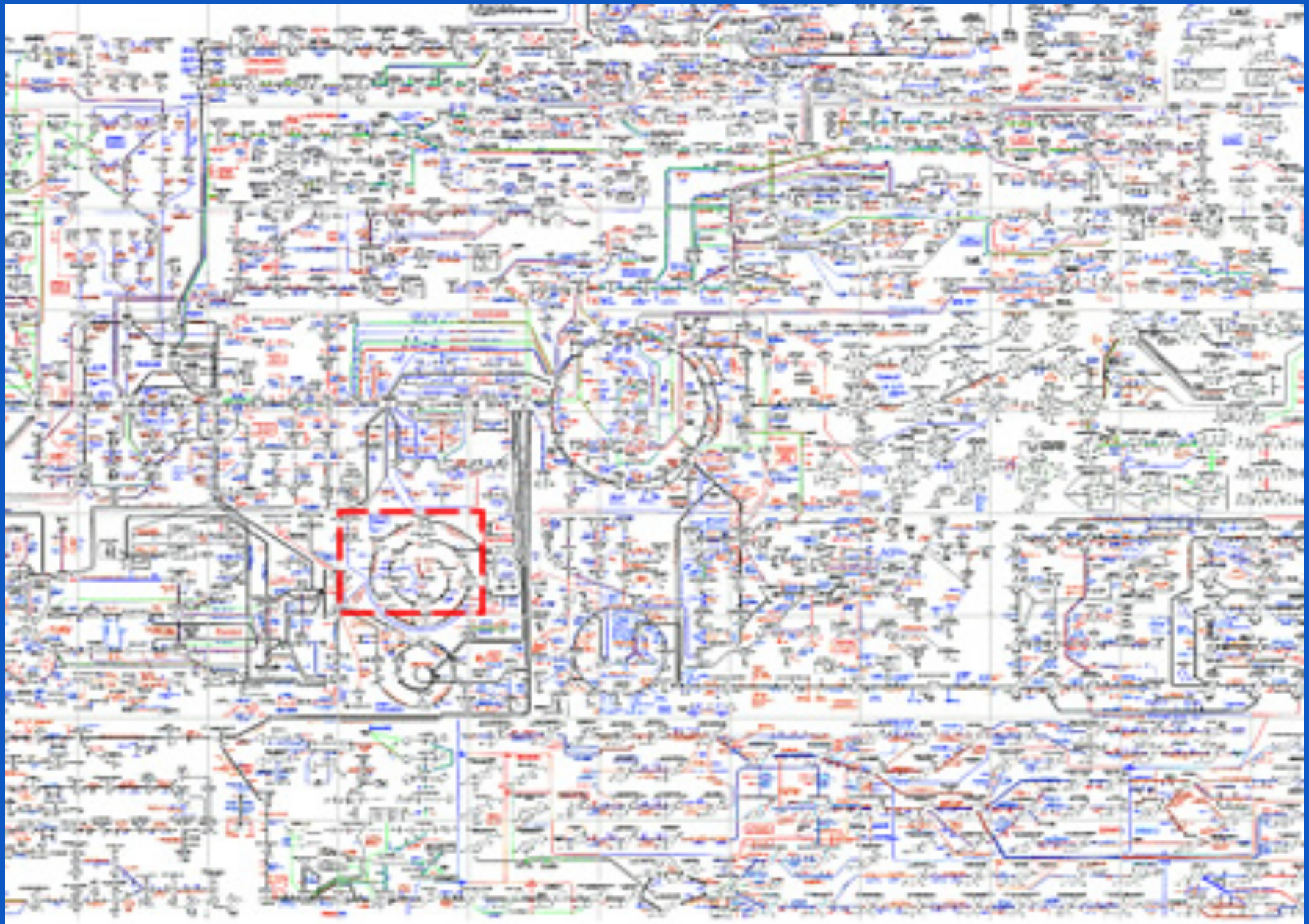
Stephen H. Smith, MD

“Proteins are subtle and delicate things...”



Functions of Proteins

- Enzymes
- Signaling
- Structural
- Transport
- Regulatory
- Storage
- Immunity



Why look at Protein Folding?

- Forces at work operate at the atomic level
- Apparent causes (forces) in nature correspond to **spiritual** qualities
- Influx “fine tunes” by effects on the electric charge


“Understanding the spiritual cascade of discrete degrees behind the physical degree of life may be a *framework* that is useful to better understand what is still unknown about protein structure, function and synthesis

Ian Thompson, PhD

Three Approaches to the Study of Protein Synthesis

- *In Vivo* (within a living cell)
- *In Vitro* (in a test tube)
- *In Silico* (computational)

Beginning of Modern Protein Science

- 19th century brewing and baking
- Pasteur's discoveries
- Pasteur vs Liebig  Traube

“Anfinsen’s Dogma”

The **sequence of amino acids** in the primary polypeptide chain determines the final folded tertiary form and, therefore, its function.

