Biology

Part I

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Part I

Mostly humnn biology

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Embryology

First embryological development of an early chordate:
Some features regarded with aspects from the **dimension model**.

Elementary definitions in geometric and physical terms in the model with complementary poles in different dimension degrees (d-degrees):

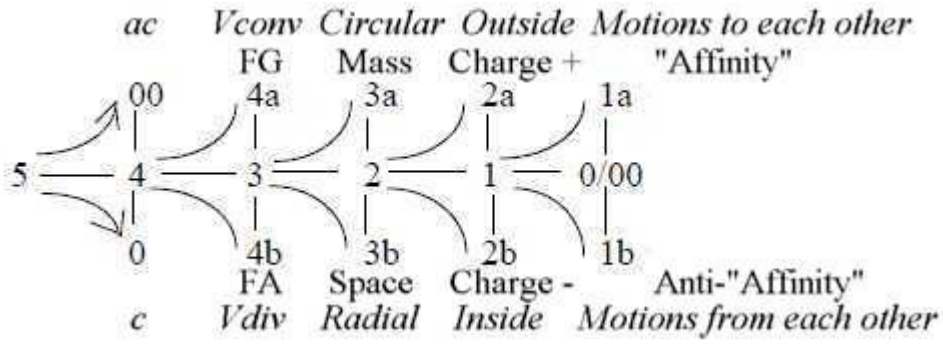


Fig Em-1

Whole 5 - Directions 4 - Volumes 3- Surfaces 2 - Lines 1 - Motions 0/00

Polarizing forces from 00-pole ~ from outside. Binding, integrating forces from the 0-pole, ~ from inside.

If the dimensional model can be applied, one has of course to count on a multiple of processing steps at different levels of underlying and superposed dimension chains more or less simultaneously.

1. Forms in the first stages of development in an embryo of a lancelet:

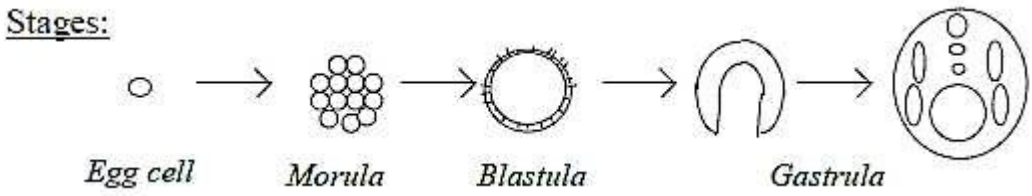


Fig Em-2-11

- First embryo cell undergoes division into a filled ball - a "morula".
During continued cell-growth the filled ball get transformed to a spherical shell of cells, a "blastula". Its inside room gets filled with blastocoel liquid.
- A coordinate axis appears defined on the blastula in patterns of growth between animal pole (A) and vegetative pole (V).
- The following processes - the "gastrulation" - involves immigration of cell material at the V-pole into the cavity of the blastula forming a 2-layer bladder and further inner differentiations into tubes etceteras.

The process can be interpreted in terms of steps in the dimension model:

2. Aspects on Morula →> Blastula:

The first step from morula to blastula is rather remarkable and it may really be asked what guides this transformation. It's mentioned in another context that outer cells of morula grows faster than the inner ones and it's is possibly one factor* but cannot explain why all cells of morula get "center-displaced" to a circumference.

*Cf. in the dimension model **velocity** as corresponding to d-degree step 1 →> 0/00, represented in each d-degree step in the dimension chain outwards.

- It's an expression of Vdiv, of pole 4b in our model, divergence, a step center to anticenter, (c →> ac).

- In **geometrical** terms it's a step 3 →> 2 in d-degrees, from a volume, a 3-dimensional ball, the morula, to a 2-dimensional sphere, a surface, the one-layer blastula. (Each higher d-degree in relation to the lower one is a relation of the type c-ac, ~ 0 to 00: there is an infinity of surfaces in a volume etc.)

- In **physical** terms it's simultaneously a polarization of d-degree 3 into **Mass - Space**, as presumed in the dimension model, however inverted in relation to macrocosm: outer mass, inner space.

(Cf. about **the cell** as an inverted atom. In atoms mass is concentrated to the center, space outside in the shell. Compare too the inversion of charge over a cell membrane in relation to an atom; negative charge inside, positive outside.)

- The polarity mass - space gets here the form of a step in **phases** between cellular (as "solid") phase (3) and the extracellular blastocoel liquid (2): note secreted inwards from anticenter.

- A third aspect on these first stages of embryo development is the relation between the properties **Mass** and **Charge**, presumed in the model to be related as d-degree 3 to 2 (although level of analysis is regarded as optional). Cf. **gravitation**, F_G, connected with mass, assumed developed in step 4 - 3, and **the electromagnetic force**, F_{EM}, in step 3 - 2.

One application of this aspect is the mass of cells of the blastula sphere and the "ion balance" of the blastocoel liquid, appearing in experiments about exogastrulation, see below. (Cf. also gravity strongest at the surface of a body !).

Another application concerns the poles A - V that develops or appear on the surface of the blastula.

3. Blastula to a 2-layer bladder and A-V-axis:

- In the dimension model the poles out of polarization of d-degree 3 have in elementary geometrical terms been presumed as circular (3a, with origin in the 00-pole and radial (3b, with origin in the 0-pole). These geometries show up in the growth of cell material: circular "downwards" from the A-pole towards the V-pole, radially "upwards" but inwards inner space from the V-pole.

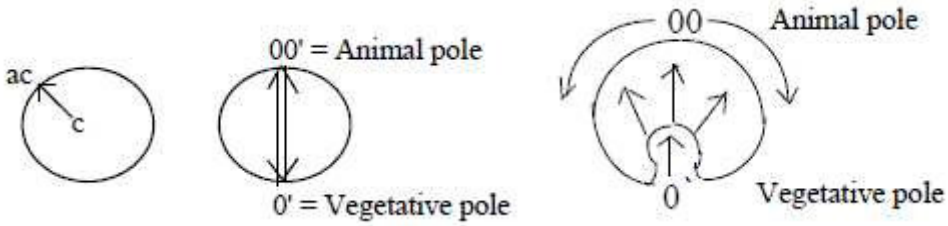


Fig Em-3-12-1, Em-4-13-1

It confirms the identification of the two complementary poles, and concerns the blastula as a 3-dimensional volume polarized into mass - space in terms of physical quantities.

Space in macrocosm is interpreted as expanding, an expression for the outward acceleration force (pole 4b, F_A) as opposite mass connected with gravitation, and inward acceleration (pole 4a, F_G). (With references here to files about **forces.**)

The pattern of growth reminds also of the M-field around Earth, divergent outwards at the North-pole, convergent inwards at the South-pole. (N-S-poles known through experiments to be asymmetric, hence the directions here.)

- The vegetative - animal poles V-A reflect also the physical properties Mass versus Charge from d-degrees 3 and 2:

Cell material at the animal pole gives a) the nervous system, operating mainly with electromagnetic signals, b) the outer surface (d-degree 2) of the embryo, the ectoderm.

Cell material at the vegetative pole gives invaginated a) archenteron and b) much of the other intestines, hence the nutrition system that operates with chemicals, in this sense mass.

The two poles represent the two main systems of the body and its dependence of the environment, its **role as "a half"**, with inflows from the surroundings.

- Geometrically the step to a 2-layer bladder illustrates further the polarization of d-degree 2 into **outside / inside** (convex/concave), the complementary poles of d-degree 2 in the dimension model: 2a: ectoderm, 2b: endoderm.

It's said also that long projections of threads develop from the inside layer of the bladder and draw this inner layer towards inside of the outer layer. Hence, there is also a structural development of d-degree 1 in this process in agreement with the model..

- The remarkable invagination of cell material at V-pole as a main feature of **life** implies a **negative or rather antipositive curvature** inwards, simply expressed as surfaces growing faster than the square of radii. (A necessity if we imagine that there has to be room for a 5-dimensional unit within a 3-dimensional space!)

In macrocosm there is possibly a negative or rather antipositive curvature of Space, as expression for the outward acceleration force F_A, and the positive curvature of mass as expression for gravitation F_G inwards. It should in the dimension model appear as a polarization of Euclidean geometry in **d-degree step 4 →> 3**,

In the multicellular animal the same antipositive "curvature" gets inward directed, yet as in Space of macrocosm expanding from V-pole *radially* into space, while enclosed through positive curvature of the A-pole.

(In a certain sense it becomes an inversion of macrocosm also with regard to what has the curvature: V-pole as representing mass reveals the negative curvature, leading to multilayer formations in inner space. While the A-pole, as defining the enclosed space, gets the positive curvature.)

- In the loop version of the dimension model where debranched degrees from higher steps outwards meet "the other way around", the step 4→>3 of polarization into positive / antipositive curvature leads to the step 2←1, the polarity inside - outside, forming the 2-layer bladder.

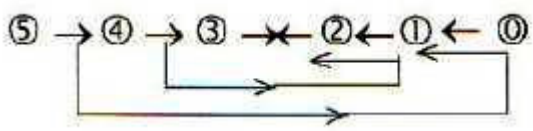


Fig Em-5

- Simultaneously the processes implies that primary force of divergence, pole 4b from 0-pole outwards from morula to blastula, in these next steps is replaced by the

complementary force of convergence, pole 4a from 00-pole in agreement with directions in the figure above.

- One general aspect on further steps of gastrulation is that material at the V-pole as originating from center-pole 0 takes back its position as center within the material from A-pole, which represents the anticenter from 00-pole.

What happens with the blastocoel liquid in the two-layer bladder? It could be presumed that this early liquid contains extra potent - 'highdimensional' - substances . Formally at least it seems to land up between outer and inner layer of the skin, between ectoderm and endoderm. The very rich differentiation of sensory receptor cells that later develops in the skin could perhaps partially depend on the blastocoel liquid being an early opposite pole to cell tissue in the blastula?

The character of V- and A-poles as originating from 0- and 00- poles and how these are interpreted in the dimension model becomes affirmed through the experiment called exogastrulation.

4. Exogastrulation:

The experiment implied that the ion milieu was changed in the blastula, which had the effect that cell material at the vegetative pole didn't invaginate but nearly separated from that of the animal pole (= exogastrulation). It turned out that the isolated cell material from V-pole went through several normal differentiations anyhow, while the cell material from the A-pole remained a formless hollow mass.

Interpreted in terms of the dimension model a center-pole implies outward and hence differentiating directions, and it has always some kind of anticenter, an outside, a surrounding with a certain polarizing effect, even if not the appropriate one. It represents also the integrating force. While a separated anticenter, the 00-pole, represent the polarizing force and without a center, something to work upon, remains a hollow mess.

Biologists draw the natural conclusion that the cell material from vegetative pole is the governing power in embryo development - possibly depending on a richer or less specialized cytoplasm in these cells (here we could say a more highdimensional cytoplasm). Notice that this is an old interpretation from 1970th. There are surely more knowledge now of how these facts are expressed biochemically.

5. The neural tube:

The V-pole as the guiding one is further stressed by the condition for the forming of a neural tube. Not until the invaginated inner material of the V-pole - the archenteron - has reached up to the A-pole inside the 2-layer bladder, the central area of cells at A-pole invaginates to a neural tube. Biologists talk about induction. It's obviously an expression for a binding force.

In terms of the dimension model the contact between the poles A-V implies a kind of momentary depolarization, hence a lowering to a deeper, higher d-degree in which the direction from the A-pole becomes "vertical" and inwards as in d-degree 4, while it in first stages was circular as in d-degree 3.

This close dependence between A-V-poles, shown at the very creation of the neural tube, is reasonably one condition behind the fact that nerve cells through their long axons can find their special inner organs in the body during the later development.

- In following steps of gastrulation, se below, the growth of material at A-pole becomes again circular but now along the inside of the surface, and the growth from V-pole becomes "radial", expressed in evaginations from archenteron: laterally to coeloms and upwards to cells for a notochord. Thus in accordance with geometries of d-degree step 3-2.

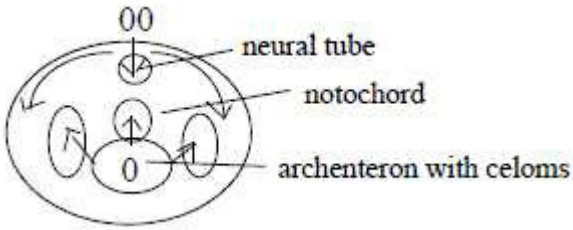


Fig Em-6-14-1b

6. The tip over of the bladder:

The two-layer bladder "tips over", which implies that a second coordinate axis gets defined, the Front - Back one (F - B). By biologists this has been explained as a result of a "displacement of the center of gravity" through a change in the storing of cell material. It sounds as a rather vague explanation and it's natural to ask: Why this rearrangement of cell material, if so?

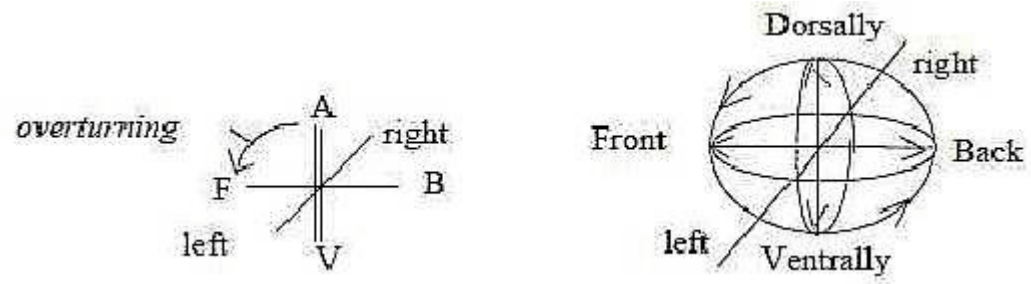


Fig Em-7-16

The tip over is a partial rotation, and in our model rotation is proposed as the 2-dimensional character of external motions in d-degree 3. That's one reason while we here assume that the tip over is an expression for the d-degree step 4 →> 3. The connection with changes of gravitational center and mass - as these concepts are interpreted in the model - agrees with the same view (**gravitation as a force** from pole 4a).

Obviously the development of this new axis Front - Back is not a result of outer gravity and position or related to an external source of nourishment but endogen. The same should be valid for the A-V-axis, the development of which has been assumed by biologist to depend on a richer cytoplasm at the vegetative pole. Thus, reference to concepts as gravity and mass reappear here about the F-B axis.

(Another reason to regard the axes as given from inside, of endogen nature, is that also unicellular flagellates include a central axis in direction of flagella.)

If the A-V-axis could be said to represent d-degree 4 or step 5 →> 4, the new axis Front - Back may be seen as representing d-degree 3 or step 4 →>3. In angle steps as halvings it's a step 180° →> 90°, which has been assumed in this step in the hypothesis about dimension chains as angular polarizations.

With the F-B-axis defined the inner, enclosed volumes turn to the lengthwise, tube-formed growth.

7. Mesoderm - the further development;

- The subsequent process of gastrulation implies the mentioned invagination of animal pole to the neural tube - and evaginations from the ventral pole, i.e. from archenteron: an opposition in agreement with our definitions of inward and outward directions from 00- and 0-poles respectively.

In general terms the differentiation of inner V-pole material implies laterally secondary polarizations mass - space into creation of a true body cavity (enterocoelom) with enclosed tubes.

- The circular - radial polarity of growth from original A-V-poles characterizes also the further process as shortly mentioned above. Material around the A-pole and neural tube invaginates too (inward direction from anticenter) and spreads circular (from pole 4a to pole 3a in the model) along inside of ectoderm - while the evaginations of endoderm from central V-pole have radial and upward direction and becomes tied off parts. The "vertical" one becomes the notochord (and in further historic evolution replaced by vertebrae that comes to enclose the neural tube), and laterally (or in an angle as ¨45°") to coelom, mesodermal material.

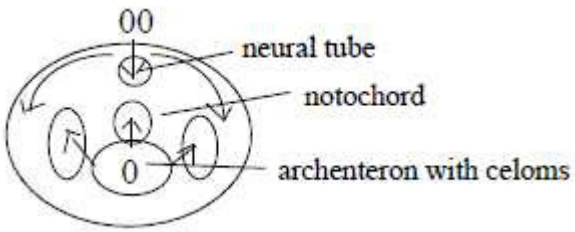


Fig Em-8(6)-14-1b

With the coelom and tube-formed growth along the F-B-axis the 3rd coordinate axis Left-Right (L-R) inevitably gets defined.

- One opposition of the type center - anticenter between V- and A-poles appear in their different contribution to mesoderm: from A-pole material it's in the form of mesenchyme, i.e. individual, immigrating cells; from V-pole material it has the form of cell layers: a difference in d-degrees of structure that shows on the more highdimensional force of integrating V-pole.

- Another step in d-degrees, 3 →> 2, is illustrated by the first development of coelom from archenteron in the form of **lateral plates**: 2-dimensional screens that grow to surround archenteron as a 3-dimensional volume (and also notochord and neural tube as volumes).

- A corresponding step in lower d-degrees, 2→>1, can be identified at the animal pole in the creation of a neural 1-dimensional wall from border of the 2-dimensional neural plate when this invaginates to the neural tube. A fold that also defines the central line between right and left sides. On a tissue level the process can geometrically be described in d-degree steps 2 →> 1 →> 0, with the last step represented by neural wall material invaginating to disintegrate into individual mesenchyme cells.

The process as such could further illustrate what in the model here is the "pole exchange" in d-degree 0/00 of motions: pole 1a, "motions to each other" is shown by convergence of folds to the neural wall and then inwards. It defines according to the model a new 0-pole (0') from which we get outward direction, "motions from each other", as shown by the divergence of cells from neural crest inside ectoderm.

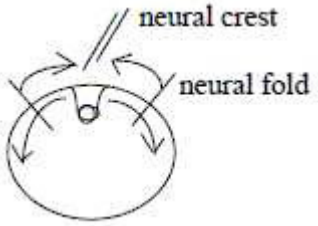
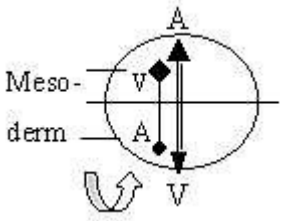


Fig Em-9-14-1a

Further development of coelom:

The whole process looks roughly like repetition on the mesodermal level of steps from underlying, more elementary steps of gastrulation in 1- to 2-layer organisms. However reversed.

With the conditions of a circular growth from A-pole and all new material having to enter through invagination from ventral side, the development of mesodermal coeloms seems to imply a kind of "pole exchange", a secondary "A-V"-axis turned upside down relative the original one:



→ Upwards - Ventral pole

→ Downwards - Animal pole

Fig Em-10

Material nearest first V-pole, "south of the equator" of a blastula sphere, should at it seems evaginate to front part of the lateral plates. After a split into 2 layers, the inner tissue layer thickens and becomes the somites that develop to striated musculature, shoulder skeleton among other things.

Material "north of the equator", closer to A-pole on a blastula sphere, should invaginate later and with this view form the ventral, back part of mesoderm. After split of the plates the inner layer of these coeloms seems to be the origin of smooth, visceral muscles.

Regarding directions, the striated muscles from front part serve outward locomotion, the visceral ones intestines etc. direction inwards with this functional aspect. A reversed A-V-axis could explain such data and also why striated muscles grow to an essential part of body mass.

