

## CHEMICAL CONCENTRATIONS

ARE NOT CAPABLE OF DIFFERING WITH DIRECTION

They are **SCALAR VARIABLES**.

Likewise **OSMOTIC PRESSURE**

**GAS PRESSURE, HYDROSTATIC PRESSURE, pressure of cartilage**  
AND TRY TO THINK OF OTHERS.

Mechanical tension is a second order, symmetrical tensor.

Tension is able of varying with direction (in proportion to cosine squared)

Fourth order tensors vary as the fourth power of cosine angle

Do you suppose that the reason vertebrate nervous systems start as hollow tubes is so that they can enlarge by pumping water into the space inside it?

**Why does the brain bulge outward more** in some parts than others, and in some directions more than others?

Because there is **more growth,**  
**more mitosis,**  
**more** water pressure  
**less** resistance to stretching?

Resistance to forces varies as the fourth (square of square) of the cosine of the angle of direction.

It can have 4 different directions in which resistance to stress is a maximum around 360 degrees of arc.

I don't know whether electrical conductivity can vary with direction.

It seems intuitively that it can't. But diffusion of water through soil is a second order tensor,

and so is resistance of flow of oil through rock. (Oil companies study such questions very carefully.)

My only example of a third order tensor is susceptibility to generation to creation of piezoelectric voltage

(and I am not sure, and don't know how to find out, either)

Magnetic fields are anti-symmetric, second order tensors, which behave much like vectors.

Curvatures of surfaces are another example of a second order symmetrical tensor.

Some researchers were trying to measure the forces that pinch cells in two in mitosis. They used suction micropipettes touching the cell's plasma membrane, and measured how much suction force was needed to pull a bulge out of cell surfaces, comparing this force at different locations (at cleavage furrows versus other locations, and during cleavage versus other times).

Their results were inconsistent. What could have gone wrong?

Suction pipettes measure and compare amounts of tension in cell surfaces as if tension were a scalar; But really tension is a second order tensor, not a zero order tension. Furthermore, cleavage depends on having a large difference in directional components of tension at the same locations.

More tension in this direction as compared with tension in the perpendicular direction, at the same places.

More tension in this direction versus that direction, instead of, or in addition to, more tension as these locations as compared with those locations.

Incidentally, mosaic development and cell lineages are controlled by spatial and positional changes in contractile tensions of cleavage stages of nematode and sea squirt early embryos. More measures of these variables are needed. If researchers treat all variables as if they were scalars, mosaic cleavage patterns will remain forever incomprehensible.

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**Shape Homeostasis:** A set of my own ideas, with very few followers.

People are not so much opposed, as that they regard it as premature

**Shape Homeostasis** (*originally called "Geometrical Homeostasis"*)

Includes *creation and maintenance of proportional sizes*;

Variables *like length to width ratios*)

Proposed for the sake of argument.

**Regulative development**, instead of **mosaic development**

mosaic = not regulative *nematode worms, sea squirts*

consistent cell lineages

**The causal difference(s) between mosaic vs regulative is unsolved.**

**Tensegrity - Geodesic Domes**, and related phenomena

Concepts borrowed from Kenneth **Snelson** & Buckminster **Fuller**

(Maintenance of geometry, but not creation of shapes)

Biotensegrity has many enthusiastic smart advocates.

(Why are geodesic domes so strong and efficient?)

(But why do geodesic domes tend to leak rain?)

Need for testable **predictions** **paradoxes**

surprising counter-intuitive observations

Unexpected, but often somehow "Wanted",

satisfy some need, clarify some inter-relation