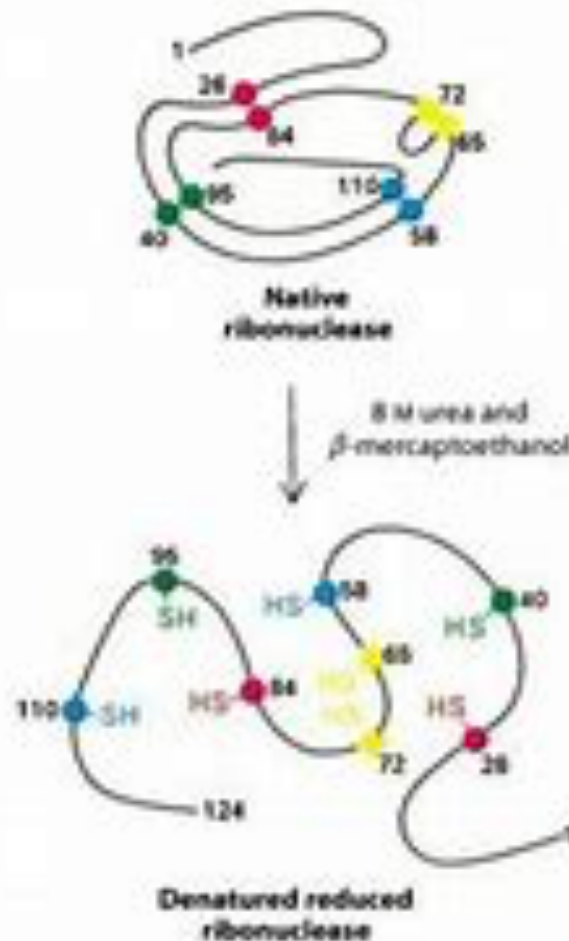
What Determines the Amino Acid Sequence?

DNA → mRNA

Ribosome ←

tRNA

Anfinsen Experiment

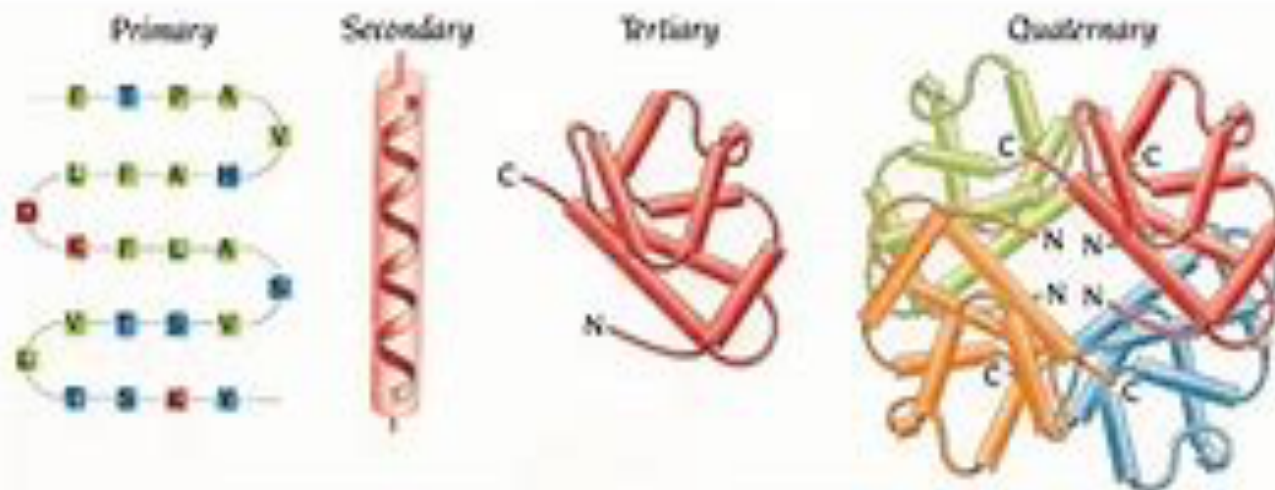


- Denaturation of ribonuclease A (4 disulfide bonds) with 8 M Urea containing β -mercaptoethanol to random coil, no activity