Below an effort, indeed very rough and approximate, to illustrate the outgrowth, separation and and split of lateral plates to coelom:

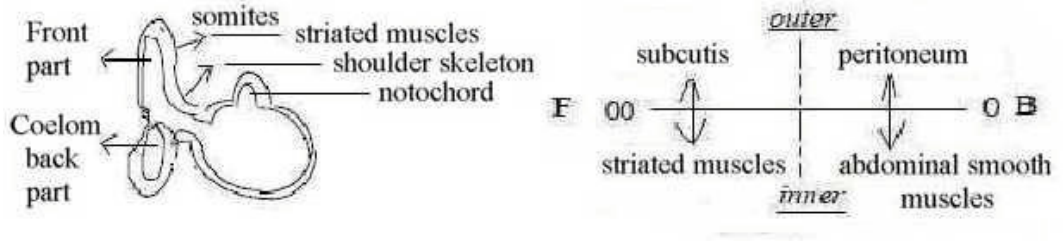


Fig Em-11-017-2

Geometrically the split of the 2-cell layer of lateral plates implies other kinds of inversions too in chordates who get a true body cavity:

- Directions outwards/inwards (step 4 →> 3) of layers get reversed - of natural reasons: Inner layer get the inward direction, becomes outside of intestines, while outer layer gets the direction outwards and becomes inside of skin or the abdomen.
- Layers of plates versus cavity can be regarded in terms of the primary polarity mass -

space in d-degree **step 3 →> 2** according to the model. Inner central cavity as divergent space becomes reversed to space as anticenter in relation to all intestines, which become more or less centralized masses. (Biologists explain the split of lateral plates as caused by "anti-affinity", which probably is chemically expressed in some terms of charge (a property assumed of d-degree 2 in our model). Anti-affinity corresponds to "motions from each other" in the model, pole 1b, which implies divergence and thus can redefine space as anticenter.

- The first split of the 2-cell layer of plates (d-degree 2 as the one of surfaces) to 2 layers can simultaneously illustrate the polarization in d-degree **step 2 →> 1** in the model, into poles 2a - 2b as outside - inside. This should imply a definition of d-degree 1 according to the model, which here seems to be nonsense, if not the first rupture between the layers may be seen as such

Another possibility is to regard the thin, small "bridge" between front and back part of the plates as a bit more substantiated expression for 1-dimensional linear connection. In this case the polarization would concern another direction, the F - B axis

We have also that longitudinal "ridges" - as "linear" formations - develop in the neighborhood of these bridges, ridges which give material to organs for excretion of fluids (kidneys) and for gonads, the reproductive system; hence possible to see as the last **step 1 →> 0/00 (~5')** in our model.

Real development of the proposed steps above is mainly the opposite to descriptions above.

A special question is why mesoderm gets so clearly divided lengthwise along the F-B axis in a front and a back part with only a thin bridge connecting front somites and back coeloms(In humans marked by the diaphragm.) It's a polarization to a certain degree complementary too. Do the lateral plates eventually grow out in 2 opposite directions? It looks as if the imagined "equator plane" of a blastula stage became more than virtual.

One aspect perhaps: Development of coelom implies that the Left - Right axis gets defined. Together with the primary A-V-axis (dorsal - ventral) it *defines a plan*e that divides the Front-Back axis. Dimensionally it should in d-degree 3 be d-degree 2 as a potential surface that act as polarizing force.

This third halving implies a mix of the earlier to complementary poles in two opposite directions, a division in 4 poles, hence the clear opposition between somites and back coelom.

8. Coordinate axes:

Coordinate axes become defined as results of polarizations between complementary "poles" (the poles also equivalent with partial structures).

Each new coordinate axis is regarded as polarized into next one.

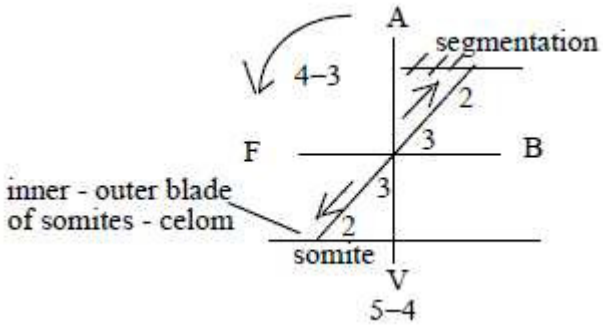


Fig Em-12-18-2

The 3 coordinate axes developed as from angle steps between d-degrees:
- First axis A-V defined through d-degree step 5 →> 4, angle step 360°→>180°.
- Next axis F-B defined through d-degree step 4 →> 3, angle step 180°→> 90°.
- Third axis L-R defined through d-degree step 3→> 2, as an angle step 90°→>+/- 45°.

The d-degree steps represent also development of the three layers of 3-layer organisms:
- A-V-axis the 1-layer stage of the blastula,
- F-B-axis the 2-layer stage of the bladder that tips over,
- L-R-axis the 3-layer stage with developed mesoderm.

With the loop version of the dimension model (figure 4 above) we get the number of tissue layers connected with angle steps and coordinate axes in this way:

5→>4: 1-layer stage: morula →> blastula: in opposite direction 1← 0/0 , the 1st axis A-V.
4→>3: 2-layer stage: blastula →> bladder: in opposite direction step 2 ← 1, the 2nd axis F-B.
3→>2: 3-layer stage: mesoderm develops: in opposite direction step 3←2, the 3rd axis L-R.
(A halfway meeting of directions in this 3rd polarity: 90°→> 45°. One aspect on the approximately bilateral symmetry developed in this stage?)

s-p-orbitals in electron shells:
The evolution of coordinate axes from the blastula resembles how the "circular" ***s***-orbitals of electrons in **atomic shells** are followed by the orientation of electrons along three coordinate axes in the ***p***-orbitals. There is the similar process from *s*- to *p*-orbitals as in the embryo from 360° to 180° to 90° of polarities in orientation.
In the next, higher ***d***-orbitals, representing the middle step 3 - 2 in the $2x^2$-chain behind the periodic system, there are also electrons divided along axes in the plane quadrants, i.e. in angles of 45°.
The axes correspond also to cleavages of cells at first stages of fertilized eggs in many organisms.

The **A-V-axis**, the first defined, mark as pointed to above the positions of invaginations, the primary **inflows from the surroundings**: 1) inflow of material (cf. Mass at V-pole, archenteron as first mouth) and 2) sensory inflow (cf. conducted through Charge, at A-pole). In this sense it represents the cell as "a half" in relation to its total environment as the other half, as the angle step 360° to 180° is a halving
F-pole represents a secondary form of animal A-pole after tip-over of the bladder. Here an invagination occurs in this type of organisms, *Deuterostomia*: the secondary mouth opening, (inward direction from anticenter): an analogy to invagination of neural tube at first animal pole.
The F-B-axis implies in relation to the A-V-axis a step from two-way direction to one-way direction mouth — anus in chordates.
The direction of external motion gets defined, at least for most fishes and land living species apart from Homo Erectus, where the original A-V-axis dorsal - ventral give the direction A → V.
The 3rd L-R-axis gives the approximately bilateral symmetry that also characterizes many **3-merous flowers**.

The polarizations of mesoderm can be described as more or less parallel to the primary ones:
- inner versus outer layer of split sideplates analogous to polarization ectoderm / endoderm,

- somites versus ventral coelom parallel to front - back axis and
- later partial segmentation of e.g. striated muscles parallel to the lateral axis L-R.
(Paired organs as e.g. kidneys and ovaries seem to be the result of this 3rd coordinate axis, not otherwise necessary in themselves. Material from mesoderm takes part in these paired organs.)

9. A summary of dimensional views:

It seems surely too easy to identify the elementary geometrical forms proposed in the **dimension model** in this complex embryonic development. Yet, it's hard to explain the "invelopments" without a similar model.

We have the polarization Mass - Space from morula to blastula, defining a surface, the circular versus radial growth during invagination from V-pole, a polarization outside - inside, which also implies the long projections between these as of d-degree 1 that draws the layers towards each other. (In d-degrees: Morula (3) to blastula (2) to projections (1). And behind these processes, necessary to assume, a field level of forces, guiding in first step the outward direction, in next step the invagination, equivalent with directions outwards / inwards. In all steps and further on expressed in d-degree 0/00 as motions from/to each other.

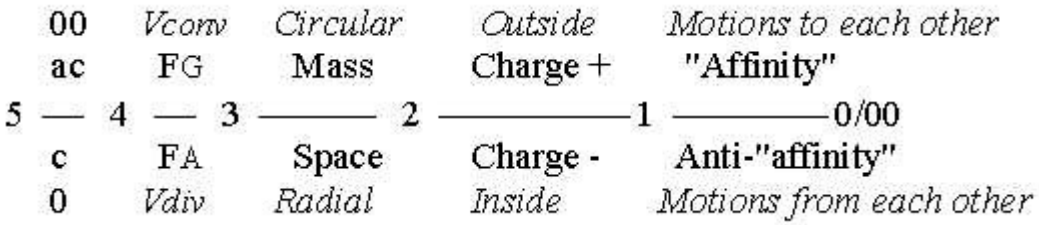


Fig Em-13

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10. Some more general aspects:

a) Affinity:

Why do cells in the blastula keep together? Biologists refer to "affinity" between the cells and the formation of tubes is for instance explained as result of an especially strong affinity. Cracks or splitting of a cell material is referred to as anti-affinity. However, it's hardly an explanation.

It's naturally another word for acting forces. These are certainly expressed in some biochemical substances but here these are assumed as just expressions for and "carrier" of underlying forces - polarizing/binding ones - in the same sense as photons are called carriers of the electromagnetic force.

In the dimension model we have convergence from anticenter. (Cf. gravitation, strongest at the surface of a body.) On the chemical level there is the hydrophobic bond, corresponding to the nuclear force and appearing in cell membranes.

We ought to imagine the atomic forces reappearing here, "extrapolated" to this multicellular level in reversed forms. (See further **The Cell**.)

It could be observed that the embryological step morula to blastula have a certain correspondence already on the elementary molecular level with the step from tetrahedrons to molecular carbon rings, through sp-hybridization.

All primary **physical quantities**, regarded as a dimension chain, should naturally be expected as expressed and involved in the embryonic differentiation, with density, added as only conceptual quality in step 5→> 4: forces (d-degree 4), distribution of mass (d-degree 3), ion balance (charge, d-degree 2 according to suggestions here) as well as distances (d-degree 1) and time (d-degree 0/00 of motions) as in relative velocities of growth.

Involepment as such could in generalized terms be the effect of binding forces from higher d-degrees (2←1←0 from 5 →>4 →>3). The ultimate binding force behind the invaginations at animal and vegetative A-V-poles would be the binding forces from d-degree 5 between 0 and 00 leading to the creation of a multilayer organism within first poles.

On superposed levels similar "affinities" between individual multicellular organisms can form groups that may function as more or less one single organism, as among cnidarians: a 40 meter long "worm" of jellyfishes where position in the row defines their different organic function!
Cf. human clans as well!

The polarizing force, the "anti-affinity", appears very early, as it's said that first cell division is initiated from cytoplasm of the fertilized egg cell. One to several divisions occur also within a first embryo cell of different species before the whole cell divides.

It's said too that eukaryotic cells, even without nuclei (artificially picked out), odd enough can divide (one reference: *http://www.sciencenews.org/pages/pdfs/data/1996/150-09/15009-16.pdf*).

What in membrane or cytoplasm induces this polarization? In any case a force from anticenter, a 00-pole in our model.

The blocking of genes in DNA that differentiates activities of cells may also be regarded as a kind of polarization and occurs through molecules from outside.

(If we regard DNA as a kind of piano and should translate the **24 codons** to two octaves of tones, perhaps the 5 G1-codons and the 5 C1-codons to the black tangents and the 7 U2-codons and 7 A2-codons to the white tangents, how should the melody of e.g. insulin or substance P sound? But DNA is sooner like a string instrument where blocking defines a tone, than a piano)

One factor behind the fundamental "affinity" that differs multicellular organisms from unicellular ones could perhaps be identified in terms of what is called "*neoteny*": a branch of evolution starting from a deeper, preceding level of embryonic development. Translated to the dimension model it would imply a start from e.g. level of d-degree 4 instead of 3, a still less differentiated one, where the binding force would be stronger.

Communication over distances in the developed body - such as nerves finding their special targets or hormones their receptor cells - is in reality the same kind of mystery as the old one how gravitation can act over distances in macrocosm. It could also be seen as an expression of "affinity". As in macrocosm, it's the forces in development of space that create the distances.

At some first cell divisions the individual cells can develop to complete organisms and obviously contain all information. Later cell divisions imply specializations.

Hence, it seems necessary to assume that the division of a cell at this stage gives daughter cells that in some respect are complementary. Hardly in the genetic code itself. Perhaps in which genes that becomes blocked, although pre-decided somewhere in DNA and rooted in geometries. (Cf. Epigenetics.) Some essential information seems lacking about how such a differentiation between daughter cells is realized (at least here in used sources).

Anyhow, such polarities at cell divisions could be suspected to be one factor behind communication over distances.

With the dimension model the distant connections could be apprehended in more abstract terms: an inner relation, represented by a higher d-degree get when polarized

"inverted" to outer connections into next lower d-degree as a new potential, including new directions and a new distance.

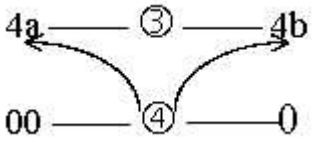

Fig Em-14

Another aspect on the question is level chains. It's assumed in the dimension model that each step in a fundamental first chain can develop to whole new chains of 2nd order, steps in these to whole chains of 3rd order etceteras., which leads to a "level chain". (In the figure below illustrated as simple loops in each first chain steps.)

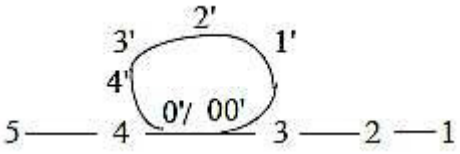

Fig Em-15

An original close relation of a d-degree step in a basic chain can in this way develop to a very far one.

Compare how mRNA is cut on its way to ribosomes: a way to reestablish the original basic relation in the hierarchy through cutting off the loops?

b) Processes of design as waves:

Tube-forms as archenteron and neural tube, which also were explained as results of extra strong affinity between cells, may be regarded in the same way as in- and evaginations of a cell membrane in a single cell, cut off to vesicles, serving import and export of material. (Cf. about the cutting of mRNA above.)

They can be interpreted as the 3-dimensional external motion attributed to a 2-dimensional structure - the tissue level - in the dimension model.

With addition of a 4th motional moment, the growth lengthwise along the front-back axis F-B the forms become "1-dimensional" canals on a macro-scale.

The wavy character reminds of the problematic turbulence of water streams where bigger whirls get translated into smaller and smaller circular whirls: a way to store a surplus of energy?

Another parallel is found in meteorology: how high- and low-pressure "cells" are tied off from the Rossby waves around the North Pole. Why are they tied off? It seems necessary to assume that a certain area on the surface gets defined and demarcated with the border defined as anticenter, from which convergence leads to the tied off "loops" - as occurs with neural tube from neural wall.

Tubes can also get designed another way as from d-degrees 0/00 inwards 1 and 2 from single mesenchyme cells when it concerns a fluid as **blood**.

In the dimension model it's a general hypothesis that the d-degree of motions increase towards lower d-degree of structure. Internal structural relations are stepwise released to external motions. Simplified: The opposition waves versus particles are seen as lower d-degrees of structure in relation to higher ones.

Segmentation could also be regarded in terms of waves. As previously mentioned the inner front part of somites gets segmented. Segmentation in the form of transverse bands takes also place of the neural tube during its embryonic development. That's quantification in rows of similar units, a linear repetition in first phase, which later may be more or less differentiated. (Cf. **Evolution** and segmented animals.)

It should be noted that segmentation concerns typically front and dorsal part of the embryo, representing the earlier A-pole (00), corresponding to primary polarizing force in the dimension model.

This feature of segmentation has the character of longitudinal L-waves lengthwise: →> 0 ← 00 →> 0 ← 00 →> 0 ←... , a variation in density, assumed as first physical quantity in the model in step 5→>4. Such linear, 1-dimensional L-waves are suspected on the field level, in d-degree 4 (as in gravitational waves if they exist). Cf. that they in typical, segmented species demarcate whole units of essential organs.

In synthesizing directions, inwards from end of a dimension chain, motions to and from each other, it becomes one way to build 1-dimensional lines. On a molecular level it could be compared with the way globular proteins or units of collagen line up after one another.

Neural tube - vertebrae give in their relation another example of how elementary waves can be applied as aspect on design:

The vertebrae come to enclose the spinal cord as magnetic field lines surround an electric conductor. There is a phase displacement too between vertebrae and segments of neural tube as between M- and E-components in an electromagnetic light wave, in this case a transversal T-wave.

First notochord and the neural tube derive from opposite poles V-A in the embryo, which could underline the complementary polarity in this later design vertebrae - neural tube.

A general view could probably be to see the whole embryonic development as materialized processes, substantiated motional structures, or formulated as "captured internalized waves", whatever to mean by that.

c) Geometry:

It seems obvious that the position of cells in the blastula decides their later roles and functions. It could be taken as evidence for geometry as the guiding principle.
A general aspect from the dimension model is also steps towards more and more differentiations of directions, i.e. towards increasingly specialized ones. Cf. about level chains above.

The c-ac polarity center - anticenter appears not only in the first phases of whole embryo and the polarity along diametrical axes. Such polarizations occur obviously also within regions on the tissue surface, i.e. in d-degree 2

Best known example seems to be the area around the animal pole, where the neural plate gets defined as center and surrounding circles of cells immigrate and come to differentiate in 8-10 separate cell types (*Kz p. 116*) - as from circles of different radii from the center (?). They include more peripheral types of nerve cells, glial cells that surround nerve cells, cells for membrane around the brain, cells for teeth, for cartilage and bone in cranium...

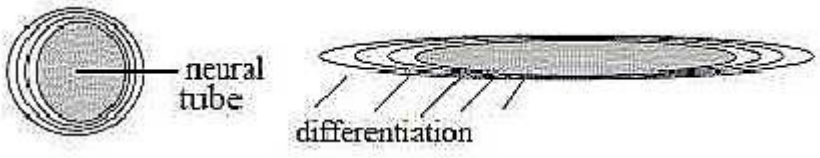

Fig Em-16-22-2

How position of a cell in morula - or generation number? - is translated to its position at surface of the blastula has perhaps been clarified during later decades (?) - but what decides the angle, demarcating the neural wall as border between immigrating cells and those remaining ectoderm?

(Material that becomes mesoderm from archenteron is also anticentric around the vegetative pole.)

Induction, the term biologists use for certain processes, includes also special geometrical features in design. It's the same term used for how E- and M-factors influence each other in a magnetic field. Thus, it concerns how complementary biological poles influence each other, expressed with views in the dimension model.

One essential example is the mentioned invagination of a certain area around the animal A-pole to a neural tube through induction by the invaginated vegetative V-pole when it reaches the inner "ceiling" of the early 2-layer bladder at A-pole. It represents a partial or momentary depolarization to higher d-degree of primary A-V-poles, where the upward direction of V-pole induces downward direction from A-pole. The induction should go via the higher d-degree as binding force and underlying, deeper level - as d-degree 4 in relation to poles 4b-4a of d-degree 3.

More or less simultaneously (?) the "ceiling" cells of archenteron from V-pole develop to the germ for a chord or notochord, also straight upwards. It could point to induction as eventually mutual.

There is however something more in this process, perhaps from mutual induction. Vertebrae come to enclose enclose the neural tube. Material with origin from V-pole, principally radial and outward directed, become anticenter around material from A-pole, principally inward directed, which thus gets the role of a center.

Another example is how the eye lens is formed: it requires the meeting between the eye cup from inside the brain with ectoderm from outside, which through this induction gets formed to the lens.

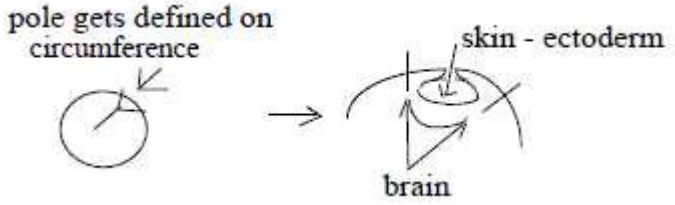

Fig Em-17-23-2

In these and other cases it is not only a question of chemistry but of geometry, a center - anticenter polarity in the design and a "pole exchange". Divergence from some centers inside, convergence from outside leads to a structure where inner material become anticenter around outer material. Pole exchange" is in the model assumed to occur in last d-degree of motions 0/00, and a step 1 - 0/00 in either direction should be involved - as it is by definition in every d-degree step in a dimensions chain.

A question is how the surface area for invagination in these examples is defined, through a certain solid angle of virtual radii from inside?