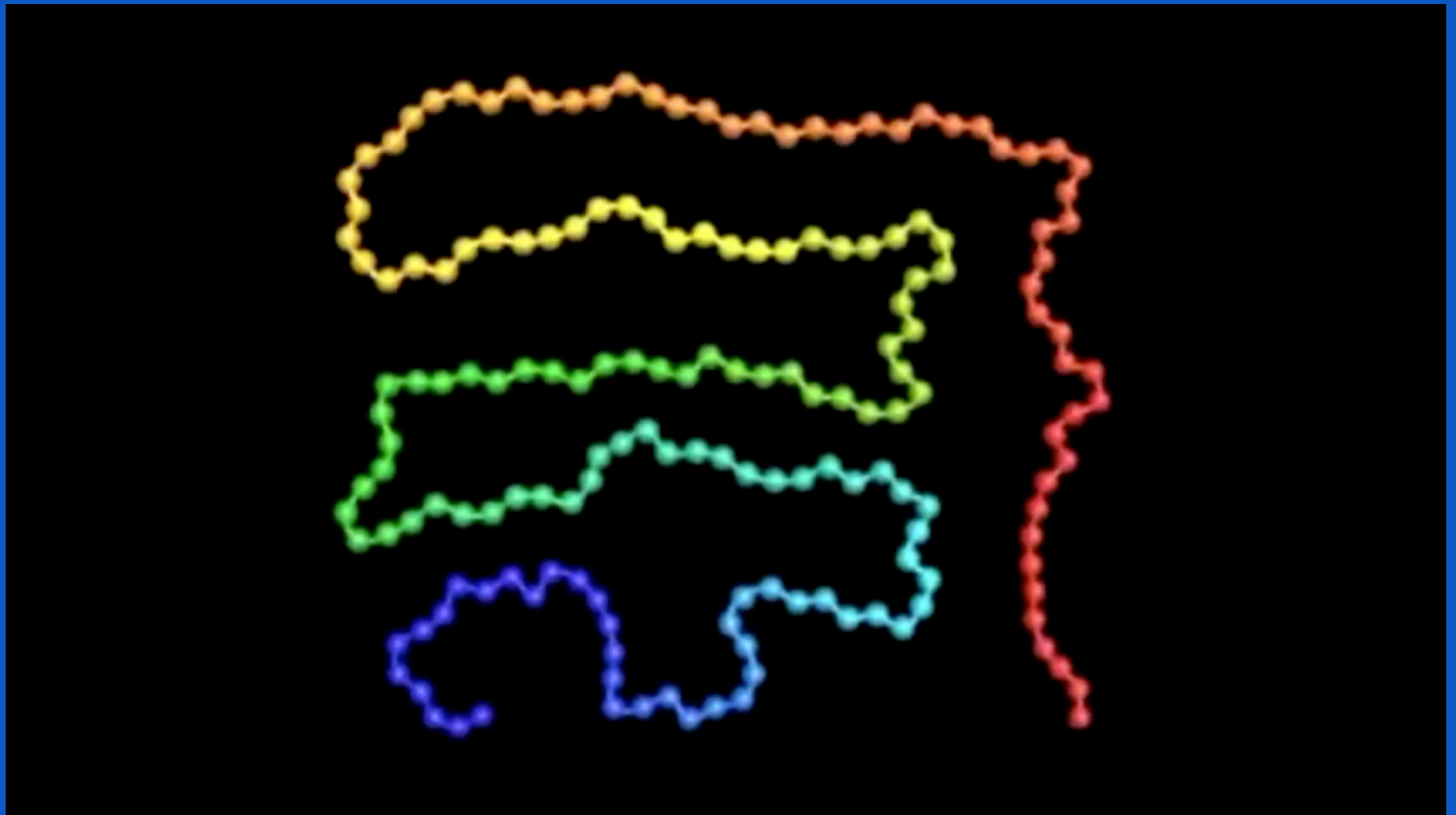
Stages In The Formation Of Proteins

1. Primary = polypeptide chain
2. Secondary = alpha helix and beta sheets
3. Tertiary = “native”, active, fully folded form
4. Quaternary = combination of two or more discrete polypeptide chains

4 Hierarchies of protein structure

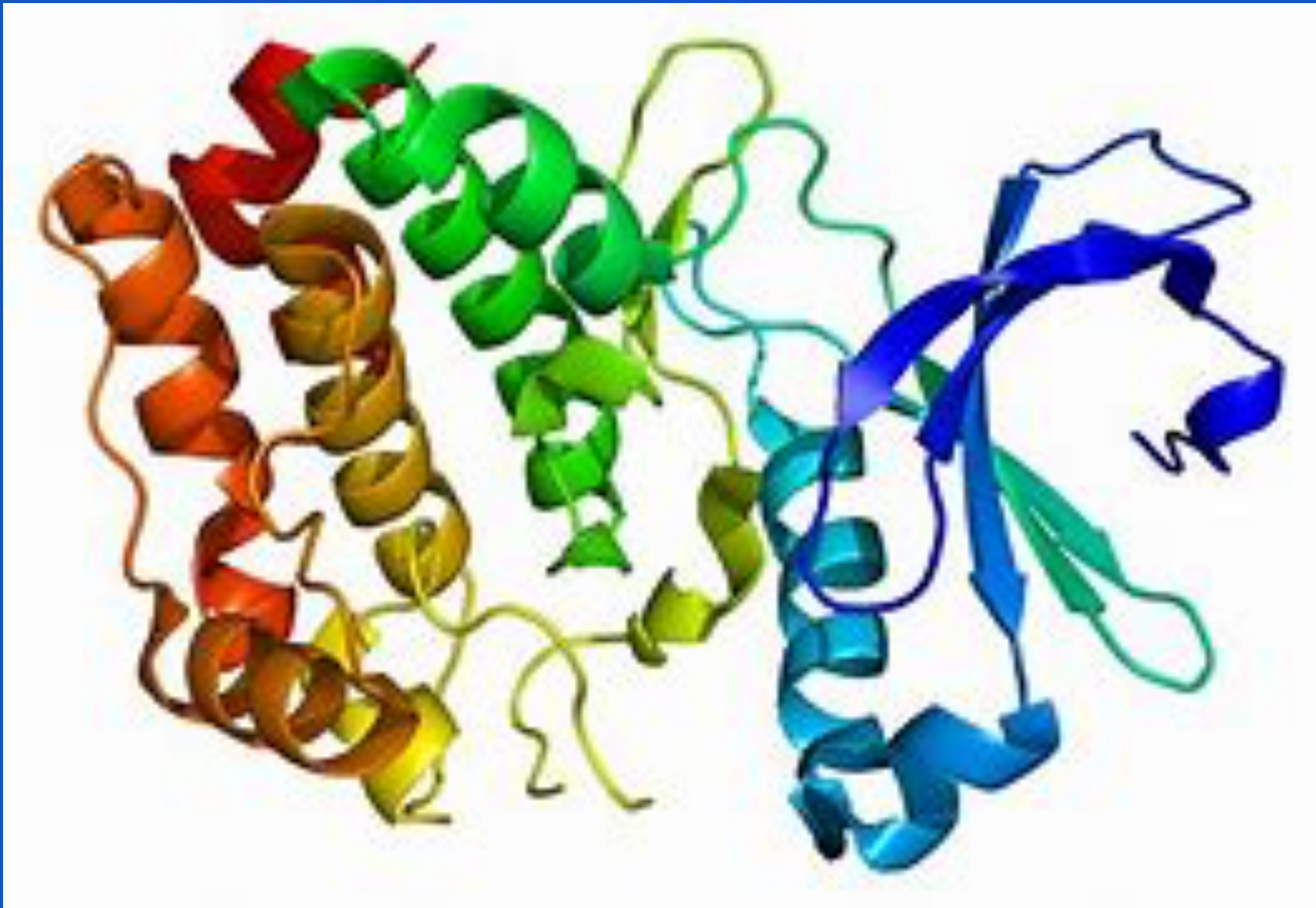


- Anfinsen: sequence determines structure





Discrete Degrees

The **end** (goal) is contained
within the cause → **the cause**
and the end are contained in the
effect.



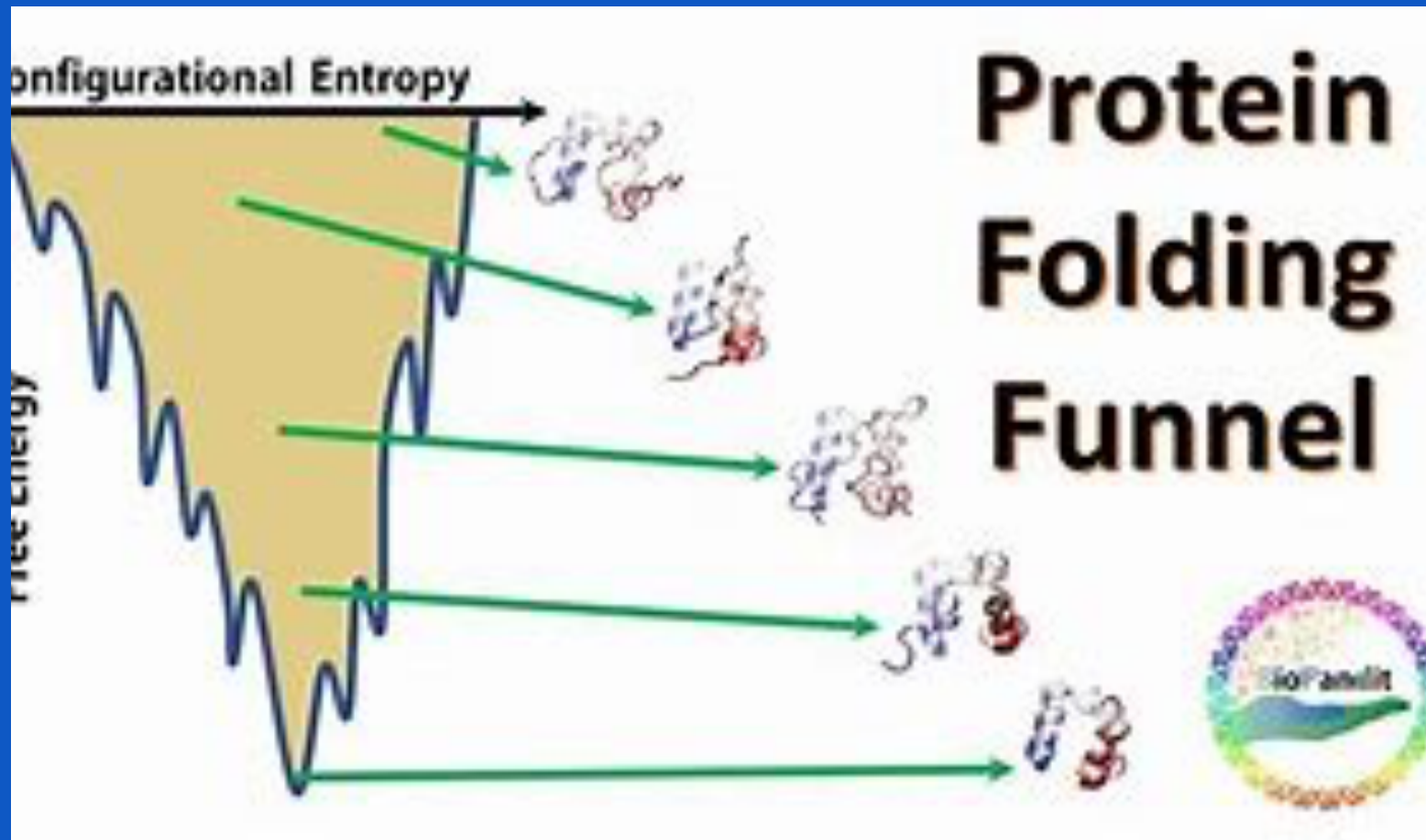
“Levinthal’s Paradox”

- With only 100 amino acids 
- Trial fold once every ten trillionth of a second 
- 10^{81} years to fold successfully
- Yet protein folding takes only a second!

Many Attempts to Solve Levinthal's Paradox

- “Bias” in the pathways? Yet from whence cometh the “bias”?
- “Funnel” energy landscape???

Landscape “Funnel”