Other examples of a similar geometry in the human body:
- Hypophysis from a pharyngeal pouch that come to enclose nerve material from the brain.
- Adrenal glands with the bark (ac) from intestines (vegetative pole, ~ 0) and their marrow (c) from the nerve tissue (animal pole, ~ 00).
- Oviducts in relation to ovaries.
- In skeleton ball and socket joints in hips and shoulders.

The aspect on the eye lens and its construction could be extended to the meeting between the whole organism as 0-pole and direction-specific environment as 00-pole: new complex centers could be expected defined at this pole-meeting on the surface of the organism and be built-in into new structures (as it occurs at the psychological level).

Examples of course are sense organs but maybe also fin rays, where bottom, ground

contact could induce rudiments of legs, of new skeleton parts under the skin...? (A geometric approach to the evolution...?)

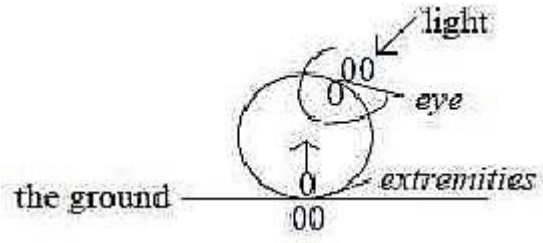

Fig Em-18-24-1

Gradual incorporation of the 00-pole is a more general formulation of the corresponding principle (cf. inward direction from the 00-pole):
- the incorporation of sperm chromosomes into the egg,
- the incorporation of surrounding space in neural tube and archenteron,
- the incorporation of external nourishment,
- on chemical level also the building-in of metal ions (00-poles in relation to non-metals etceteras.

(Universe as a camel trying to pass through the needle eye of a cell!)

Number of cells becoming the human, amniotic embryo after a certain amount of cell divisions is said to be 4-5. All the other become coverings, some with the function to penetrate into uterus. Apart from the interesting number, it shows obviously that it is the geometrical position as center that indeed decides the potential for development. It confirms too what was find in experiments with exogastrulation described above.

d) Mass - Space:

Masses are built-in into vacant space in macrocosm and "vacant" space as primary antimatter built-in into atomic structure in microcosm. We could see gastrulation and multilayer structures as a similar double process at a size level between micro- and macrocosm.

Surrounding space gets built into cavities as "negative mass" within closed cell layers in neural tube and archenteron, coelom etceteras., and these get built-in as positive mass in the cavities of the embryo.

And as presumed in text about physics atoms "breathe vacuum" and are depending on surrounding "vacant space" for maintaining their structure as atoms, so the embryo with archenteron and neural tube supports itself on its environment.

**(File about the atom in Physics not yet translated.)*

A multilayer creature from repeated positive - negative curvature:

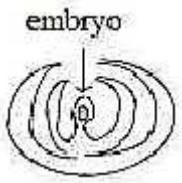

Fig Em-19-22-1

A note:
It's easier to visualize the whole embryological process in d-degrees 3 - 2, and perhaps we should imagine the process as a stepwise "inversion" of deeper levels through step 3 — 2 to superposed ones?

The cello string - an association:

A speculation, without any knowledge, about vibrations in a cello string:

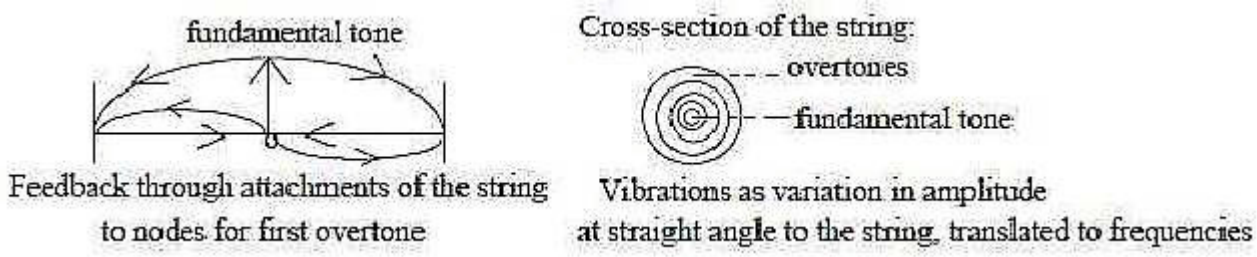

Fig Em-20-28-2

Quantification of waves with obscure allusions to biology:

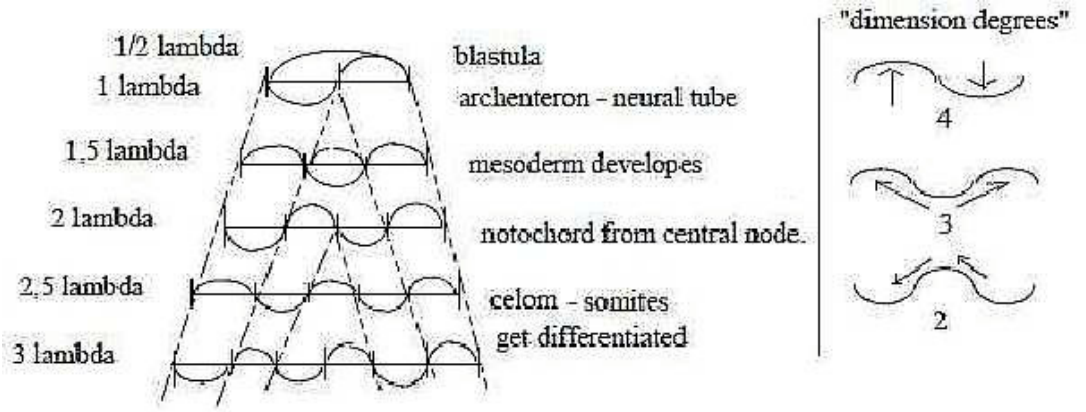

Fig Em-21-28-3

Displacements of side-waves through new vibrations as "serial inlays" from the middle. With half-steps: in every second step bellies in the middle, in every second nodes, witch imply tied off centers.

Levels in an organism and systems at large
- some outlined aspects -

In the dimension model it's assumed that each step in a fundamental chain can develop to secondary whole dimension chains and so on, thus to "level chains".

Levels in accordance with a dimensional chain - a "level chain":

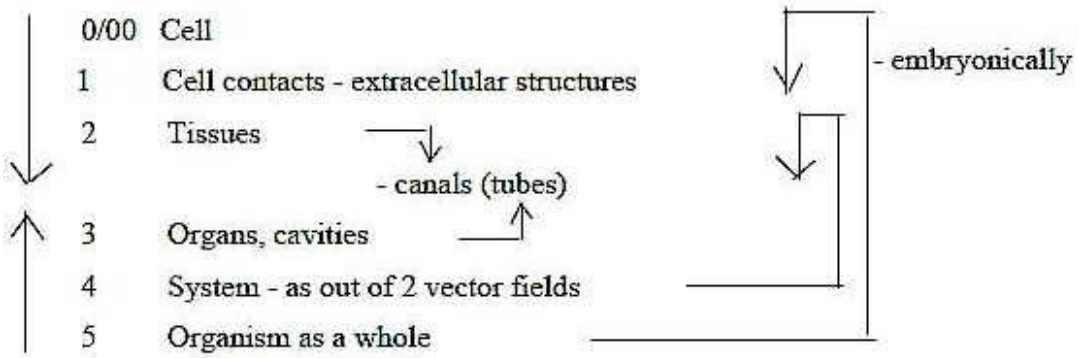

Fig L-1-29-1

In physical and geometrical quantities:

Forces / vectors –	Mass / Space –	Charge ± (surfaces) –	Distances –	Motions
systems..	*..organs / cavities..*	*..tissues..*	*..networks..*	*..flows*
4	3	2	1	0/00

Fig L-2-29-2

Poles:
- c-ac: organism - environment,
- 4b/4a: nutrition system <—> nervous system, inward/outward directions in the two systems,
- 3b/3a: mass - space (~ cavities) in the design of organs and tubes of the body,
- 2b/2a: differentiation of tissue layers in e.g. inner/outer layers ,
- 1b/1a: negative / positive affinities between cells, one expression for "movements to/from each other ". or

2a - 2b: differentiation of charge over tissue layers and e.g. outside - inside
1a - 1b: convergent flows and divergent along transportation nets.

Steps in a dimension chain in direction outwards as progressive design and differentiation, could be written: 4 = 3 + 1, 3 = 2 + 1, 2 = 1 + 1…
Applied to the organism:
4. Systems →> organs + "infrastructure": canals, streams, communication
3: Organs/cavities →> tissues layers + channels, transport routes
2: Tissues →> cells + cell projections and produced extracellular fibers.
1: Cell level with cell projections as structures or translated into motions in dimension degree (d-degree) step 1-0/00, designed in many ways at different levels.
The development takes the opposite way.

Links between steps according to the loop model:

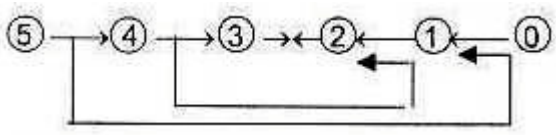

Fig L-3

5-0/00: organism – cell
4-1: system - infrastructure
3-2: organs – tissues

Fig L-4-29-3

2. Systems:

Nutrition and a sensory/motor system as mutually opposed vector fields from V- and A-poles (see Embryology) are both bi-directional in themselves, illustrated here as superimposed:

Inward/outward directions of vector fields (d-degree 4):
a) Nervous system: sensory nerves inwards, motor nerves outwards.
(From ectoderm.)
b) Nutrition system: digestive organs inwards; blood system for distribution outwards.
(From mostly endoderm.)

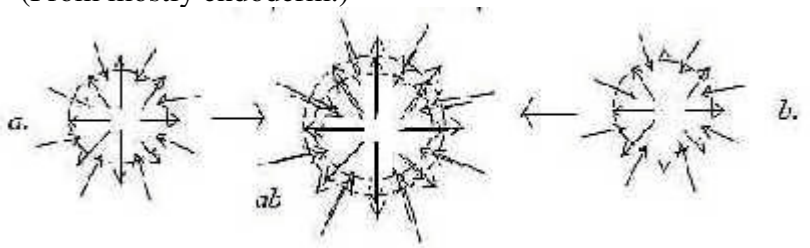

Fig L-5-30-1

Real neurons are found first in Diploblastica, multicellular organisms with sooner 2.5 layers (see **Evolution**) but even unicellular organisms have sensitivity for light and excitation.

Nutrition system and nervous system are interwoven in such a fact that the same peptides can be both digestive enzymes and neurotransmitters in the nervous system.

However, the two systems operate mainly with chemical versus the electrical one. In the dimension chain of physical quantities mass and charge has been interpreted as a relation d-degree 3 to d-degree 2. The neural system operates primarily with charge over the surface of the cell membrane (d-degree 2), the nutrition system with molecules representing what can be regarded as mass in this context, in the interior of the cell (d-degree 3).

Hence, we can see the two systems meeting from opposite poles in d-degree step 3 - 2

00 —> 1 --> 2 --> <— 3 <-- 4 <-- 0
Nervous ystem --> surface of cell inside of cell <-- Digestive system
——————> <——————
charge mass
<========== 4 ==========>

Fig L-6-30-3

Systems —> Organs:
Regarded as vector fields of d-degree 4 in our model, both primary systems develop a

growing complexity of double-directed infrastructures (of d-degree 1 on a macro-scale). The vector fields get expressed in d-degree steps ... ← 2←1←0/00. Cf. 0 and 00 are "outer poles" or partial structures of d-degree 4. Constructions get stepwise substantiated as from field lines, from motional pathways to linear strings and canals etceteras...

(From steps 5 → 4 → 3 the steps 2←1 ←0/00 may be said to follow as debranched d-degrees meeting in opposite direction according to the loop version of the model, see figure L-3 above.)

Polarization of directions within the two systems:

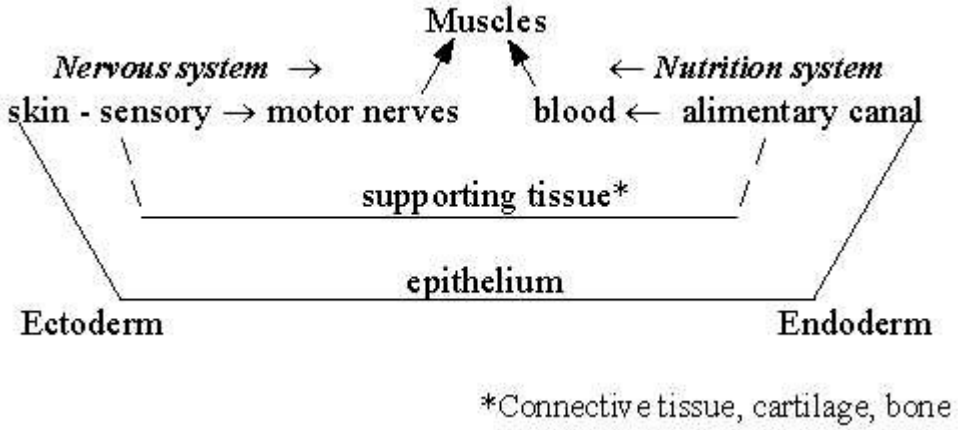

Fig L-7

- An essential part of body mass (d-degree 3) is made up of muscles and supporting tissues as skeleton and so in, mostly from mesoderm, the 3rd , middle tissue layer.

It could be mentioned here too that muscles need innervation to develop.

3. Organs individualized:

Individual organs in relation to the "vector systems" could be compared with word classes in relation to syntax in languages.

The stepwise synthesis from lower d-degrees 3← 2← 1← 0/00 can be referred to the integrating force from 0-pole (cf. **Exogastrulation),** while the individualization of centralized organs from the field level can be suspected as an effect of the polarizing force of anticenter, the 00-pole.

Organs, from the main "vector systems":
(The border between main "systems", "organs" and "tissues" can be discussed.)

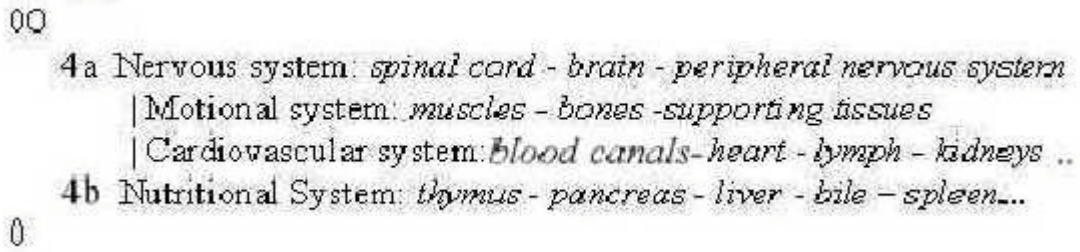

Fig L-8

Origin of the systems, approximate positions in blastula stage of an embryo:

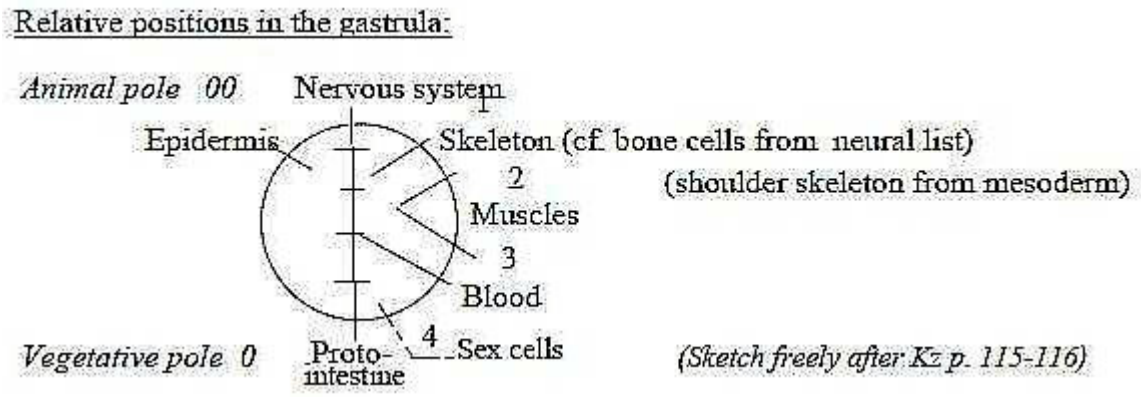

Fig L-9-31-3

With the assumed secondary developments of dimension chains within each step of a basic chain, the individual organs as more or less "tied off" and centered units (like organelles in single cells) could perhaps be imagined as expressions for such secondary evolutions designed in zstep d-degree 3 to 2. The principle illustrated with the unpaired organs from the nutrition system:

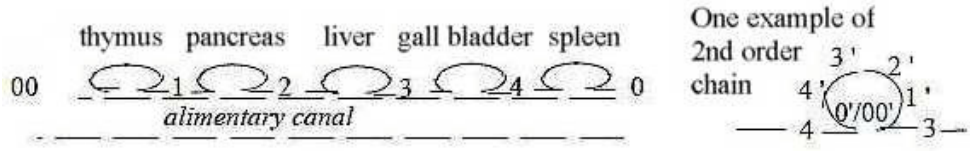

Fig L-10-33-3

(Tonsils, thyroid and parathyroid glands and others in the gullet wall not included.)

The animal pole and nervous system doesn't show a similar row of secondary individualized units apart from the spinal cord and brain. Cf. again **Exogastrulation** in file Embryology,

Nutrition →> Blood system:
The nutrition system develops a primarily "radial" distribution system outwards, the blood system. A branched forefront of the intestine can replace a blood circulation in primitive species.

In the embryo of less primitive species the blood channels develop from archenteron as a dorsal and a ventral aorta, along the F-B-axis. Blood is also in lower chordates produced by the spleen, which in turn is derived from the intestine. And lungs in the blood system develop from the gut.

One example of the loop version of the model (see *figure 3* above) with debranched degrees from higher d-degrees meeting 'the other way around' could be how blood later gets produced in skeleton bones; skeleton as supportive tissue interpreted as of lower d-degrees, see below about tissue levels.

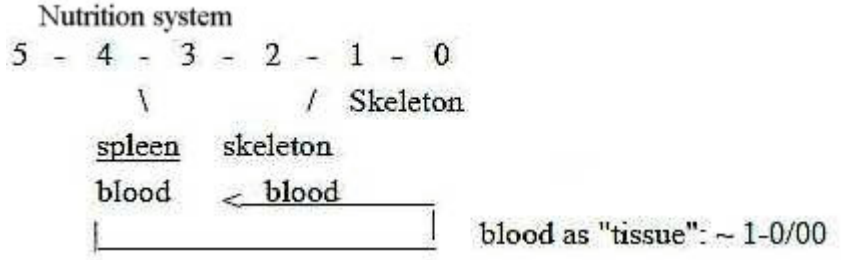

Fig L-11-33-2

Nervous system →> Muscles:
Development of muscles requires the nervous system (at least striated muscles of vertebrates). Muscles atrophy if they are not innervated. (The nervous system from the 00-pole in our application of the dimension model, should as a first polarizing force appropriately act as a differentiating factor.)

In the skin bag of "2.5"-layer species (*Diploblastica*) sensory nerve cells and muscle cells are differentiated adjacent to each other with parallelly running threads in a layer of the skin bag, muscle filaments inside nerve fibers (figure *Ez p. 62*).

It's perhaps noteworthy that these primary muscles act circularly *contracting* and that the active force of muscles is convergent, geometrical features derived from anticenter, the 00-pole in our model.

4. The organism as such and principle of individualization:

The demarcation of the multicellular organism by the skin, the outer ectoderm, and its reproduction capacity through stored genetic information in sex cells could be regarded as primary in relation to development of the vector fields, as 00- and 0-poles respectively in our model. They derive from opposite poles of the first embryo and could perhaps be called the ***"individualization"*** system.

The immune system with thymus, spleen and lymph system is linked with the blood system and implies breaking-down processes as phagocytosis in similarity with the inward directed, digestive phase of the nutrition system.

Immune system could be seen as an expression of the individualization principle on the deep, underlying level, as a biological defense from inside the genetic heritage, developed through the nutrition system. The skin is an equally essential counterpart of an individual existence, an own(-ed) anticenter and a more mechanical defense.

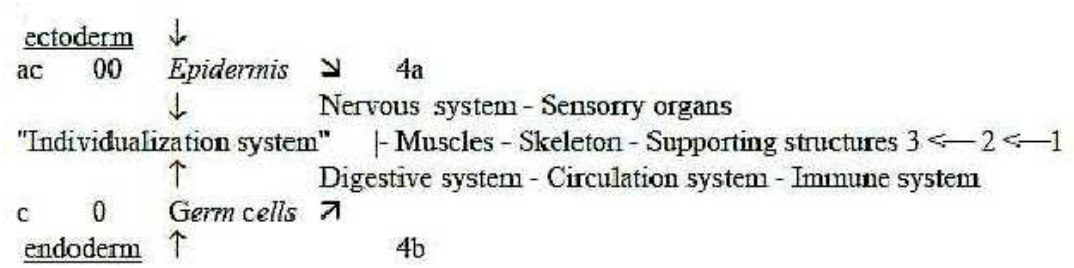

Fig L-12-31-2

5. Tissue level, 4-5 types:

Biologists talk about 4-5 tissue types, where the liquid one is regarded as the 5th "tissue" (*Mf, Kz*).

Order of tissues according to their origin during embryo evolution:
Epithelium: appearing in *ecto-, endo-, mesoderm*
Nerve tissue:- *from ectoderm*
Muscle tissue: - *from mesoderm*
Supporting tissues: connective tissue, cartilage, bone: - *from mesoderm*
Body fluids like blood, the 5th "tissue".

The tissue types can be described and ordered after degree of cell contacts and of extracellular substance produced, i.e. different degrees of internal versus external fiber production. It implies a chain of decreasing "density" (in a general sense), in this respect resembling the stepwise transitions in a dimension chain from higher degree of internal structure to more externalized relations and 1-dimensional forms as debranched d-

degrees. (Cf. density, according to previous definitions of **physical quantities** the first "quantity".)

- ***Epithelium***: Dense cell contact. Epithelium dresses all outer and inner surfaces. It represents obviously the fundamental form of 2-dimensional tissue surfaces.
- ***Nerve tissue***: Contacts between cells through their projections via synapses. Single tubules of protein fibers within axons and dendrites.
- ***Muscle tissue***: The cells separated by connective tissue, cells = "muscles" almost completely filled with protein fibers.
- ***Supporting tissues,*** reticular type: Cells more or less scattered in the extracellular substance. When cell contacts, these are just point-formed contacts between long cell projections. External production of protein fibers as elastin and collagen.
  With such fibers as 1-dimensional threads external 2-dimensional layers are built and 3-dimensional networks of external relations.
- ***Liquids***: No cell contacts. (Blood cells lose also their nuclei.)

Both liquids and external fibers can be classified as secretion products, analogous to "branched off" lower dimensional degrees from higher dimensional steps in the dimension chain.

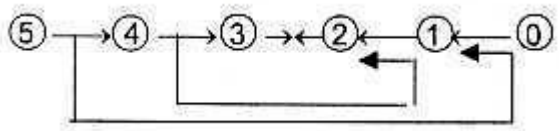

Fig L-13

The loop version can illustrate a connection between first tissue type and the last one: epithelium forming glands with liquid secretion.

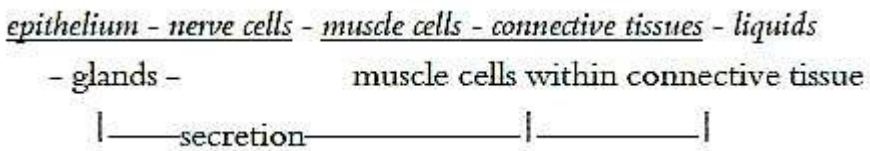

Fig 14-35-1

It's more doubtful if a similar relation may be found between nervous and connective tissue in next step. However, we have osteoblasts deriving from the area around the neural plate of blastula, among other cells becoming e.g. glial cells. Osteoblasts form connective tissue in bones, often in concentric circles around blood vessels.
(Perhaps also glial cells as astrocytes in the brain can be regarded as "connective tissue", although not described as such?)

6. Cell contacts:

Cell contacts are classified as follows (*Kz*) and show up to be clearly 3- to 2- to 1-dimensional (possible to complete with a 0-dimensional one in reticular tissue.):

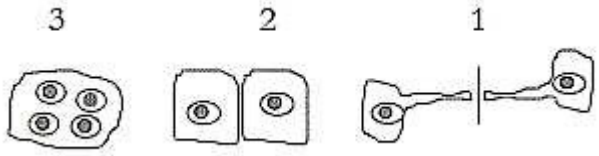

Fig L-15-36-1

3-dimensional: Symplasma: nuclei of cells share plasma within the same cell. There are two complementary types representing opposite directions.
a) *Plasmodium*: Fission: a nucleus is divided into several within a shared cell membrane; example (some?) liver cells. Note outward direction: liver part of the blood system, subsystem to the nutrition system.
b) *Syncytium:* Fusion of several cells to one within a common membrane; example striated muscle cells. Note inward direction, muscles as subsystem to the Nervous system.

2-dimensional: *Wall-to-wall contacts*, typical for epithelium.
1-dimensional: *Desmosomal junctions*: long projections of cells in wall-separated point contact; example reticular tissue.

Hence, contacts as common room, common wall, common creation of "lines" through extensions but only a common "point".

We may note that in embryo development the first divisions occur within the cell as mentioned in that file, which corresponds to 3a here, plasmodium. Then, in the blastula, we get the wall to wall-contacts. First during later gastrulation and from mesoderm the 3b) type, syncytium appears. It seems to agree with outward and inward (polarizing - synthesizing) directions in our dimension model.

7. Fibers - levels of storage:

It is noteworthy that number of storing levels of extracellular fibers at the final stages in the chain of tissue types are 5 - 4, from the individual molecules to the fiber - as if they corresponded to steps in a chain (*Kz p.154, 139, Fb p. 29*):
- ***Collagen:*** 5 levels: collagen molecule - protofibril - collagen fibril - bundle of collagen fibrils - collagen thread.
- ***Hair:*** 5 levels: keratin molecule - protofibril - tonofibril - bark cells - hair.
- ***Cellulose fiber***: 4 levels.
(Cf. chromosomes: 5 storage levels of the double helix of DNA.)

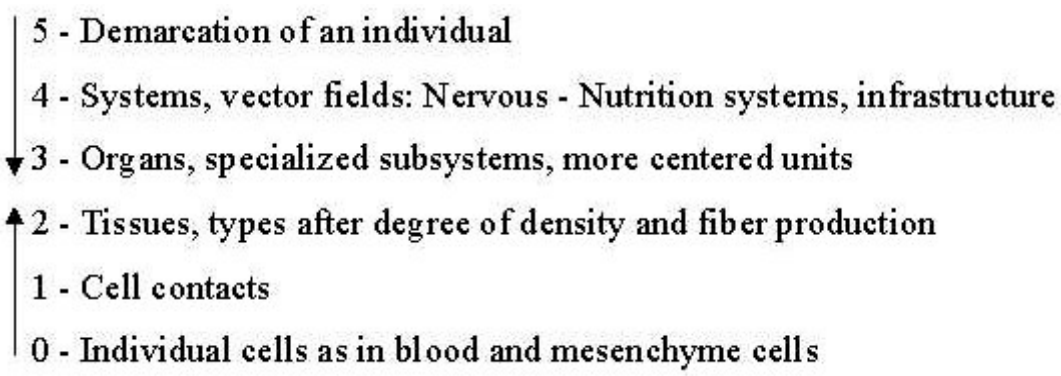

Fig L-16

Glands

1. Glands - a general structure:

The **System level** - like an underlying "syntax" - becomes formulated in differentiation of glands on all following organ, tissue and cell levels.

Glands are formed from all kinds of epithelium. Glands means actually differentiation as such between substances produced by epithelial cells.

The basic model for glands seems given already on the gastrula stage of embryo development: an already specialized surface layer of cells, which faces on to outer room and an inner cavity and invaginates from the surface in certain areas in similarity with how gland tissue is descended epithelium.

The whole archenteron could in this sense be regarded as a primary gland, as well as the neural tube with its secretion of cerebrospinal fluid (CSF).

2. Two special glands:

The nervous system and nutrition system as two opposite directed vector fields meet during the evolution in two glands on the organ level: in ***hypophysis*** and ***adrenal glands*** composed of tissue from both. They become complex combinations of those poles (or partial structures) from underlying level of higher dimension degree (d-degree) on a level of lower d-degree.

(Systems →> Organs as a d-degree step 4 →>3 in the **level chain** in our interpretations here.)

The information via hormones is chemical as are the transmitters in the very synapses of the nervous system. The way of information goes the way of the nutrition system via the blood system outwards.

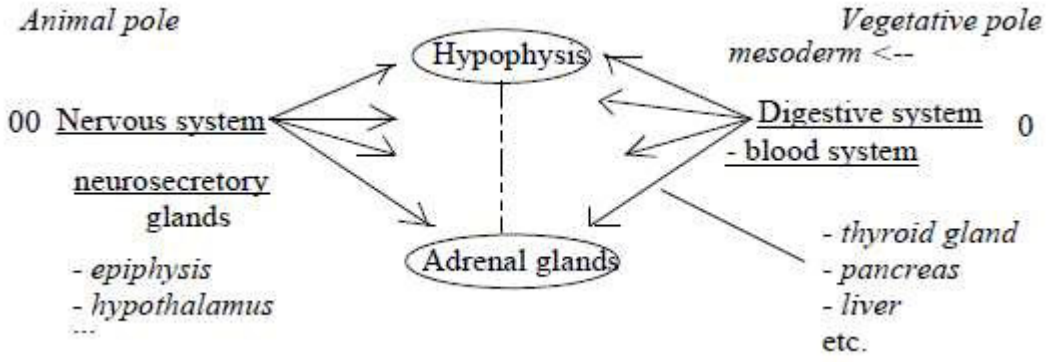

Fig Gl-1-37-1

In this meeting of poles in hypophysis and adrenal glands there is also a geometrical "pole exchange" in terms of the dimension model:

Nervous tissue (00-pole in relation to nutrition system from 0-pole) becomes the inner, the center, the marrow of adrenal glands from cells in the sympathetic nervous

system, and the tissue from the nutrition system (coelom, indirectly from vegetative pole) becomes anticenter, the adrenal cortex.

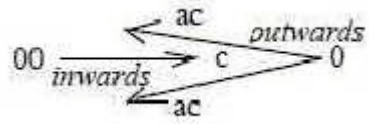

Fig Gl-2-37-2

In hypophysis it's tissue that has immigrated from the throat (pharynx) that forms a pocket around the nervous tissue.

(It's certainly said that the pocket derives from ectoderm, not the vegetative pole in the embryonic development. Yet, throat is part of the digestive canal in the nutrition system.)

The hypophysis is historically a later development in evolution and it may be asked which more such combined organs that could follow with a further biological development? Is there actually any other reason than a dimensionally given "pole meeting" that biologically - chemically gives cause for adrenaline cortex and adrenaline marrow (*medulla*) to combine to one organ, when they produce different types of substances (cortex: steroids as cortisol; marrow: adrenaline and noradrenaline)?

Pancreas with its mixed gland tissues seems to represent a secondary type of "pole meeting" within the nutrition system, In humans it develops as a compound of one ventral and one distal "bud" or invagination from the intestine, hence from a polarity of second order. It is also two-way directed in its function with both endocrine and exocrine secretion.

3. Gland shapes:

As glands are epithelium invaginating inwards, the macrostructure of glands seems dimensionally develop inwards also in the sense of towards higher d-degrees in shape: from single cells to "linear" tube forms to branched, hollow tubes along 2-3 coordinate axes - to branched, cell-filled tubes - to centered, cell-filled organs with only canals connecting to the surface of epithelium. These latter develop often radially ordered cell lines as of pole 3b in our model and get own blood supply.

Hence, it's a development as in d-degree steps 0 →> 1 →>2 →> 3. The liver for instance has first only a tube form.

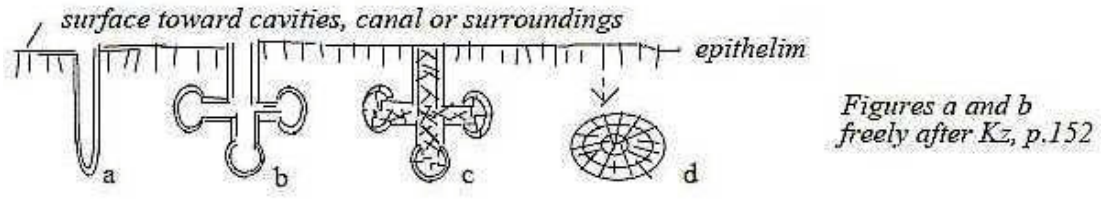

Fig Gl-3-38

(Cf. figure b with how coelom first grow out from archenteron in the embryo.)

Surface epithelium is often of *squamus* type (low, flat), while epithelium of glands often is cubic (*cuboidal*): Such a detail points to a d-degree step of type 3←2 already on the level of single cells. (Stratified epithelium may have up to 6 layers. Cf. 6 layers in the cerebral cortex.)

4. Differentiation of glands:

We could see the differentiation in terms of polarities related to the dimension model: in directions, in center - anticenter formation (as mass - space) and in positions along coordinate axes - naturally besides type of secreted substances:

On the level of the whole organism there is the polarity between glands with secretion outwards the surroundings and those with secretion inwards: skin glands versus internal ones.

On the organ and tissue levels there is the polarity exocrine - endocrine glands, directions of secretion (poles 4b - 4a).

The general development seems to go from exocrine secretion outward cavities to more endocrine secretion, inward blood vessels.

In centered organs the polarity center - anticenter as marrow - cortex appears as the d-degree relation 3 - 2.

The differentiation along the Front - Back axis of the digestive canal in relative positions is reasonably to a certain degree related to kind of passing substances, carbohydrates, proteins, fatty acids, but that's surely only a part of the truth, underlying polarities of the coordinate axes another.

A sketch:

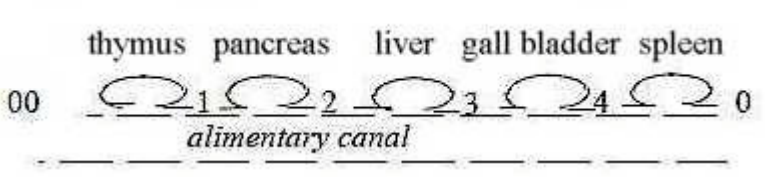

Fig Gl-4-33-3

Generalized it seems possible to regard the whole body more or less as a hierarchy of glands. Simultaneously the development of glands implies a continuous growth of inner surfaces from the first embryological stages (like the growth of a coastline towards infinity when one goes deeper and deeper into details). A question is if position on a surface is a necessary condition for the differentiation of cells in genetic activity - or the reverse, a result of it?

Blood system

1. Stepwise substantiation:

The cardiovascular system becomes a progressively substantiated design of the vector field of divergent distribution in the nutrition system.

The peculiarity that front part of intestine in bivalves goes right through the heart (*Ez*) could be taken as a particular manifestation of this close relation.

As mentioned earlier a branched front part of intestine may replace a blood system in certain of the simplest invertebrates.

In simple species the circulation of the nutrient fluid is also performed by amoeboid cells and /or by contractions of muscles, before development of a blood system.

Among types of tissues (file **Levels)** fluids became the 5th "tissue" at the final step. Blood cells derive from mesenchyme cells and reticular tissue, next last tissue type. Later blood is produced from bone, also a supporting tissue of reticular type.

(The fact that blood cells come to lose their nucleus might be a result of their character of last step in a chain of tissues, anticenter in the dimension model: their function as only transporting vehicles?)

2. Geometry in the development:

The development of the blood system is a typical example of a process through geometrically increasing dimension degrees (d-degrees) as in steps 0 →> 1 →> 2 →> 3 →> 4:

~ 0: scattered blood islands from free mesenchyme cells, migrating inwards,
~ 1: blood islands aggregating to strings,
~ 2-3: strings developed into tubes, where outer cells form inner wall of the vessel (endothelium), and inner cells become blood corpuscles.
Channels curve in convolutions through opposite directed currents:
~ 3: swellings grow together into a central organ, a heart,
~ 4: a pump with currents outwards - inwards as a two-way directed vector field of d-degree 4 in terms of the dimension model.

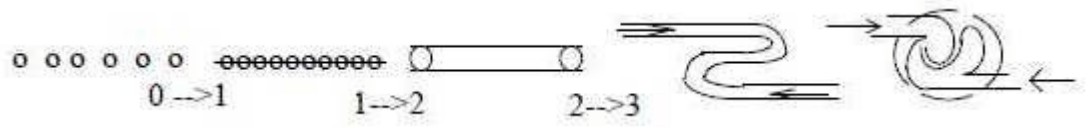

Fig Bl-1-39-1

The transformation of the blood canals to a heart has perhaps (?) similarities with what plasma physicists call "two streams instability" (*Frances F. Chen: Introduction to Plasmaphysics, 1977):* according to the author a state difficult to analyze. The function has a gap at vx = 0. (So has life when the heart stops!)

We can observe the geometry:
- Upper, dorsal side, representing primary 00-pole: direction of the blood stream backwards (~ inwards).
- Lower, ventral side, representing primary 0-pole: direction of blood stream forwards, (~ outwards).

Swellings of the S-shaped curve form through a kind of overthrust upper and lower heart (atria - ventricles):

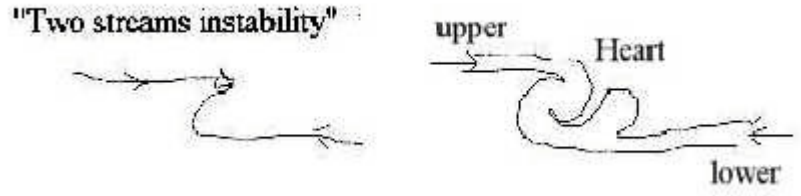

Fig Bl-2-40-1

3. Evolution of heart chambers:

In a simplified description the evolution goes from a 2- to 3 - to a 4-chamber heart, as gradual steps of polarizations.

A 2-chamber heart is found in mollusks and among chordates in bonefishes (*Fc p. 660*).

The evolution among chordates goes from a tube-shaped heart in lancelets and proceeds to a 3-chamber heart in amphibians, a "3.5"-chamber heart in most reptiles (2 atria and a not quite divided ventricle) and to the 4-chamber heart in birds and mammalians with complete division between the arterial blood in the left half, venous blood in the right half.

(Biologists may argue that a 4-chamber heart was triggered by life on land requiring lungs and with that a double circulation, but one could imagine the reverse: that dimensionally given polarization steps led to both lungs and the subsequent double circulation, which allowed the general upward direction from sea to life on land and in air. Why didn't animals stay in the water?!)

4. Heart in humans:

Divisions of the 4-chamber heart agree with the polarizations in coordinate axes of the embryo: Front - Back (from Animal - Vegetative poles) and Left - Right.

Two divisions give 4 parts, the atria and ventricles, and diagonally as in 45° in complex combination the big systemic circuit and the small pulmonary circuit.

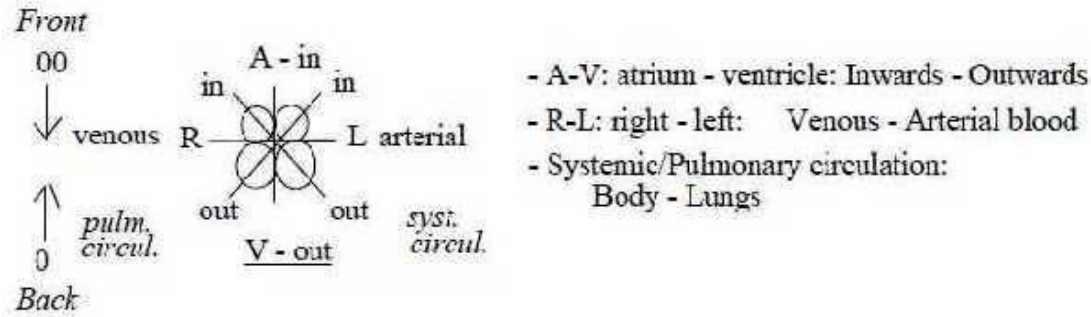

Fig Bl-3-41-2

sssThere are notable details that seem derived from those primary poles.