The Protein Folding Problem

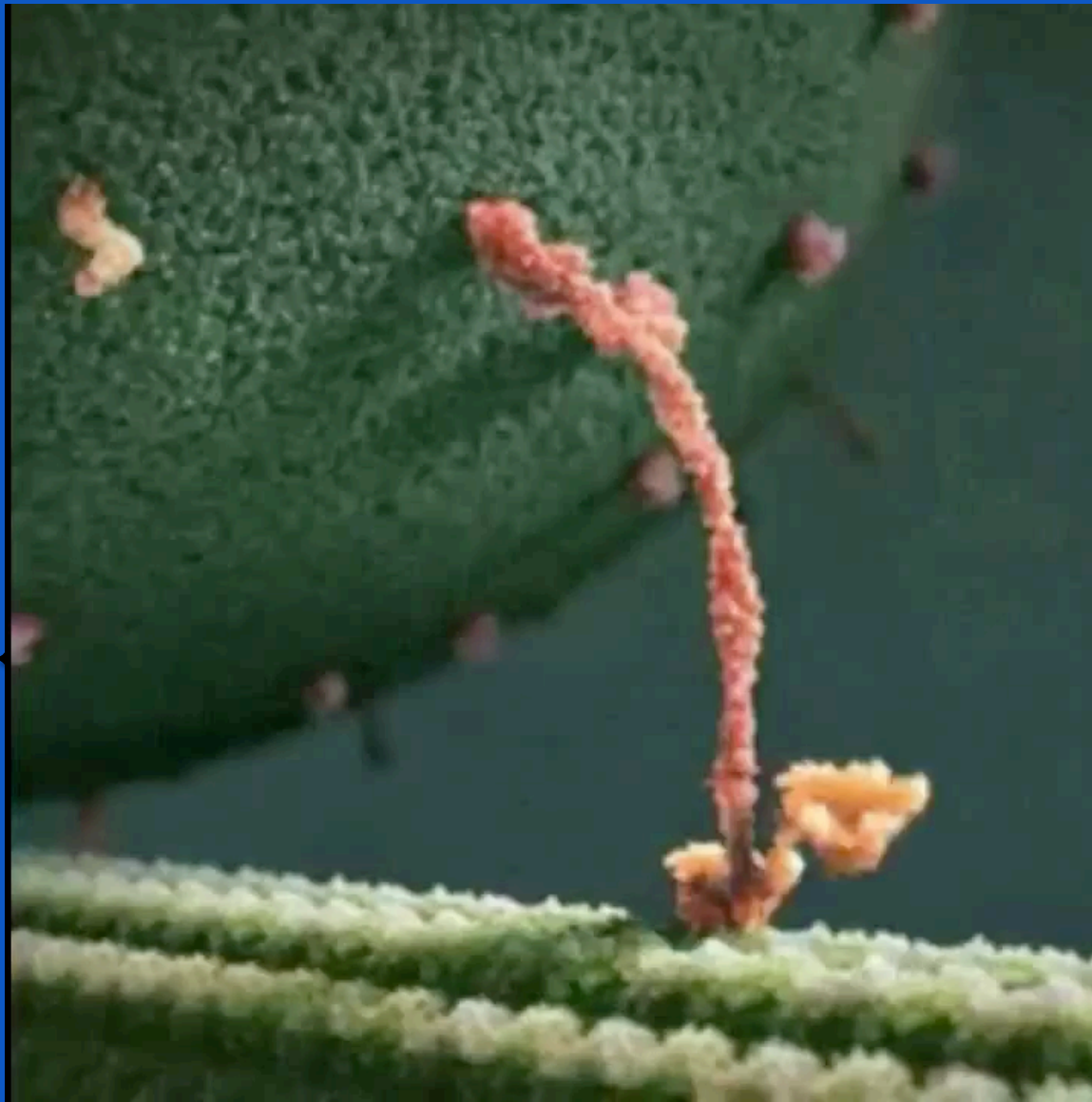
- A new distinct branch of science: utilizing chemistry, biology, and physics (both classical and quantum physics).
- And now, for the first time **theology!**

Key Theological Principle:

Causes are **spiritual**, they
only *appear* to be from
nature!

Key Theological Principle:

All forms tend toward the
human (form).



Competing Theories of Protein Folding

- Thermodynamics: Gibb's Free Energy
- Place different emphasis on hydrophobic-hydrophilic models
- Research is largely computational and increasingly statistical

Protein Folding - from a Theistic Science Perspective

Forces and interactions that fold
and stabilize proteins **and their
possible correspondences!**

Protein Folding - from a Theistic Science Perspective

Electric charges implicit in
the forces and interactions
of folding can be **fine tuned**
by immediate Divine influx

Forces and Correspondences!

Which forces are
dominant must be
related to **use!**

Hierarchy of Forces

- van der Waals forces
- Hydrogen bonds
- Ionic bonds (salt bridges)
- Covalent bonds
- Peptide bonds
- Hydrophobic interactions

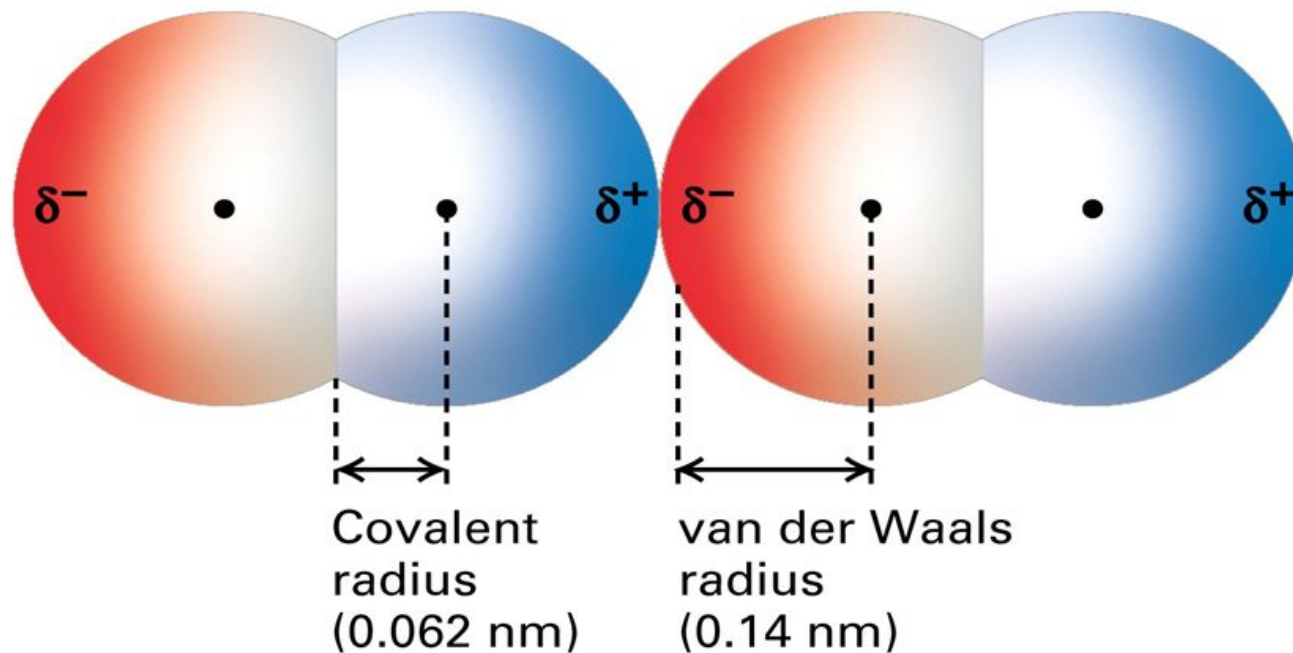
van der Waals interactions

- Atoms moving in close proximity generate a brief, weak attraction
- Almost all the atoms in the interior of the molecule are involved