The coordinate axes Front - Back as derived from A-V-poles represents a secondary axis 00 **<=====>** 0 (file **Embryology**. This implies in terms of the dimension model that we get

- ***outward direction*** from the ventricles that have the lower, rear position, corresponding to original vegetative 0-pole, with blood forced forwards towards the 00-pole,
- ***inward direction*** from atria that have the upper, front position, corresponding to original animal 00-pole, with blood forced downwards, backwards towards the center pole.

This in spite of the fact that it entangles the connection to blood canals.

We have also that it is the ventricles (from 0-pole) that during evolution get divided later. (Polarizing force from anticenter in our model.)

The very triangular form of the heart as a whole corresponds to a 0-00-polarity with apex as center closer the back pole, the breadth at the front. Apex is also turned more to the ventral side.

The heart as a 3-dimensional organ, polarized mass (muscles) — space (with blood), shows also the radial structure (pole 3b in the dimension model) in its papillary muscles that depart from near bottom of ventricles (the apex).

Another detail is that the right ventricle is partly bent around the left one (*Mf p.105*), which seems guided by the venous direction inwards, hence reflecting the function of 00-pole as anticenter and inward direction in relation to the 0-pole as center and outward direction.

A similar feature is that atria from inward direction have thinner walls (highly expandable) and can be more flattened (*Aph*) - as d-degree 2 in relation to ventricles of d-degree 3 with the aspects here.

Still another, similar feature is that the channels for flows outwards from both ventricles are centered at the median of the heart, while the inflows are peripherally located: also a feature of center - anticenter relation.

In addition, the fact that inflows (have to) pass an antechamber before entering ventricles, while the outflows go directly to canals, can be interpreted as an illustration of origin of directions in a dimension chain:
- Inflows via atria as 3-dimensional rooms, i.e. from anticenter and lower d-degree towards d-degree 4.
- Outflows from higher d-degree 5 and 0-pole to d-degree 4 and straight to canals that can be regarded as substantiated structures of d-degree 4b.

Valves:
The aortic and pulmonary valves for outflows are both 3-lobated, the half-moon shaped cusps.

The valves for inflows however differ in a way that seems to reflect the opposition between the big systemic circuit and the small, pulmonary one. It's

3-divided in tricuspid valve for venous blood from the big body circuit,

2-divided in bicuspid valve for the small circuit with blood from lungs.

It happens to correspond also in number with our interpretation of the coordinate axes (file **Embryology**) as representing d-degree 3, Font - Back, and d-degree 2, R - L respectively.

It's surely interpreted in other, more physical terms by biologists. Yet, there is the similar 3-2-relation between lungs: right lung with 3 lobes, left lung with 2 lobes. (A division of number 5!) Hardly referable to the same physical causes. Neither could the fact that 2/3 of the heart is located on the left side of the middle be an explanation. Why this asymmetry? It indicates sooner that asymmetries appearing along the coordinate axis L - R have a deeper root, inherited from original complementary poles of higher d-degrees in terms of the dimension model. There is the asymmetry too in ways of arteries to head and body (as there is between the cerebral hemispheres).

5. Canals - the vascular system:

The big, systemic circuit is mainly branched 180° along the F-B-axis (front - back). The small pulmonary small circuit to the paired lungs branches naturally along the R-L-axis (right - left).

With the **earlier view** on these axes as representing d-degrees 3 - 2 it could be noted that it's connected with the d-degree step in **phases**: between exchange of chemical molecules in the big circuit and of gases (CO_2 - O_2) in the small circuit.

Number relation 2 - 1:

Arteries and the deep veins are together enclosed in a capsule of connective tissue as an expression for the two-way Direction of d-degree 4.

Often 2 veins go parallelly with the one artery, a number relation 2 to 1 between inward direction from 00-pole and outward direction from 0-pole. These data concerns humans.

Fig Bl-4-42-2

Similar 2-1 relations appear in the canals of lancelets, the simplest chordate with a developed blood vessel system:

Ventral canals, both front and back parts, are single, unpaired canals.

Dorsal veins are paired. So is front part of dorsal artery canal, not its back part (resembles a fork).

Dorsal side represent primary anticenter, the animal 00-pole, the front part the secondary anticenter (00') in the embryological development. Hence, the doubling of canals (veins) or branching of canals (arteries) seems guided by the 00-pole, in opposition to ventral 0-pole representing singularity. The opposition 2 - 1 affects both axes: Distal - Ventral and - in distal artery - the Front - Back axis. (A simplified figure below after *Kz p. 19*.)

In the dimension model the 00-pole, from which follows inward direction, is defined as primary polarizing force. It's difficult to imagine any biological reason or other necessity for the duplication in inward direction (distal, front, blood direction in veins), than the simple numerical one: the polarization of 1 to 2.

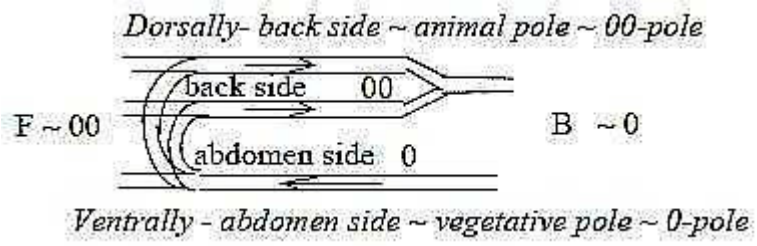

Fig Bl-5-43-1

A radial - circular polarity:

In the human body there is a net of superficial skin veins without corresponding arteries, (*Mf p. 117*) as a kind of "circular structure" of d-degree 3 towards the surface, while the arterioles instead are branched more "radially" outwards: a polarization of type 3a-/-3b in the dimension model.

Dimensional steps in size of arteries:

With biologists' designations we get a whole chain of dimensional decrease in size, (simultaneously as the ramification of vessels increases the dimensional structure as a whole 1→> 2 →> 3):

Heart -> Aorta/arteries —> arteries-> arterioles--> capillaries -> synapses.
" 5 4 3 2 1 0/00 "

Fig Bl-6-43-2

Simplified, 4 types of tissue layers can be distinguished in the arterial system:
5-4: Heart: striated, special musculature of branched cells.
4-3: Aorta - thicker arteries: 3 layers with intermediate layers of mostly elastic threads.
3-2: Thinner arteries and arterioles: 3 layers, intermediate layers of smooth muscles.
2-1: Capillaries: 2 to 1 layers, outer layer only a net of reticular web.
1-0/00: Synapses: Transportation through walls of capillaries to/from the tissue fluid.

The "pole exchange" outward/inwards) through the walls of the capillaries from the arterial to the venous system implies a kind of reverse relations in hydrostatic and osmotic pressure between arterial and venous capillaries (*Zf*), which could be regarded as expression for a "pole exchange" in terms of the dimension model in last d-degree 0/00 of motions.

(The surplus of outflow pressure is taken care of by the evolutionary later developed lymphatic system.)

From vibration to rotation:
It is noteworthy that the blood flow at an early stage of evolution (e.g. in annelids) is bi-directional: one moment inwards, next moment outwards in the same vessel à la vibration. It develops during evolution to the circular system with separated out-/inflow vessels, what may be apprehended as a rotation, a 2-dimensional motion.

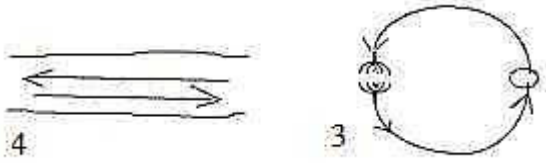

Fig Bl-7-41-1

The development corresponds to the presumed d-degrees of **motions** in d-degree 4 and 3 in our model. We get outward - inward flows, poles 4b - 4a (from 0- and 00-poles respectively) of d-degree 3 in different canals.

The appearance of special lymphatic vessels, later in evolution, implies a secondary polarity of the character 00-0, here between veins and lymphatic vessels: the opposition blood *from cells* as centers in veins versus blood from *extracellular* fluid (anticenter) in the lymphatic vessels.

Vibration →> Rotation →> Translation in 3 dimensions?
A 3-dimensional motion as "translation in 3 directions" - could perhaps be identified with the further branching of vessels in the whole body - and/or more specifically the capillary networks in all tissues as the 3-dimensional motion presumed in d-degree 2.

The lymph:
With the evolution of a lymphatic system, we have once again the relation 2 to 1, here in number of systems: 2 systems for inward direction, 1 for the outward direction. The lymphatic system connects to the venous system.

In our model the 00- pole represent the primary polarizing force, upholding potentials when in balance with the integrating 0-pole or when stronger breaking them.

This property could be seen expressed in the role of lymph in the immune system with activities of macrophages etceteras.

Geometry of lymphatic nodes seems to reflect proposals in the dimension chain:

The nodes have one convex side, one concave, which is one of the geometrical polarities of d-degree 2 proposed in our model: 2a convex →> 2b concave.

In agreement with this geometry vessels inwards the nodes go to the convex side while the outgoing vessels depart from the concave side.

Further, there is the polarity of many incoming vessels, few outgoing ones as secondary manifestations of the 00- and 0-poles, a-poles versus b-poles.

Pathways of lymphatic vessels show the same bilateral asymmetry as arteries, in fact a rather curious asymmetry: right side vessels come mostly from right side front, head and arm, while left side vessels comes from the whole body, trunk, intestines and head and arm on left side. There is a certain similarity with ventricles of heart: right ventricle pumping blood to lungs, i.e. only a front part, while left ventricle pumps it to the whole body. Yet, this cannot explain the asymmetry of pathways out in the body.

(If left hemisphere of the brain governs muscles in vessels of right side, shall we then assume that it doesn't care about the whole and only manages to serve half of the front?)

6. The liver:

The liver develops during evolution from a tube-shaped gland to a separated 3-dimensional organ. It could be said to represent the very transition between the nutrition and blood systems. It continues the breaking-down process of nutrients in the alimentary canal (proteins, lipids) but performs also synthesis, for instance of a carbohydrate as glucose. (Hence, backwards relative the process of glycolysis.)

As the liver has a double-directed performance of breaking-down and synthesis, it has double exits: excretion of dross products via the bile in one direction and distribution of nutrients in the other direction, through *vena cava*.

It is regarded a part of the venous system but blood from both arteries and veins enter the liver and merge in sinusoids: roughly 1/3 and 2/3 respectively (*Aph, p. 890*); note the returning 2-1-relation if so. According to other sources the quotient is circa 1/4 and 3/4 (*Mf*, *Wikipedia*).

Geometry of the liver shows up to be remarkably regular and strict internally:

It is the most massive gland and its cell masses and blood rooms, the sinusoids, can illustrate the polarization mass - space of d-degree 3 in our model.

Each lobule has a hexagonal (5 - 7 edges) shape and the blood canals and fluid directions illustrate to an exceptional degree the fundamentals of step 4 →> 3 in the dimension model: inward direction from anticenter, that's from the corners in the hexagons, outward direction from the center, the central *vena cava inferior*. There is simultaneously the polarity between a manifold inwards from anticenter versus unity from the center.

The lobules illustrate further the geometrical poles of d-degree step 3-2 (3b - 3a) in the radial arrangement of cells versus the circular blood rooms.

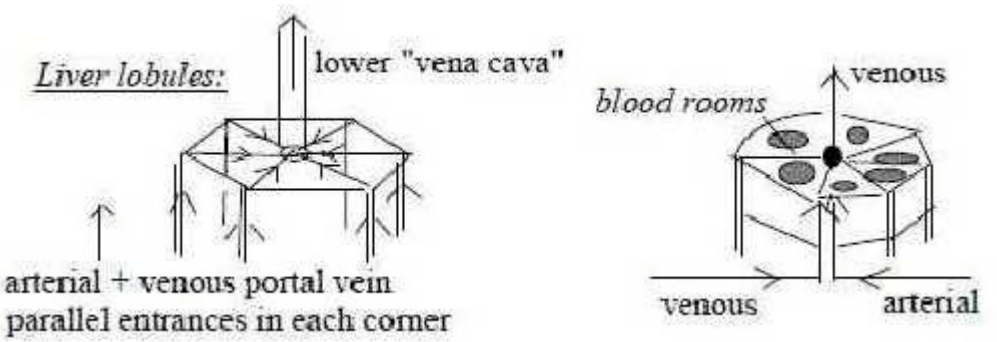

Fig Bl-8-45-1

Lobules are plates, only 1 cell thick, i.e. 2-dimensional. Thus, they give a picture of how radial/circular poles 3b-3a could characterize d-degree 2 in a way not presumed before in the dimension model. In their 3-dimensional storing they show at the same time the polarities of higher d-degrees 4 and 3, center-anticenter, outward-inward directions.

(On the macro-scale the liver is divided in 4 lobes of different sizes, right - left - quadratic and caudate lobes, as if mass was differentiated along a separate dimensional chain 4-3-2-1. With size associated with d-degrees we could imagine two levels: a) d-degree 5 polarized 4-1= quadratic + caudate lobes, b) 5 polarized 3-2 = right and left lobes.

It's said (*Aph p. 891*) that each lobe contains about 10^5 lobules, in number of 10-powers as from a dimension chain.)

Cells in the liver can have several nuclei, what is called plasmodia, the fission type where nuclei divide without division of cell plasma; this in opposition to the multi-nucleate muscle cells of the heart that are the result of fusion between individual cells, syncytium (*Kz p.150*).

This polarity fusion - fission on the cell level agrees in directions with the relative polarity F -B (00-0) of mesodermal muscles from front somites versus liver as a gland from vegetative pole. The same polarity is expressed in positions of heart versus liver, on opposite sides of diaphragm.

It's notable that liver cells also in human beings have the capacity to regenerate, showing a highdimensional potential.

7. Liver and lungs:

Gills and lungs belong naturally to the blood system. Liver and lungs illustrate in several respects the differences between higher and lower d-degrees and the complementary polarities derived from 0- and 00-poles in origin, directions, positions and shapes:

- Lungs develop from front part of the alimentary canal, partly from ectoderm, the liver as a gland from central part of endoderm.

- Lungs are positioned in front part of the body, liver in back part, below diaphragm.

- Lungs are pairs, liver an unpaired organ.

- Ways of the blood: in lungs one-way directed venous →> arterial, v →> a, in the liver v + a →> a plus the double direction to bile and *vena cava inferior*.

- Phases of substances: in lungs exchange of gases, in the liver fluids and organic molecules.

Phases:

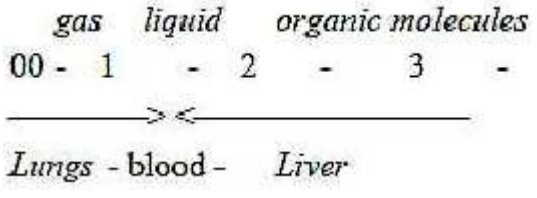

Fig Bl-9-46

Geometrical arrangement of blood vessels can illustrate the complementary polarities of d-degree steps 2-1 versus 3-2 in the dimension chain: In lungs as an organ of the surface

blood vessels get structured as half-spherical nets outside of and around the alveoli*, with gas exchange between outside and inside as poles 2a - 2b. In the liver the vessels are organized vertically and radially along perpendicular coordinate axes with blood in the inner "rooms", both features of poles 3a - 3b.

*Compare the kidneys where the blood vessels themselves get shaped as balls within a bowl-shaped capsule, a kind of inversion of the structure in the lung alveoli.

Number 5 again:
In the lungs the number 5 appears again as so often in biology- and the asymmetry left-right. Together the lungs have 5 lobes, divided 3 (right lung) - 2 (left lung). (Right bronchial tube goes also more straight downwards as a direct continuation of the windpipe.)

Each lung is then divided in 10 segments with an own bronchus to each, divided on the 3 right lobes 5 - 3 - 2 and on the 2 left lobes 5 - 5. (fusing to 8).

Muscles

1. The basic units of muscles:

Muscles are in the service of locomotion, both internal and external. How to interpret this fundamental and intricate invention?

Threads of **F-actin** are found in most cells and F-actin is said to be among the most common proteins in animal world.

Cells include a rich net of tubuli constructed of protein spirals from the membrane of nucleus outwards as a more or less complicated vector field transformed to radial and circular structures. (The nucleus then as a complex 0-pole.) They seem to function as ways for transportation of substances. So also for instance in axons of nerve cells. Such tubuli become the essential components in cilia and flagella, the first organelles for external locomotion of unicellular organisms. The contractile proteins in these have also been described as a kind of actomyosin complex (*Zf p. 212*). (Many of the involved proteins have been identified during later decades.)

The basic units of muscle cells within Z-bands of a sarcomere are the threads of F-actin and **myosin**. They are arranged in a way that in many respects illustrates the dimension degree (d-degree) step 1 →> 0/00 in the dimension model, polarizations of d-degree 1 to "motions from each other" (pole 1b) and "motions to each other" (pole 1a). D-degree 0/00 in the model is defined as the d-degree of motions.

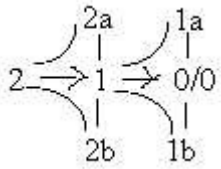

Fig M-1-54-2

- The linear threads (d-degree 1 on one level) of ***F-actin*** and ***Myosin*** within the Z-bands appear as a polarization in positions and motional directions:

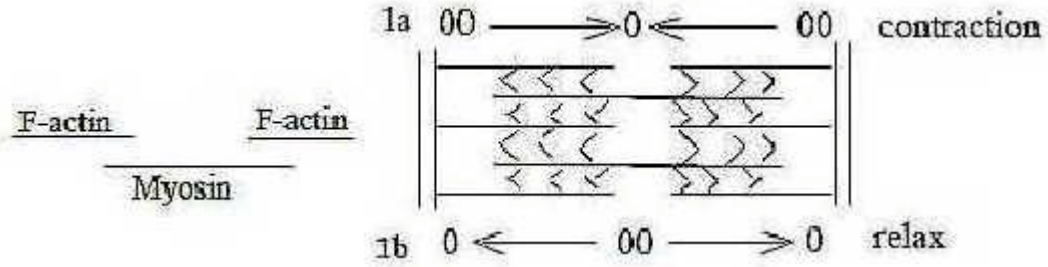

Fig M-2-5-1

- ***Myosin*** threads illustrate the "motions from each other"; they are bipolar threads with "heads" outwards and connected tails as center; the "heads" move outwards in opposite directions when active.
- ***F-actin*** threads illustrate the "motions to each other"; they are divided, the parts attached to opposite borders of the sarcomere, an anticenter arrangement, and move or rather get moved in direction inwards during active phase, returning to original position during relax.

- It should be observed that it is Myosin, representing the center, that is the active force, divergence (Vdiv), as 0-pole is defined as the binding, integrating force in our model.

- The polarity between F-actin and myosin appears also in the different construction of the threads:
Myosin (the thicker threads) is composed of double spirals of simple protein chains, while F-actin is chains of globular proteins (G-actin) as strings of beads. It could be regarded as a relation between d-degrees 4 and 3 on the level of individual proteins: vector-shape of d-degree 4 (myosin) versus the 3-dimensional globular units of G-actin, representing quantification.
(Higher d-degree is defined as binding force in next lower one in the model. So is myosin in relation to F-actin in active moments.)

We have something of a similar relation between "linear" arranged nucleotides in mRNA versus globular ribosomes, the rRNA at **protein synthesis**: a similarity perhaps worth reflecting more upon.

- Further, F-actin contains about 300-400 G-actin and the bundles of myosin about 300 parallel threads (*Aph*): hence approximately the same numbers but F-actin lengthwise, myosin "vertically", another complementary polarity.

If we regard the relation myosin - F-actin as a d-degree step, the one d-degree debranched in such a step could be identified with the transverse connections as "***catches***", polarized into motions.

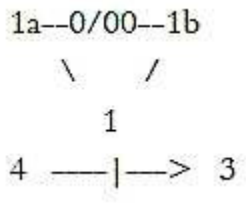

Fig M-3-56-1

In the active moment myosin and F-actin get united through catches on myosin which climb stepwise on actin in opposite directions outwards, which results in the passive contraction between the two F-actin halves. That's how the real force of activity originates from the outward direction and is depending on center as binding force.
(Elastic thin protein threads of *titin* keeps myosin bound to Z-bands.)