van der Waals interactions

van der waals interaction

- caused by transient dipoles, the momentary random fluctuation in the distribution of the electrons of any atoms
- $1/r^6$ dependence



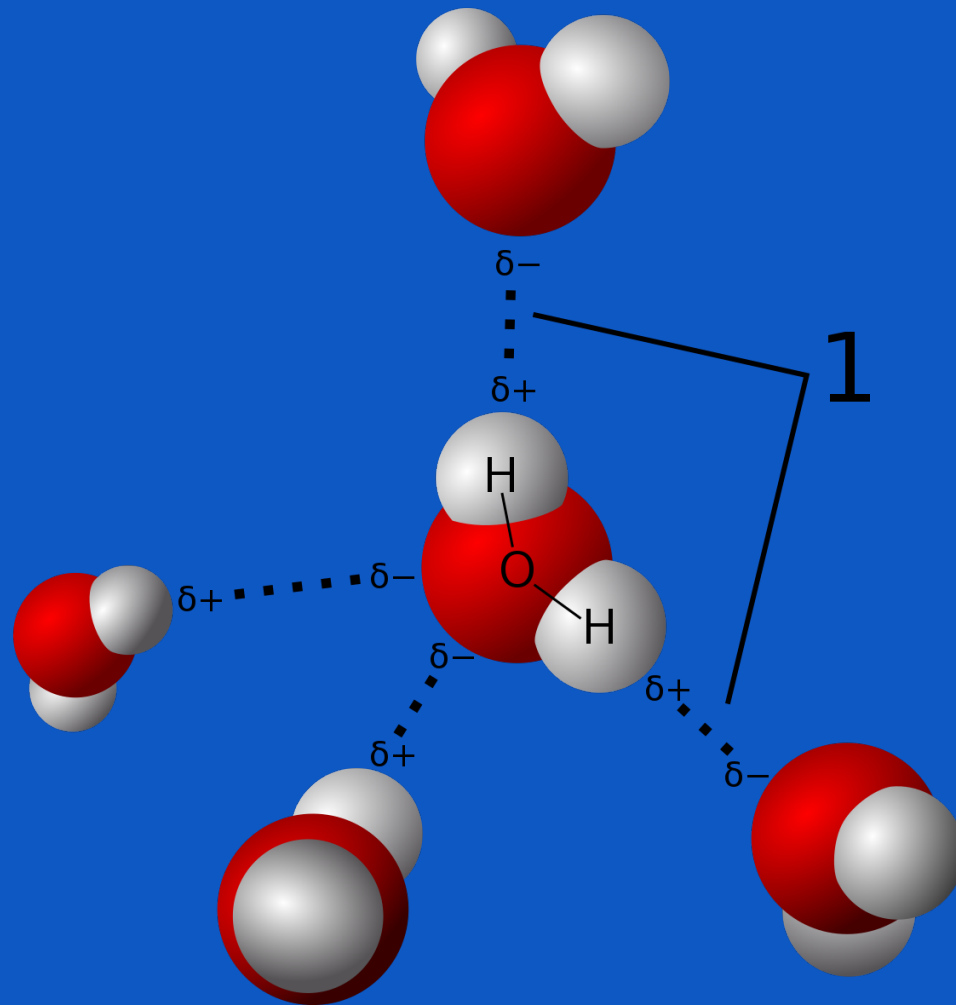
van der Waals interactions

- Correspond to “bare facts”?
- Level of “effects” only?
- Corresponds to the sensual/corporeal?

Hydrogen Bonds

- Very common in proteins
- 12 of the 20 amino acids form hydrogen bonds
- Asymmetric electron density between closely aligned atoms