- Actually, the arrangement could in essential respects illustrate ***human walking*** on a much superposed level, with F-actin as the ground, bonds to active sites on F-actin as footholds. .

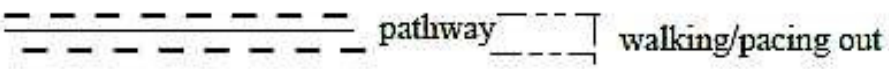

Fig M-4-56-2

There is the divergent moment, (like one foot forward) where the head of myosin with attaching catches is pointing outwards, then the drawing moment of convergence when the head of myosin gets more and more inward directed until it loses the grip (like lifting the back foot) - and a new moment of divergence starts. (A bit unfortunate to call the catching place "heads" of myosin!)
Human beings have too legs and feet. The single myosin is composed by two protein threads and has two heads as feet. (Said with reservation for any parallel in interaction.)

In the dimension model we have that pole 1b (here myosin) as "motions from each other" defines distance as a new anticenter pole 00' while pole 1a - " motions to each other"- defines a new 0'-pole. Even these definitions seem applicable in the process.

Walking includes stepwise, a bit wavy displacements of the center of ***gravity*** of the body. The bond of catches to active sites of F-actin could imply such a displacement of center. The process expressed in d-degrees should probably be described as going via d-degree 1 as binding force of motions: 1b →> 1 →> 1a, 1a →> 1→> 1b.

(With the view on F-actin as representing the 00-pole, in the model primary polarizing force, we could suspect some force from F-actin threads - or from borders of sarcomeres as anticenter - on the myosin threads too, indirectly affecting its divergence? The complexity increases when the analysis deepens towards more microscopic, underlying levels and several other proteins are involved.)

In fact, we could regard the walking or the activity of muscle filaments as a kind of substantiated **L-waves**, the type that hypothetical gravitational waves are assumed to belong to. Two parallel, phase-displaced ones - or a polarized one!

00→> 0←00 →>0 ← 00 →>0 ← 00
→> 0 ← 00 →>0 ← 00 →>0 ← 00 →>0...

An additional question is if the relations myosin - actin eventually could tell us something interesting about the relation between the outward acceleration **force (F_A) and gravitation (F_G)** in macrocosm? In which sense could F_A contribute to the contraction (F_G) of masses?

- The structure affecting the binding moment is complex (*Aph*). F-actin is in reality surrounded by winding threads of *tropomyosin*. Each of these covers 7 active sites on F-actin. (Cf. earlier arithmetical speculations about number 7 in **file Biochemistry, 1/7.**).

At the middle of these are small molecules of *tropin* attached, which have 3 binding sites: one to G-actin, one to tropomyosin and one for Ca2+ that induces the uncovering of active sites on G-actin, which get the catches of myosin to bind to them.

In this sense the active moment starts from F-actin and from Ca2+, a metal ion representing the 00-pole among **elements**, acting as such polarizing when breaking up the cover of sites on actin.

If we as above regard the structures of myosin and F-actin as a relation d-degree 4 to 3, could we eventually associate the numbers of binding sites, divided in 7 on G-actin covered by tropomyosin, and 3 on tropin, with these figures: 7 = 4 + 3, 3 the d-degree of globular F-actin?

A note
An association, however wild it may be, about molecular weights:
The relation between molecular weights of myosin (~ 500 x 10^3) and G-actin (46 x 10^3) is 500 to 46: F-actin as n x 46.

An association to numbers in the genetic code: In the suggested number series behind the **genetic code**, the numbers 500 and 460 appear, see the figure below. And total sum of the 20 + 4 double-coded amino acids for 24 differentiating codons = 6 x 546.
Ca2+, 40 A, is the ion that when attaching head of myosin triggers a contraction.

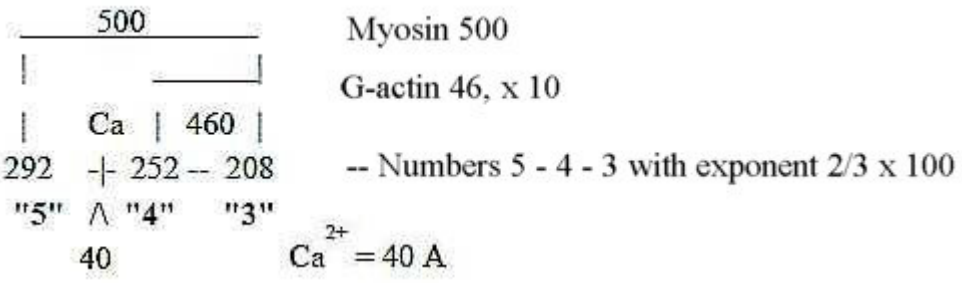

Fig M-5-56-3

[Since mass number 101 of side-chain of Arginine represent last step 1 - 0 (+1) in this **exponent series,** one could wonder if this amino acid eventually plays an important role in the structure for locomotion. It's said to be rich in fish sperm-tails and is essential in the creation of creatinephosphate and in the corresponding energy-storing substance arginine phosphate among shellfishes.]

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2. Levels of storage:

The number of levels from the single protein threads of F-actin and myosin to a whole muscle is about 5 to 6, as number of steps or "borders" in a dimension chain.

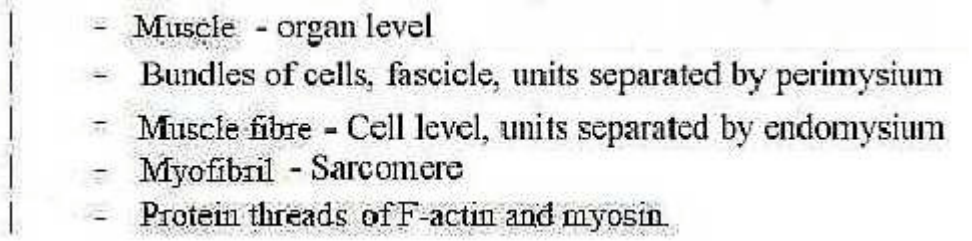


Fig M-6-54-1

Compare number 5 in levels of storage in other structures too as those in a hair or in collagen.

[It's natural to ask how then the number of something would be related to a chain of different dimensions. Through a dimension chain as process outwards a 5-dimensional unit gets translated to 5 x 1 linear dimensions. The addition of units in each step inwards could be suspected as guided by convergence from the 00-pole at end of the chain. (Just one aspect among others. Cf. 5-merous flowers and fingers of a hand.)]

3. Muscles in chains of organs and tissues:

Muscles originate from mesoderm and can be regarded as the essential intermediate organs between the two vector fields (file **Levels**), the nervous and nutrition systems (as between poles 4a - 4b in the dimension model). Striated muscles need innervation to develop and one primary function of locomotion is seeking for food, demands from the nutrition system (4b),

Muscles become massive organs and fill a big part of the body between central intestines and the body surface of an early chordate as the lancelet. In grown up humans the muscles make up about half the weight.

In the chain of **tissue types**, with regard to degrees of internal to external fiber production, muscle tissue appear in the middle, from mesoderm but still without the external fiber production characterizing bone, cartilage and connective tissue.

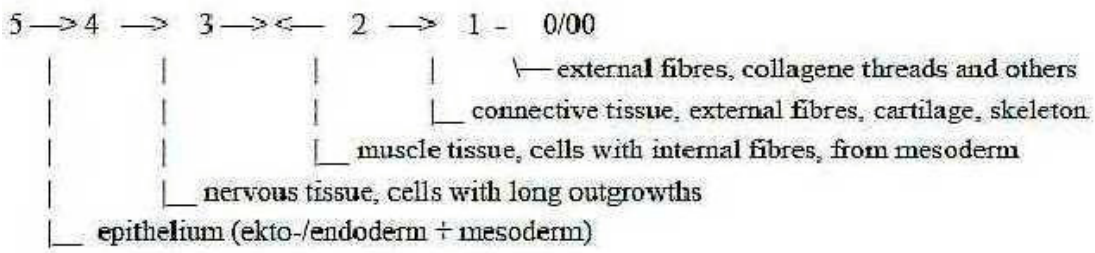


Fig M-7-47-2

A muscle as organ is encapsulated by connective tissue and a web of reticular threads (steps 2 - 1 in the tissue chain), while nerves and blood vessels (regarded as vectors from higher systemic degree (poles 4a and 4b, outer poles of d-degree 3 in the model) enter at straight angles through the covering, both through outer *perimysium* and inner *endomysium*. Often together (thus not as in the figure below).

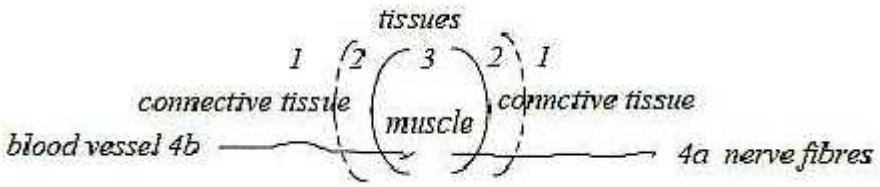


Fig M-8-47-3

4. Nerve cells - muscle cells, evolutionary aspects:

A motor nerve cell has long axons with tubuli of proteins radially outwards from the cell.

A muscle cell in an early version as in cnidarians is the *epitheliomuscular* cell (*Ez p. 59*). It has the protein fibers in straight angle to a short projection of the cell and is part of a ring-shaped contraction system (*Ez p. 59*). Hence, it resembles in structure a bipolar cell in the sensory nervous system.

As motor and sensory pathways represent outward and inward directions respectively and simultaneously have the relation between higher and lower d-degree, so could this early muscular cell reveal the relation between the nervous system and muscles as organs. Cf. the angular step 180° to 90°, corresponding to a step 4th to 3rd d-degree according to assumptions in this model..

Fig M-9-48-1

Muscles develop in similarity with other organs from lower towards higher d-degrees: from muscle threads (as d-degree 1) to layers (2) to muscle masses (3).

In the history of evolution first muscles seem to appear in "2.5"-layer organisms, *Diploblastica*, with 2 layers and an intermediate substance but no real mesoderm. The mentioned epitheliomuscle cells form a ring around the border of the bell-shaped jellyfishes for instance. (However, already 1-layer organisms have certain cells that resemble visceral muscle cells (*Ez p. 54*).

Later during evolution a skin-muscle sac develops as for instance in earthworms: a tube-shaped layer of circular and longitudinal muscles, which becomes one expression for poles of d-degree 3 in our model.

Then, in 3-layer animals comes the development of striated muscles out of the inner, thickened plates of somites and several muscular layers combine to "muscle *mass*".

It would be a possible alternative to regard the design of muscle tissue also as substantiation of external **motional moments** in different d-degrees:, in this case from higher to lower ones. As suggested in the model:

- In D**4**: Vibration, halved, just one of the moments, contraction, designed in operation of the individual actomyosin threads.
- In D**3**: Rotation, motion in the plane: designed as a ring of muscle cells.

- In D**2**: Motions in 3 directions, in one form rotation plus "translation": designed e.g. in the tube-shaped layer of the earthworm or e.g. in the peristaltic motions of intestines. Note that these latter muscles in reality go in spirals (*Kz p. 187*), another form of 3-dimensional motion: rotation superposed a linear pathway. Or, as "translation in 3 directions" (with the terminology from motions of 2-atomic gases) the 3 directions of muscle fibers in the tongue.

- In D**1**: A 4-dimensional motion suggested identified with pumping inwards **/** outwards: designed in the heart sac and its spherical muscle net (also with a kind of spiraling layers) and with internal radial muscles to valves in the ventricles.

5. Muscle types:

a) Striated - Visceral muscles:
This polarity reflects both the original center - anticenter one of vegetative - animal poles and the derived front - back polarity:
- *Visceral muscles* serve the central nutrition system, alimentary canal and its glands, blood vessels - and womb (uterus), also an organ for nutrition.
- *Striated muscles* connect (via tendons) parts of **skeleton**, identified here as developed in d-degree 2 - 1 in the dimension chain of organs.

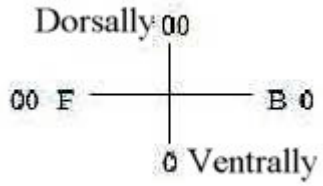


Fig M-10-50-1

- The inner (*splanchnik)*, obviously more ventral back part of lateral plates of mesoderm gives visceral muscles.
- The inner part of the front, dorsal plates from somites gives striated muscles.

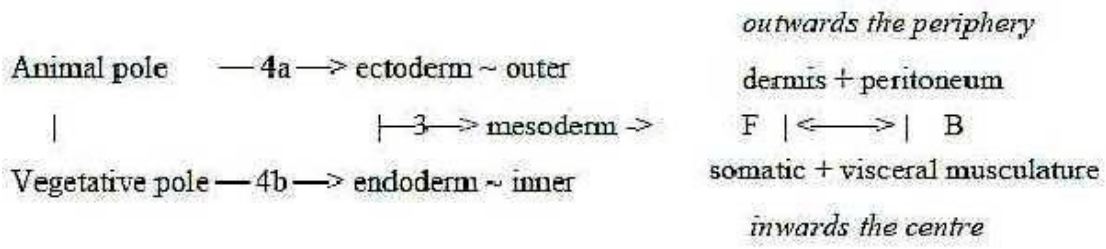


Fig M-11-47-1

"Striation" seems to be an effect of the front and anticenter 00-pole. Visceral musculature around front part of the alimentary canal during evolution develops to the striated type in jaws and gill arches. And as mentioned above, (at least?) striated muscles need innervation from nervous system as 00-pole to develop.

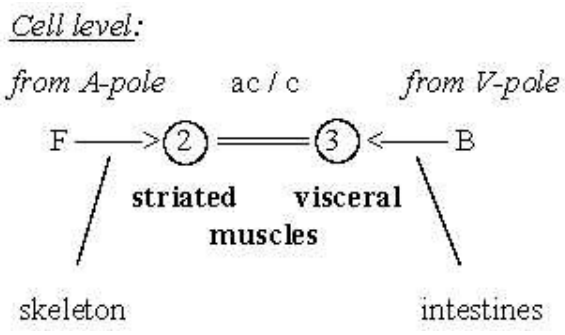


Fig M-12

The two kinds of muscles show on the cell level a polarity of the type 0 - 00 in more than one respect:
One is the opposition unity - multitude, another center - anticenter:
- *Visceral muscles* have only one nucleus.
- *Striated muscles* have several nuclei. These are also result of fusion, in this sense of inward direction, as from the 00-pole, the front pole of the F-B-axis.

(There exist also a type of intermediate multiunit smooth muscles (*Aph*) and in striated muscles single-nuclear cells surrounding the other that have the ability to fuse, i.e. converge from anticenter, and at damages begin to produce fibers.)

- Inner and back visceral muscles around intestines have their nuclei in the center.
- Outer and front striated muscles have the nuclei at the periphery, the anticenter.

- Visceral cells have filaments and fibrils unordered in different directions.
- Striated muscles have the filaments paralleled and arranged in the "sarcomeres", described in No. 1, and in myofibrils. They also differ a bit biochemically in effectuation of the motions (*Aph*).

How should this difference be interpreted with aspects from the dimension model? We could see the "unordered" multidirections of fibers in the visceral type as of higher d-degree in relation to the paralleled, linear order and one-way direction of the striated ones. More "order" towards lower d-degrees? Cf. that striated muscles, gathered to the 4th level of storage (fascicles) can have different directions: convergent, pennatem, circular besides the parallel one (*Aph*).

- Visceral muscles have a certain own capacity of electric conductivity - and are regulated by the deeper, autonomous nervous system, while striated muscles are governed by more superposed centers in the brain. Also, naturally, connected with the fundamental 0-00-polarity.

The innervation of visceral muscles differs too, possible to regard as a geometrical expression for a radial 3-dimensional structure versus a plane 2-dimensional formation:
- Visceral muscles have more unordered free nerve ends in the neighborhood.
- Striated muscles have end plates of the nerves in close contact with the muscle cells.

b) Electric tissue:
Relative to other tissues and organs muscles have here been regarded as representing a development in d-degree step 3 - 2. Thus, it's interesting that muscles can be specialized to electric tissue. With the general assumption in the model that **Charge** in relation to Mass as physical qualities may be analyzed as a relation of d-degree 2 to 3, this specialization implies a step or half one to d-degree 2: the muscle fibers become flat layers, one-sidedly innervated, stored in Volta piles with the ability of electric bursts. (Simultaneously with a reduction of fibers.)

c) Heart muscles:
The heart muscles represent a third type besides visceral and striated ones, combining

properties of both, a kind of pole meeting between the other types (cf. *figure 12* above). They serve the nutrition system but is positioned in front part of the body (~ that of the 00-pole), on an early stage in *suprasternal fossa*, the juggular notch (!).
- Cells have only one nucleus, with central position as in visceral musculature.
- Filaments are however striated, paralleled, but cells also branch to a network; cf. radial divergence as one pole of d-degree 3.

Further, the musculature is autonomous in nervous activation - as to a certain degree the visceral muscles. It has its own center for nervous impulses. With the loop version of our model where opposite directions meet in the central step 3-2, a new kind of center may be assumed to develop. (See the **Blood system**.)

Heart muscles in 3 layers form the "spherical" sac, and inner radial muscles guide the valves; hence illustrating the geometrical polarity circular - radial in d-degree step 3 - 2.

Radial components depart from a center. In similarity with the radial muscles to the heart valves, departing from bottom of the ventricles, which represent outward direction of the blood, the signals from atrium go first to the bottom of the ventricles before they spread upwards = outwards in the walls of ventricles.

6. Arrangement of striated musculature:

a) Limbs:
Striated muscles in the limbs get the function of binding forces between skeleton parts as higher d-degrees in relation to lower d-degrees in our model. They are principally "phase displaced" in relation to sections of the skeleton bones in arms and legs - in a certain similarity with the arrangement of myosin and actin in the individual muscle cell fibers, - and with steps in walking:

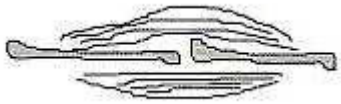


Fig M-13-52-1

Since the activity of a muscle is only contractive, the polar function between stretching and flexing moments (← → and →←) in motions is attained through complementary, antagonistic arrangement of the muscles.

The upper arm of a human being taken as one example: It has muscles with 5 origins as attachments, divided 3 and 2, triceps and biceps.
- **Biceps** with 2 "heads" or origins is a muscle on ***ventral*** side of the upper arm.
- **Triceps** with 3 origins is a muscle on ***dorsal*** side.

This arrangement seems at first to contradict what we could believe from aspects on the dimension chain where dorsal side originate from 00-pole and lower d-degrees, ventral side from 0-pole and higher d-degrees. It seems also to contradict biological needs; 3 origins of a muscle should give more strength, better needed in flexing activities of the arm than in stretching it? (Demonstration of strength shows the biceps, not the triceps!)

The explanation seems to be just geometrical, the arrangement founded in geometry: The 3-headed muscle ***stretches*** the arm, expressing the radial factor of d-degree 3 in our model, while the 2-headed biceps ***bends*** the arm, expressing the circular factor of d-degree 3, derived from inward direction and anticenter in the model. (Such facts could support the views here that fundamental geometries rule.)

(Yet, the 2 origins of biceps attach to front parts of the shoulder blade (scapula) on *dorsal* side of the trunk. (Insertion on forearm, inside of elbow.) Triceps: 1 origin on lower part of dorsal scapula, 2 origins on upper arm. Insertion on forearm, outside of elbow.)

A muscle is mostly firmly anchored in one point, movable in the other, which implies that it has a kind of direction. Cf. poles 4a-4b as outer poles of d-degree 3 in our model.

The complementary relation in the function of these muscles appears also in lengths of their tendons: biceps has long tendons proximally, short distally, while triceps has short tendons proximally, longer distally (*Mf p. 81*).

Number 5 in origins of these muscles return - naturally? - in the 5 spinal nerves that innervate the arm. Possibly too connected with the number 5 in hands and feet.

(The bending of the arm could also be regarded from the aspect of angle steps, 180°→> 90°→> 45°..., hypothetically assumed connected with d-degree steps 4 →> 3 →> 2...)

Muscles in the legs show the same agreement between number of origins and geometrical function as the arms: the "4-headed" muscle stretches the leg at the knee; a 1-2-headed muscle bends it. In the legs however, the number of origins don't contradict the dorsal-ventral polarity: the 4-headed muscle is ventral, the 2-headed muscle dorsal.

This fact could in itself follow from origin of ventral and dorsal sides from primary vegetative 0-pole versus primary animal 00-pole: arms at front part from original 00-pole, legs at back part. It could indicate the reversal of reversal in directions:

0→> 4→> 3 →><← 2← 1← 00.

About the number of heads of the muscles, we could here remember the loop version of the model which implies three steps of polarizations of number 5:

5 → 0 + 00, 5 → **4** + 1, (~ legs), 5 → **3** + 2 (~ arms).

Cf. legs — corresponding to the d-degree step 4 → 3 from A-V-axis to front - back axis F - B. (See **Embryology.**)

b) Musculature of the trunk:

Along the median line of the trunk there are no muscles, probably depending on the fact that muscles originate from mesoderm and somites laterally, on either side of the central coordinate axis of the gastrula.

Both longitudinal (rectus), transverse and oblique muscles develop in the trunk, as expressions for angle steps 180° →> 90° →> 45° (associated with coordinate axes 4 - 3 - 2 in the assumption about angle steps).

(The six outer muscles of the eyeball operate in a similar way: horizontally, vertically and in oblique directions.)

The transverse muscles lie under the layer of oblique and longitudinal ones as the ring-formed muscles around intestines inside the longitudinal. It's naturally explained by the function: the latter should of course not be included in contraction of the ring-formed, transverse ones. It could however simultaneously reveal that the ventral - dorsal coordinate axis in the plane of these muscles precedes the front - back axis in the **embryological** development.

Then, the two longitudinal, ventral muscles go closest to central F-B line of the trunk, on each side, as in agreement with the dimensional interpretation. They reveal a reminiscence of segmented animals and segmented somites of the embryo in being divided by transverse bands of tendons into 4 -5 or 6 sections ("the six-pack"). Notice again the number about 5 as steps in the dimension chain,

Muscles of ribs:

Inner and outer layers of oblique muscles develop more laterally. Cf. the lateral coordinate axis L-R as the 3rd one in embryological development, assumed as

representing d-degree 2. After a d-degree step 4 →> 3 (180° →> 90°) we get a polarization in two directions to +/- 45° as illustrated in the figure below. This could explain why there are two layers of oblique muscles and how one of these layers on illustrations seems to lie under the longitudinal one, one outside it.

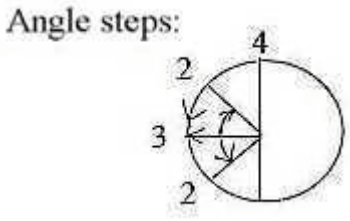


Fig M-14-53-1

One definition of geometrical poles out of d-degree 2 in the dimension model is the polarity inside - outside, with origin in the poles outwards - inwards of d-degree 4.

The oblique muscles of the ribs that serve the breathing illustrate these polarities:
- Inner rib muscles when contracted give ***exhalation***, ~ outward direction of air.
- Outer rib muscles when contracted give ***inhalation***, ~ inward direction of air.

Further, direction of the muscles at exhalation is outwards from central line viewed in direction back →> front, while direction of muscles for inhalation is inwards the middle:

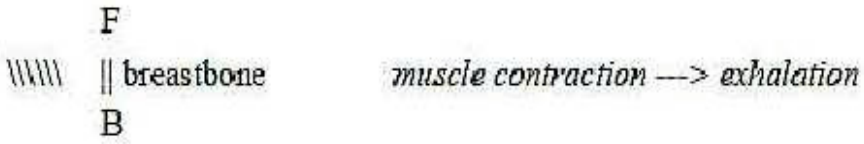


Fig M-15-53-2

Fig M-16-53-3

Skeleton

1. Muscles →> cartilage →> bone, tissue types:

Muscles get encapsulated in connective tissue and tendons of connective tissue attach to the skeleton of cartilage or bone.

Cartilage and bone originates like muscles from *mesoderm*, the 3rd layer in the gastrulation of the embryo. It's characterized by scattered cells in extracellular fiber substance, corresponding to step 2 - 1 in the suggested chains of tissue types (file **Levels**, No. 5).

There are several features besides the tissue type that support the view on skeleton as characterized by dimension degree (d-degree) step 2 - 1 in a **dimension chain of organs** - to the extent that the organs can be interpreted as such a chain. It's also characterized by anticenter in several ways:

- The mentioned origin from mesenchyme cells, i.e. free cells at the end of the **level chain**. (Bone can also derive from cartilage.)
- Osteoblasts and osteocytes are formed from the neural wall (*Kz p. 16*) around the neural plate, original animal pole 00 of the embryo.
- Bone cells become oriented in concentric circles in the tubular bones as anticenter around blood vessels.
- Inorganic material is built-in into the skeleton from the surroundings, metal ions as Ca2+ for instance (metals representing the 00-pole in relation to non metals among elements in the **periodic system**). Notice that the same concerns blood, the last, 5th kind of tissue. Metal ions from surrounding anticenter become part of the structure, not only free ions in liquids.
- Elementary forms of skeleton on a macro-level is "1-dimensional" needles or tubes, straight or bowed, or 2-dimensional "surfaces", bone-plates or shells.

An exoskeleton is clearly a surface, d-degree 2. In an endoskeleton as supportive structure the spinal column and skeleton of limbs give the basic form of the organism as lines (d-degree 1) like elements in an architectural drawing.

2. Evolution:

Already unicellular organisms show elementary forms of skeletons as spicules or shells. Skeleton substance get stored as layer outside the epithelium of the skin, for instance by corals.

One-layer organisms as sponges produce needles, spicules in the substance inside the outer epithelium, between outside and inside - as between d-degree poles 2a and 2b (!):

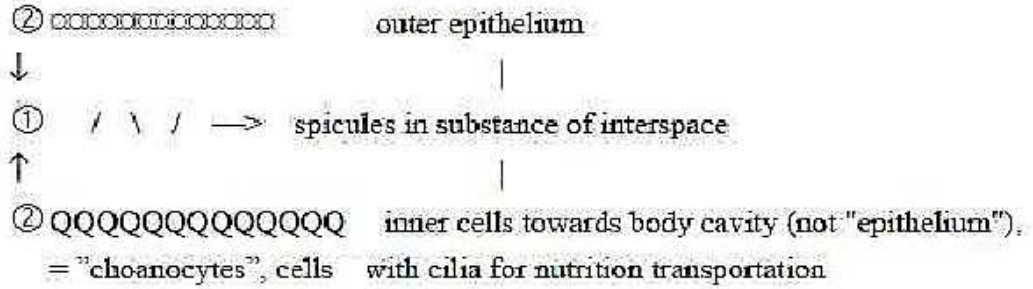
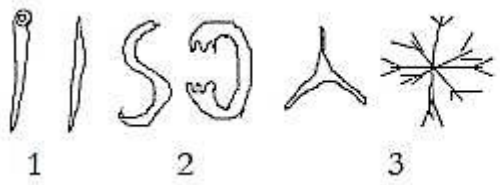


Fig Sk-1-57

Spicules of the sponges have a lot of varying shapes, "drawing elements" that differentiate species: with / without endplates, S-formed, bowed with opposite directed, concave and lobated endplates, radial three-numbered or 6-numbered with secondary ramifications etc. They seem to express geometries of d-degrees 1- 2 - 3. (Radial /circular shapes for instance, poles 3b - 3a in our model, are outer poles of d-degree 2.)



(fig. freely after Ez p. 55)

Fig Sk-2-58

It would be very interesting to know how these different shapes are expressed in genetic differences!

A main division in **evolution** of species among 3-layer animals is the one between *Protostomia* as arthropods with a skeleton as an outer shell, an exoskeleton, and *Deuterostomia* with endoskeleton: a spinal column in vertebrates and many staff- and tube-shaped elements.

This opposition concerns origin of material from ecto- versus endoderm, thus directions from outside or inside respectively, poles 4a and 4 b in the model, which also are assumed as "outer poles"of d-degree 3. See further **Evolution**. It shows also features of the polarity circular - radial structures in next step 3 - 2.

A secondary polarity of tube-shaped bones is the one of convex versus concave ends, geometries of poles 2a and 2b of d-degree 1 (the tubes on a macros-scale):

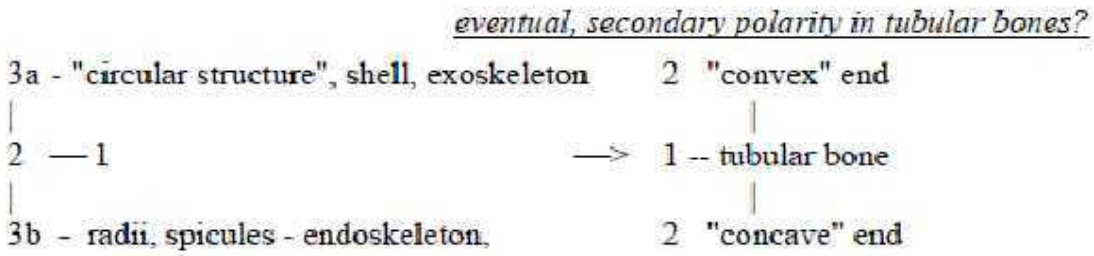


Fig Sk-3-58-2

However, also the vertebrates develop shell-like plates as around the brain and in the pelvis. There are no absolute borders.

The primarily most massive, "3-dimensional" skeleton element in vertebrates seems to be the vertebra. It could be connected with the fact that they in evolution develop as bony replacement of the notochord, which originate from archenteron and the vegetative pole, the endoderm.

3. Skeleton of the trunk in vertebrates:

In a lancelet, regarded as a basal subphylum of chordates, the **skeleton** of the trunk as a whole gets roughly the same structure as the **blood** system (lacking blood cells). (Note that both make up the last tissue types where also metal ions are built in as elements of structure.)

The notochord stretches along dorsal aorta, ribs along arteries of gills, breastbone along ventral aorta.

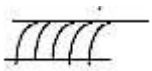


Fig Sk-4-58-3

Simultaneously, the relation blood system - skeleton shows opposite directions: ribs depart from the dorsal side (~ 00-pole), from the spine, and only some of them reach the breast bone. While the blood stream through gills has opposite direction, goes from ventral aorta (~ 0-pole) upwards through gills towards the dorsal one. It's a polarity as from V- and A-poles respectively, ventral - dorsal sides, originally from inside - outside.

(It may also be noted that the ribs on the ventral side bow upwards towards the front part: ventral side as from 0-pole with direction forwards seems to have an impact on this secondary feature.)

The ribs - in the plane of the 3rd coordinate axis right-left (from step 3 - 2 in the embryo development) get roughly a circular structure. The segmentation of the ribs becomes analogous to the segmentation of somites of the embryo, which gives striated muscles, i.e. characterizes front and dorsal parts as polarizations from the 00-pole.

Coordinate axes 4 - 3 - 2
in the embryo

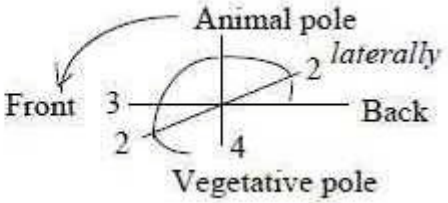


Fig Sk-5-59-1

The complementary features in **dorsal - ventral** design appear in later chordates in the surface character of the shoulder blades as rest of a dorsal ("circular") ***shield*** versus the radial character of collarbones (*clavicles*) on the ventral side; the opposition 3a - 3b in he dimension model.

It could be added that the ribs are 2 x 12, at least in humans, as sum of 5 + 4 + 3: cf. the **genetic code** and 14 and 10 in the $2x^2$-series behind **the periodic system**. The 12 pairs divided: 7 (attached to breastbone), 5 divided into 3 that are fused and join the 7, + 2 "floating" without any ventral contact.

Shoulder blades and bones of the ***pelvis*** with ridge and "knobs" could in themselves illustrate forms of d-degrees 2-1-0. Pelvis bones of back part (from vegetative pole) form more of a circular form from d-degree 3, and are bigger in size.

The bones that cover parts of the dorsal side underlines skeleton as an organ characterized by anticenter: distal side representing original 00-pole. They serve as shelters but also as attachments for muscle tendons of the limbs, the "extremities".

About the production of blood *(from file Blood)*:
Blood is at first in the embryo and among early chordates produced by the spleen, a gland developed from the vegetative and nutrition system. Then it becomes produced in the skeleton.

This "changeover" could be interpreted in accordance with the loop version of the dimension model, where the d-degree step 4 →>3 correlates with step 2←1 inwards the nutrition system. a turn in direction towards the nutrition system to which blood system belongs.

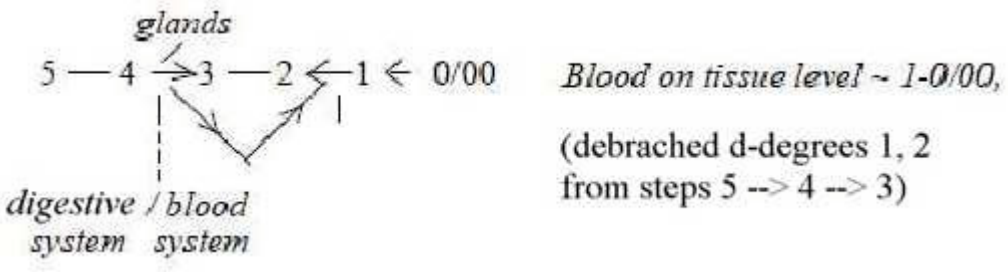


Fig Sk-6-59-2

4. Why extremities and why from surface of the body?

It feels natural (at least for a closer relative to a starfish) to think of extremities as radiating from a center, bones in extremities departing from spinal column or the like. This is however not the case. It's truer about blood and muscles but skeleton for arms and legs are derives from lateral tissue at the surface of the body like the spicules of sponges mentioned above, and they are only loosely connected with skeleton of the trunk. A rather curious fact. (Cf. on the unicellular level where basal bodies of **cilia** are positioned right below the surface of the cell membrane.)

One simple aspect on this fact is the simple geometry on a macro-scale:
Trunk →> Skin →> limbs as d-degrees 3 →> 2 →> 1.
The same simple view could be applied on ciliated unicellular organisms.
(However, we should eventually see d-degree 1 in this case developed "between" trunk and skin in step 3 - 2; cf. that 3 of the 5 origins of arm muscles in humans, serving the elbow joint, attach to the trunk, 2 to the forearm.)

Another aspect is function: the limbs become vectors, developed as the fundamental, dimensional polarity 0 == 00 of d-degree 4 between **whole organism as 0-pole**, defined by its demarcating skin, and its **surrounding as 00-pole** (water or later solid ground).
The extremities serve locomotion, d-degree 0/00 of the dimension model, locomotion in the external world.

Tubular bones of limbs develop and get strengthened through pressure. Pressure (F/m^2) becomes a 2-dimensional force when the primary force as in the model here is defined as a 4-dimensional vector (e.g. F_G, gravitation). Hence, the limbs could be suspected to be primarily straight (linear) vectors as counterforces to this pressure.
(In this sense legs could be seen as created or induced from outside, from the environment, with a divergence force from the pressure pointing inwards the body and radiating to several (5) segments of spinal cord for innervation.)

However, the development of legs in 3-layer animals must have a deeper cause. Internally given. Segmented animals as e.g. millipedes have 1 pair of legs on each segment, segments that in human beings are merged and united to 2, head uncounted. (Already the division of **mesoderm** shows this division into 2 differing "segments".)
Segments get obviously uniting during evolution. (Cf. that 5 foremost segments of neural tube in crabs become its brain.)

Legs develop along the lateral axis left-right, L-R (as in crocodiles), and become later among land living chordates mostly or partly parallel to the dorsal - ventral axis, which corresponds to original animal - vegetative axis (A-V). With first 3 axes, A-V, F-B and L-R representing d-degree 4 - 3 - 2 (see file **Embryology**), legs appear given as the 4th axis, corresponding to d-degree 1.

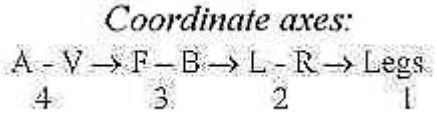


Fig Sk-7

Simultaneously, while legs of chordates develop from the paired (hence "lateral") fins of fishes, many fishes have also dorsal and ventral fins. Cilia →> bristles →> fin rays are to regard as the general principle of something sticking out as vectors or "field lines" into the surrounding, getting many functions for both sensations and locomotion.

5. Tetrapods and their extremities:

On a macro-scale a tetrapod gives a picture of a pentagon or hexagon (with or without tail!), as the rings of the molecules in RNA - DNA or in carbohydrates as riboses - hexoses. (Leonardo da Vinci, who drew the man in a circle, didn't know about molecules and their forms!)

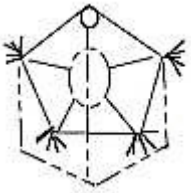


Fig Sk-8-60-1

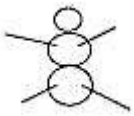


Fig Sk-9-60-2

Number 4 in extremities:
Number 3 in division of the body: head, front part and back part of the trunk.

Number 5:
Why is exactly this number 5 developed in limbs of chordates? In human hands and feet? Hardly accidental. There is the same 5 in **"5-merous" plants**. Cf. also development of the 5 brain bladders. Number of gill arches is also usually 5 in cartilaginous fishes (*Kz p. 29*). And as said above there are the muscles with 5 origins to the arm, nerves from 5 segments of spinal cord (vertebra) to arm etc.

(It is said that the original segmentation of somites, of muscles etc. among fishes has been indistinct in tetrapods but can be seen in the embryos (*Kz p. 179*).)

The 4-legged fish *Ichtyostega*, found on Greenland, had already the 5-rayed design and all the 27 bones of a limb including hands, forearm and upper arm bones of a developed land living chordate.

The number 5 appears already among the invertebrates, early precursors to the vertebrates, as for instance in the number of arms of starfishes, although secondarily developed. Among invertebrates along the other line of evolution there is the big group of *decapods* among crustaceans with 5 pairs of extremities, and further for instance the ten-armed cuttlefish (*cephalopod*) with 10 tentacles.

Pairs of segments that get used as legs: either a multitude or →> 4 →> 3 →> 2→> 1: crustaceans 4 where the 5th pair becomes gripping (prehensile) claws; spiders 4 pairs; insects 3 pairs, mammals 2 pairs, birds and human beings 1 pair.

Here is this number 5 naturally assumed as rooted in the 5-dimensional background model, a development of number of steps in a dimension chain:

Transformation of a dimension chain as structures to number of something:

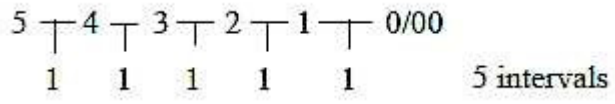


Fig 10

6. Geometrical forms of arms and legs as a dimension chain:

D-degrees of geometry: Finger tips 0/00: points;
↑ hard nails (dorsal side ~ 00), soft tips (ventral side ~ 0)
↑ Fingers: 1, lines
↑ Palms: 2, surfaces
↑ Wrist bones: 3, "nodules", ~ mass
↑ Arm bones: 4, vectors: outwards 1, "inwards" ← 2.

Joint types*, *3 →> 2 →> 1 bending axes:
Types of synovial joints in the body are about 5 or 6 if we include the gliding ones between metacarpal bones: Ball and socket j., Pivot j., Ellipsoid (condyloid) j., Saddle j., Hinge j., Gliding j. (*http://www.teachpe.com/anatomy/joints.php*).

There is mainly decreasing degree of flexibility from shoulders and hips towards fingers: To simplify:
- Shoulders and hips: Ball- and socket joints, a 3-dimensional motion.
- Elbows and knees: Hinge joints + the pivot, rotation type between radius and ulna in forearm and corresponding bones in calves. Motions in 2 planes.
- Wrist: Condyloid (ellipsoid) joints between forearm and carpal bones: More limited motions in 1 of 2 planes.
- Saddle joint of the thumb, allowing rotation in 1 plane.
- Finger joints between phalanges: hinge joints, mobility in only 1 plane, extension / flexion.