Hydrogen Bonds



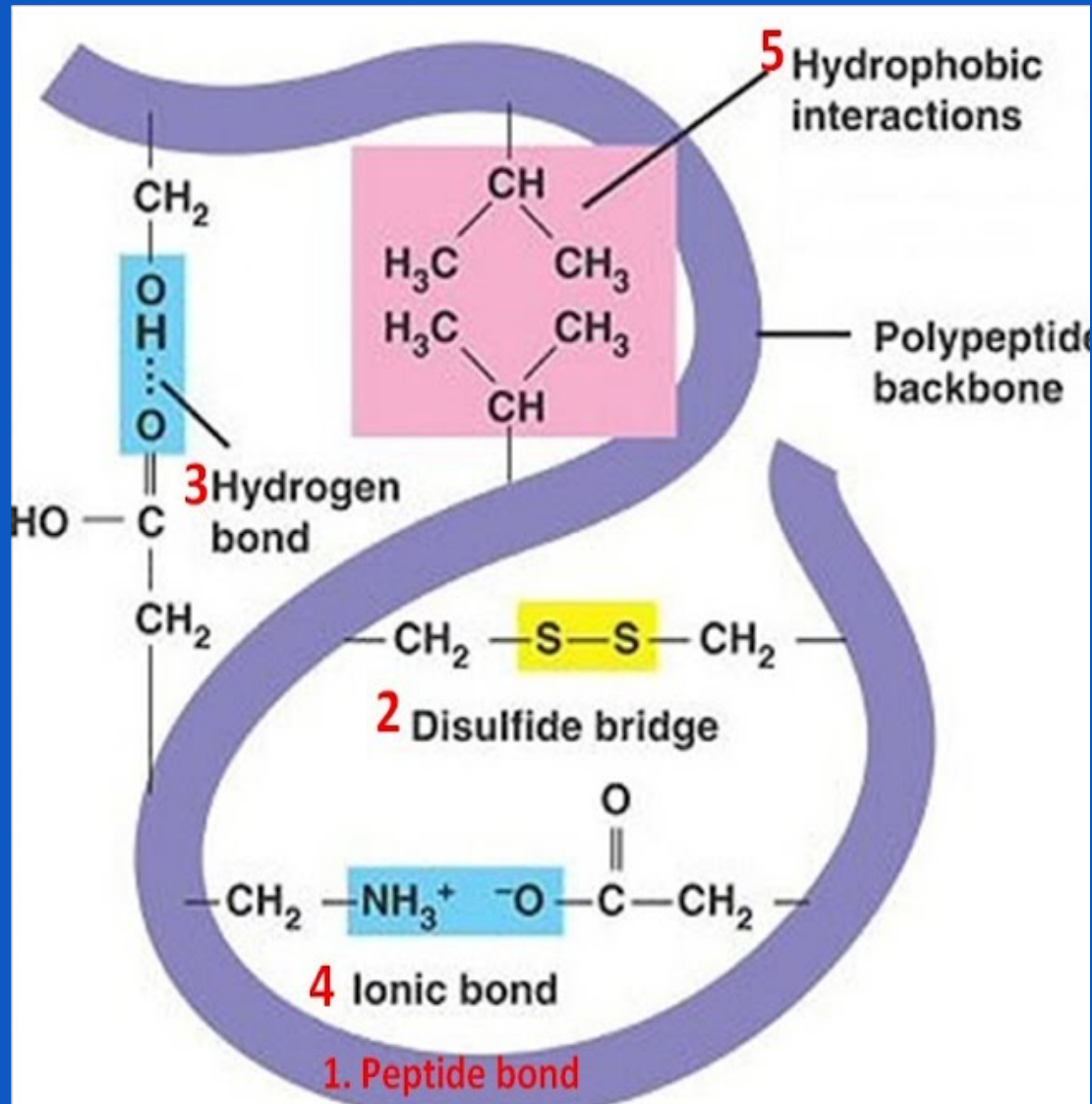
Hydrogen Bonds

- Corresponds to natural knowledge common to our lives → “scientifics”?
- Level of “apparent causes and effects”

Salt Bridges (Ionic bonds)

- Ion pairing (salt bridging)  oppositely charged amino acid side-chains are in close spatial proximity

Ionic Bonds



Strength of an Ionic Bond:

$$F = q_1 q_2 / d^2 \epsilon^*$$

- * ϵ “dielectric constant” of the solvent
(larger epsilon = smaller attraction!)

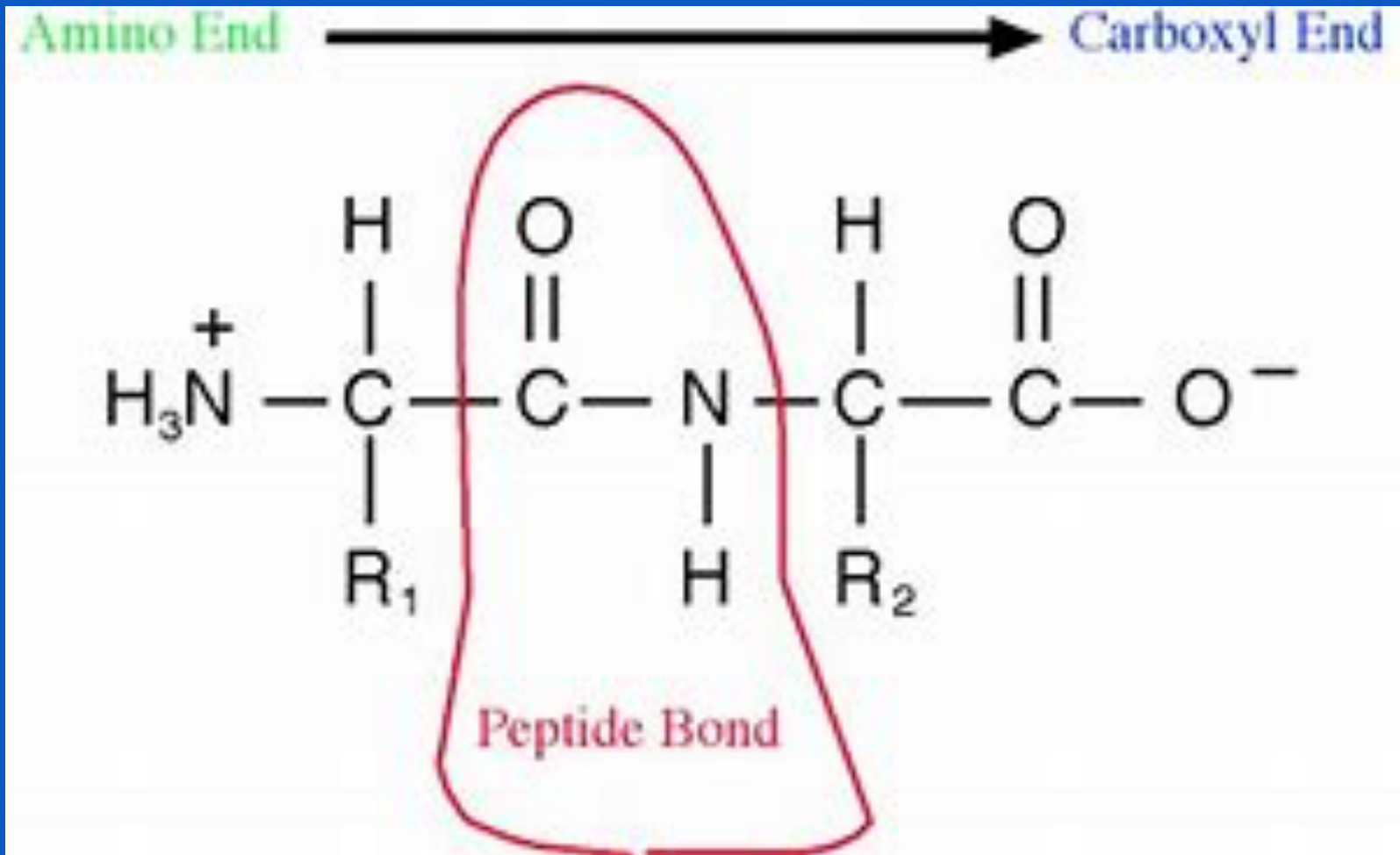
Salt Bridges (Ionic bonds)