The directions of mobility get more crystallized towards one-way direction outwards the fingers in accordance with a main view in the dimension model. Simultaneously, the "freedom of degree" increases naturally with every joint along the limbs - as d-degree of motions increases towards lower d-degree of structure in the model. (However in about 7 steps in tetrapods).

An outline of the directions of movements as angle steps:

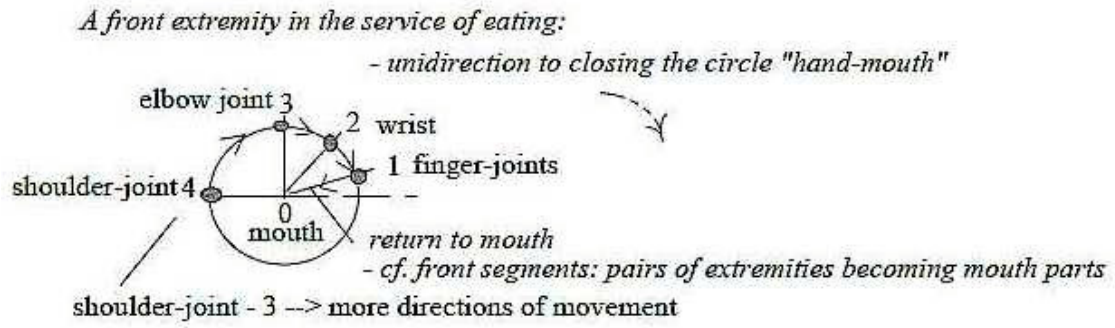


Fig Sk-11-62-1

7. Hands and feet:

- From wrist to fingertips (radially) there are 6 bones, proximal and distal wrist bones

(carpal bones in approximately two rows), palm bones (*metacarpal bones*) + 3 finger bones (phalanges), 2 in thumbs.
- Left-right (circular) there is principally 5 branches.
Cf. 6 "borders", 5 intervals in the dimension chain:

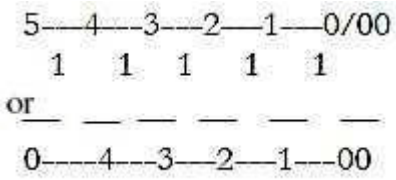


Fig Sk-12-62-2

A certain differentiation appears in human hands also among the "branches", here illustrated as angle steps of a dimension chain:

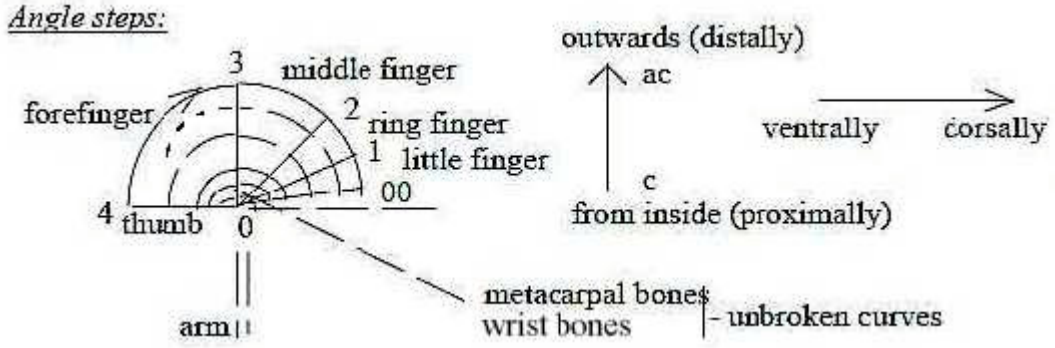


Fig Sk-13-63-1

(Cf. Some of the names: "forefinger", in Swedish "pekfinger" = the pointing finger, is associated with direction, d-degree 4.)

Tendons:
Details of tendons in the hand and its innervation can be interpreted with aspects from the dimension chain.

Relation between ventral palm and dorsal back of the hand originates from the 0- and 00 polarity which also is a relation between higher and next lower d-degree. The loop version of the model implies 3 polarizations of 5: 5 →> 0 - 00, 5' →> 4 - 1, 5" →> 3 - 2.

Dorsal side (~ 00-pole) of fingers has no muscles, only tendons, connective tissue of lower d-degree than muscles according to the identifications **here**. While ventral side of fingers and the palm (~ 0-pole) includes muscles.

Tendons to fingers, number division:
- Back of hand, dorsal side: division to fingers: 1 - 3 - 1
- Palm, ventral side: division to fingers 1 - 4.

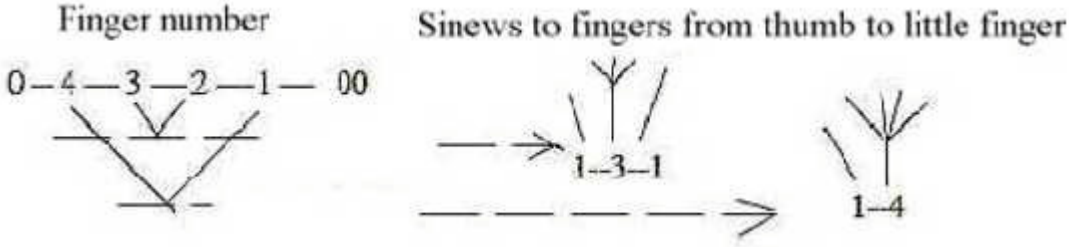


Fig Sk-14-63-3

Innervation:
The innervation - if rightly understood here - follows a similar scheme of divisions 4-1 to 3 - 2 when it concerns the polarity motor - sensory nerves, outward/inward direction, also a polarity corresponding to higher versus lower d-degrees:

The *motor* nerves:
- *N Medianus* through the center of forearm and wrist innervates the bigger muscles of the thumb and its opposition to the other fingers.
- *N Ulnaris* passes through forearm more distally and innervates the smaller muscles of the other 4 fingers plus their lateral movements.
Hence, the motor innervation divides the fingers 1 - 4: thumb - the other ones.

The tactile, *sensory* innervation divides them approximately 3 - 2 (or 3.5 - 1.5):
- N Medianus innervates the 3 (3,5) inner fingers,
- N Ulnaris the 2 (1,5) outer ones.

The arrangements illustrate how the opposite directions outwards → ← inwards (~ poles 4b - 4a) between motor and sensory nerves also simultaneously appear as a d-degree step in number division 4 - 1 to 3 - 2, in accordance with the loop version of the dimension model.
It's notable that the sensory innervation as inward direction from anticenter also is displaced a bit, half a step towards the 00-pole ~ outer side.

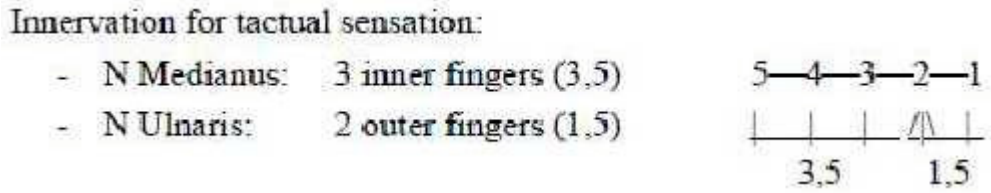


Fig Sk-15-64-1

Carpal bones 8 (+/-1):

There are 8 bones lengthwise from shoulder joint to finger tips and 8 (+/-1) carpal bones arranged as in two rows along a transversal axis, a turn 90° The number could eventually be interpreted as the sum of vectors poles 4b and 4a, turned to a 90° of polarity in d-degree 3, see figure below?
Another aspect concerns the transformation between numbers 5 and 8: how 5 become 8 or 8 becomes 5 - a principal sketch:

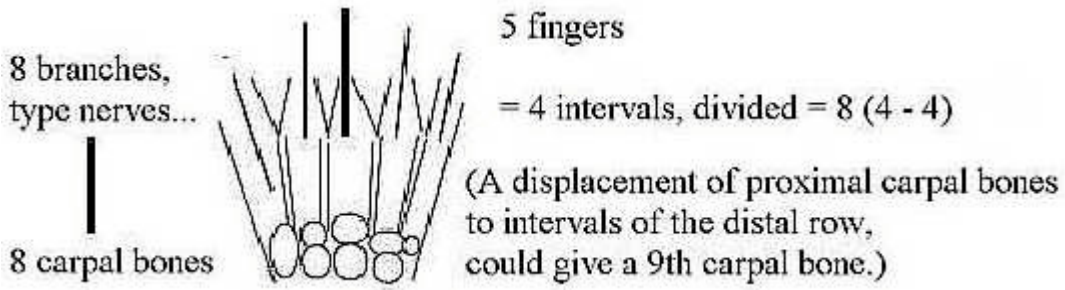


Fig Sk-16-64-2

The arm lengthwise = 8 steps, interpreted as 5 in accordance with the same principle:

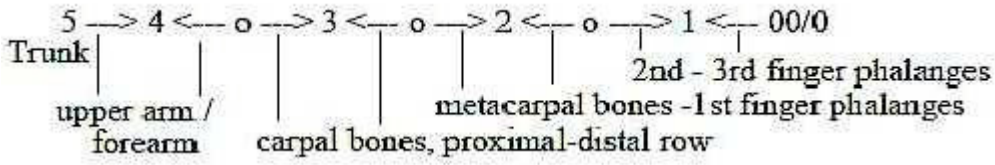


Fig Sk-17-64-3

Compare the interpretation of geometrical forms above:
- upper arm-forearm as vectors (4) outwards **/** "inwards"*,
- wrist bones (carpal bones) as nodules (3),
- palm bones (metacarpal bones) as surface (2), cf. web between fingers **/** toes !
- finger phalanges (1).

How to motivate implications of such a figure?
- That bones principally are formed through the opposite forces outwards **/** inward pressure may not be too difficult to imagine.
- Tube-formed bones have more or less marked one convex and one concave end - a polarity of d-degree 2 in the model and in agreement with our interpretation above of skeleton as organ of d-degree step 2-1 in a dimension chain of organs.

In addition there is the polarity in thickness between the 2 bones in forearms and calves. (The number relation 2 - 1 between bones of forearm and upper arm could also be seen as expression for the inward relative outward direction.)

The change at the wrist, in the figure in step 4→>3, is principally an angle step from 180° to 90° as assumed in the dimension chain: the limb transforms as induced from outside to a surface (d-degree 2) characterized by circular and radial structure in accordance with outer poles of d-degree 2 from d-degree 3 in the dimension chain ("circular" in arrangement of carpal bones in the wrist, in demarcation of the palm outwards - and perhaps also later in the opposition of thumb to other fingers).

The impact of meeting the environment as anticenter and 00-pole can surely be seen in the transition:←2 ← 1← 00.

In other respects, as divergence from each other joint and convergence to the other joints, the figure seems difficult to motivate.

[Arm versus hand reminds a bit of the double nature of light as particles and waves: the wave patterns that appear when photons pass through holes of a certain small size in a screen. What could have served as the "hole" for passage when "straight" forearm transforms to 8 (-/+1) carpal bones and 5 "waves"? The contact point with ground a reasonable answer?

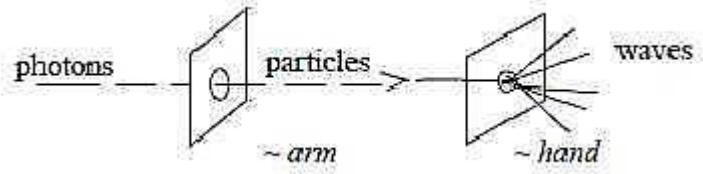


Fig Sk-18-65-1]

8. Reduction of toes:

The big toe, the most proximal, disappears in tetrapods of the kinds below - as a displacement outwards in distal direction. In the history of evolution the even-toed mammals are later than the odd-toed ones (*Fz p. 147*), also a displacement half a step outwards. As illustrated here, a displacement of the middle:

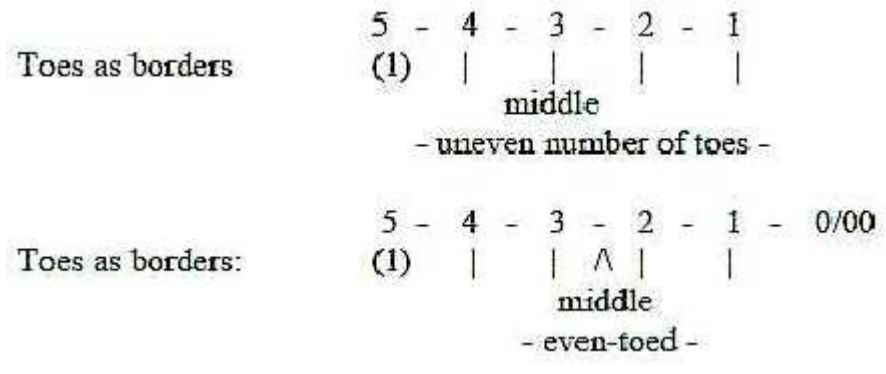


Fig Sk-19-65-2

Cf. **Evolution**: the direction of evolution towards Deuterostomia and chordates as inwards higher d-degrees. The 5th toe, the big one, and thumb could be regarded in the same inward direction as first fully developed in use with the primates.

9. Number of bones in human extremities:

Bones in hands are 27, divided: 8 wrist bones, 19 finger bones.
We can observe that it is numbers in the x^3-series (x = 5-0) in step 3 - 2:

x^3: 125 — 64 — 27 — (19) — 8 — 2 — 0

Adding 3 bones in the arm plus scapula and collar bone it makes 32, 1/2 x 4^3.
32 is approximately the same number as vertebra in the human spinal column.
Legs: 3 pelvic bones, 3 bones in the leg, 7 ankle bones and 19 toe bones gives also 32.

* 7 bones in human ankles make 26 in feet. However, wrist and ankle bones in original type of tetrapods are said to be 9 according to one source (*Kz p. 84*).

Number of bones in a human being approximately around 216 = 6^3.
The information can vary, probably depending on if some bones are counted before or after they have grown together. (Sources here *Mf* and *Kz*.)

29 vertebra + 3 to 5 caudal vertebra (here assumed 5)..... 34
29 bones in the head..... 29...Sum 63
1 breastbone + 24 ribs..... 25.....88

2 x 2 bones in shoulder girdle (clavicle + scapula)..... 4
2 x 30 bones in arm + hand.....60...Sum 64
2 x 3 bones in pelvic girdle (hip, seat and pubic bone).....6
2 x 29 bones in legs + feet.....58...Sum 64.....128

Total: $5^3 + 4^3 + 3^3 = 216 = 125 + 64 + 27 = \mathbf{3^3 \times 2^3} = 27 \times 8 = 216$

An anthropocentric history:

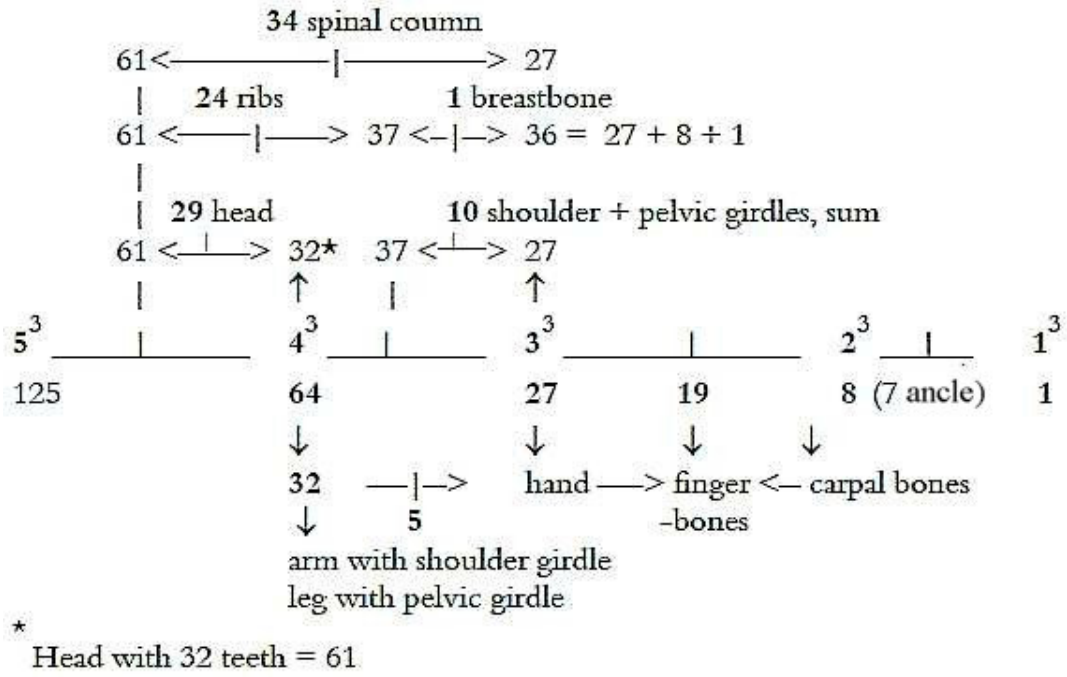


Fig Sk-20-67-1x

An anthropocentric interpretation, yes. The anteater *pangolin* has 49 caudal vertebra!

10. Mouth - Teeth:

Fig Sk-21-68-1

Both the mouth and the enamel of teeth originate in chordates from ectoderm, from the animal 00-pole. The new mouth of *Deuterostomia* is formed through invagination of ectoderm inwards the front part of intestinal canal.

The environment is primary anticenter and 00-pole to the organism as 0-pole, and the direction inwards (pole 4a) through mouth is expressed in the **eating**, also a stepwise building-in of the 00-pole into the center as one principle in the dimension model.

The direction inwards is also defined as primary polarizing, splitting force, which becomes expressed in the chewing of food, a decomposing process.

In the history of evolution teeth originate from a carapace skin such as in carapace sharks (*Placoderms*), which later were reduced to placoid scales in present-day sharks. Thus, they were structures at the surface that later immigrated into the mouth cavity.

The osteoblasts, the kind of single cells that build skeleton, form also the hard material of teeth and originate as said above from the neural wall in he embryo, i.e. from anticenter to the neural tube at animal pole. (While the inner, sensitive dental pulp derives from mesoderm.)

In an earlier species as *cyclostomes*, e.g. present-day lampreys, the mouth lies in the surface plane with circles of horn teeth pointing inwards the tongue in the center - with 1 tooth on the tongue! The opposition in tongue muscles from mesoderm (originating from vegetative pole) and teeth from around the animal pole is here very clearly expressed in the center-anticenter polarity, in this case in the 2-dimensional plane.

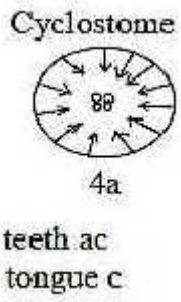


Fig Sk-22-69-2a

In *crustaceans* one tooth immigrated as far as down into the stomach - a polarization center - anticenter among teeth!

A precursor to the cyclostomes as the lancelet without a cranium had a "wheel organ".

We can note that later evolution implies polarizations from the circular structures into lower-upper jaws, ventral - dorsal rows of teeth, in directions upwards - downwards etc.

The polarity in origin of tissue between tongue and teeth may be seen expressed in their main, later functions:
- Teeth — Eating = inward direction.
- Tongue — Speaking = outward direction. (See Language, **Speech organs.**)

Differentiation of teeth, dimensional forms:
They correspond to the form of contacts with food: points-linear-2-dimensional:
0 →1 →2:

- Sticking, hewing — 1
- Cutting, biting, chisel-shaped — 2
- Knobby formed, grinding — 3

Fig Sk-23 .

In early chordates all teeth were approximately of the same kind. They became more and more differentiated during the evolution towards mammals. Bony fishes and reptiles had only teeth to grip and cut with. Thus, the evolution should dimensionally have been of the forms 3 ←2 ← 1 to the knobby molars.

About number 3:
In the early subclass of mammals, "*Prototheria*", the molars had 3 nibs in a linear row. In later mammals, "*Eutheria*" , these knobs formed a triangle, hence were 2-dimensionally arranged.

Apex of the triangle pointed inwards in upper jaw, outwards in lower jaw (*Fz p. 144*), a detail that also seem to express the fundamental opposition between directions in the polarity dorsal - ventral and original 00- and 0-poles of the embryo.

END