- Salt corresponds, in a good sense, to affection for truth
- A salt bridge might therefore correspond to a relationship based on **affection for truth**.
- Now at the level of “**cognitions**”?

Peptide Bonds

Form the backbone of protein structure

Peptide Bonds



Peptide Bonds

- A tight bond that resists rotation
- Corresponds to the **rational**; links the natural mind to the spiritual mind in search of truth?

Covalent Bonds

- Share electron pairs between atoms

Covalent Bonds

- Correspondence: a **marriage**: the bond of good and truth?

Hydrophobic Interactions

Hydrophobic amino acid residues are found mainly in the core of the functional (native state) protein!

Hydrophobic Interactions

- Hydrophobic lipid (hydrocarbons) corresponds to **love (the will)!**
- Like the hydrophobic amino acids in the folded state, **love is interior!**
- Hydrophobic **interactions with water** are primary drivers in folding!

Hydrophobic Amino Acids and Water

- Quantum physics of water key to understanding the folding mechanism!
- The dielectric constant “ ϵ ” of the solvent and the interior environment = an opportunity for “fine tuning”!

New Horizons!

- Long range interactions
- Solitons
- The cell as an “electrome”

“Everything in the universe that is in harmony with God’s plan relates to goodness and truth.”

New Jerusalem and its Heavenly Doctrine 11

Arcana Coelestia 3629

“Also, they do not know what correspondence is and what influx is, and that when the spiritual flows into the organic forms belonging to the body, it establishes the living workings such as occur there. **Nor do they know that without such influx and correspondence not even the smallest parts of the body can have life or be set in motion.**”

Chaperone Proteins

AKA “heat shock” or “stress”
proteins

Chaperone Proteins

Correspondence to **celestial angels**, spiritual angels and good spirits?

“Behold I Make All Things New”

An additional role of
chaperone protein
molecules!



Chaperone Proteins

- May preserve a totally new protein for some future use!
- How does it recognize it as potentially useful?

Arcana Coelestia 5131

“... To enable the cause to exist the end must act on the level where the cause belongs, calling on **assistant** means to help it –the end- to bring the cause into existence, and to enable the effect to exist the cause likewise must act on the level where the effect belongs, by calling on **assistant...**”

Arcana Coelestia 4523

“...Thus the whole body is an organ composed of the deepest arcana belonging to everything which exists within the natural world, and its formation is determined by **hidden forces** by which all things act and the wonderful manner in which they flow.”

Fine Tuning

End → Cause → Effect



Transient, small fluctuations in
constants of nature

Fine Tuning

“The existence of life as we know it depends delicately on many seemingly fortuitous features of the laws of physics and the structure of the universe.”

Paul Davies,
The Mind Of God

Fine Tuning

“There are three types of change to consider. Tiny infinitesimal changes are possible. If we change the value of **the fine structure constant** only in the 20th decimal place there will be no bad consequences for life...if we change it by a very small amount, say the 2nd decimal place, then the changes become more significant.

Continued on next slide

Fine Tuning

Continued from last slide

Properties of atoms are altered and complicated processes like protein folding or DNA replication may be adversely affected.”

John Barrow
The Constants of Nature

Fine Structure Constant

$$\alpha = \frac{1}{4\pi\epsilon_0} \frac{e^2}{\hbar c} = \frac{\mu_0 e^2 c}{4\pi \hbar} = \frac{k_e e^2}{\hbar c} = \frac{c\mu_0}{2R_K} = \frac{e^2 Z_0}{4\pi \hbar}$$

where:

- e is the elementary charge ($:= 1.602\,176\,634 \times 10^{-19}$ C);
- π is the mathematical constant pi;
- $\hbar = \frac{h}{2\pi}$ is the reduced Planck constant ($:= \frac{6.626\,070\,15 \times 10^{-34} \text{ J}\cdot\text{s}}{2\pi}$);
- c is the speed of light in vacuum ($:= 299\,792\,458$ m/s);
- ϵ_0 is the electric constant or permittivity of free space;
- μ_0 is the magnetic constant or permeability of free space;
- k_e is the Coulomb constant;

Arcana Coelestia 4524

“And because there must be a continuous connection with the spiritual world in order that every single thing may be kept in being, or constantly come into being, it follows that the purer or more interior things within the natural order, and consequently within the human being, spring from that world, and the purer or more interior things are forms such as are able to receive influx...”