THE ADULT COMMON FROG *RANA TEMPORARIA* L.: A LINKOLOGICAL EVALUATION

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Fossils of allegedly ancient frogs show that adult frogs have always resembled frogs. Therefore, the bulk of this article considers evidence which is intra-somatic and ecological, rather than comparative and evolutionary. It is based firmly upon Biblical principles and has potential, which only computers can help biologists to achieve in the quest for the full appreciation of the 'design-linkage,' that is the observed evidence for Special Creation. Although water appeared before dry land, creationists may safely assume that adult frogs were formed first and not spawn or tadpole stages.

Plan of the Article

Introduction

Belief in Special Creation allows biologists to assume things about the frog, which evolutionists could never have begun to consider. In the first place, it was the adult stage which was formed and not the spawn or tadpole stages. Secondly, although adult frogs breed to form offspring, which culminate in their metamorphosis to resemble them 'after their kind': nevertheless, it seems safe to say that present-day frogs are not quite like those formed in the Original Creation. Before the Curse following the Fall of Man, no animal ever fed upon another to kill it for food. Therefore, originally frogs never fed upon invertebrates such as worms and flying insects, but only upon lush algae. Perhaps the toothless nature of present-day frogs is a relic of that deathless ecosystem in which only green plants and fruit were given for food. Also, in the primeval food chains, no consumer ever ate another deliberately. Therefore, the frog itself did not appear upon the menu of any passing grass snake or heron as is the case nowadays. Thirdly, before the Deluge the climate was fairly warm without the present-day marked seasonal changes, so there was no need for antediluvian frogs to hibernate. But, as in the Parable of the Sower and in Darwin's observations, there is in the present ecosystem a struggle for existence termed 'environmental resistance' as well as varying success in breeding termed 'differential reproductive capacities.' It is in that post-diluvian setting that the adult frog must interact. That is why this article deals with the actual condition of anatomy and physiology of adult frogs that exists nowadays.

1 DRAWING A BLANK

The adult frog shows a remarkable constancy of body plan. That is all the more evident since the discovery that the fossil *Protobatrachus* (formerly named *Triadobatrachus*) is really a specimen of the late tadpole stage, instead of being at the adult frog stage as was previously believed. Therefore, its ribs and tail do not represent an earlier stage in frog evolution, although that species was found in rocks classified as Triassic.

Similarly, the fossil species named *Miobatrachus* is nowadays reckoned to represent the larval stage in the metamorphosis of the labyrinthodont amphibian *Amphibamus* (alias *Mazonerpeton, Mordex, Pelion, Peliontonias, Platyrhinops, Potamochoston, Raniceps* and possibly also named *Eumicrerpeton and Micrerpeton*) whose adult stage also occurs in rocks classified as Middle Pennsylvanian (= Upper Carboniferous).

1.1 *Vieraella* fossil

When commenting upon frog fossils, Professor Romer, in 1966, admitted the following:

> Although these finds carry the story far back in time, they do not tell us much of frog evolutionary history, for even the 'primitive' frog families differ only in relatively minor features from the more 'advanced' ones. The basic pattern of anuran structure was already established by the early Jurassic and exemplified by the South American—*Vieraella*—essentially a modern frog in its general adaptations, despite its great age.[1]

1.2 Vital functions

Clearly evolution has drawn a blank. The fossil record can shed no light upon the significance of the timeless structure of the adult frog. Therefore, the key to understanding adult frog design must lie in a different approach which is what the rest of this article is about.

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The proposed new approach is termed 'linkology.'

In effect, linkology deliberately turns its back upon evolution in order to look for evidence in the opposite direction. Whereas evolution deals in resemblances between different species, linkology emphasizes how the many parts work together to perform vital functions necessary for the well-being of the individual. Instead of being inter-specific like evolution, linkology is primarily intra-somatic. It draws attention to complementation which enables an individual to exist at all rather than bothering about competition which enables only the fittest individuals to survive.

2 DELVING INTO BASICS

Before examining some of the details about the adult stage of the Common Frog, it seems appropriate to delve into some basic questions prior to going into definitions of certain linkological concepts in the following main section of this article.

2.1 Observable linkage

A short list of useful questions to probe biological phenomena might well include the following:

(a) Why are the bodies of all known organisms made up of various parts?
(b) What causes each isolated part to be in itself made up of a set of sub-units (or components)?
(c) What exactly enables parts to become linked with others in order to work together?
(d) Do all sub-units belonging to the same set have equal status?
(e) What (if anything) is the relationship between structure and function?

Of course, one phenomenon lies behind each of the questions listed above. It is linkage. But a far more fundamental question to ask than linkage is to ask what lies behind it—"Why do links exist at all?"

2.2 Original lack

A wonderful insight into the problem of the need for linkage is provided by the account of the creation of Adam and Eve in Genesis chapter two. After reading through that account it becomes obvious that Adam was deliberately created to be 'not good . . . . alone,' so that that first man could have a relationship of human companionship with part of himself formed into a separate entity. In other words, there would be no picture of organic life without the jig-saw puzzle piece fit of its component parts. So Eve was 'tailor-made' as a suitable helper for Adam, because the LORD God made him originally lacking.

Like the touch of King Midas that was reputed to turn everything into gold, so nothing within the compass of Biology is free from the effect of its created 'original lack.' What use is guanine without cytosine as molecular versions of Adam and Eve? Without linkage between those base pairs there could be no genetic code as we know it. Also without those paired bases becoming unlinked there would be no copying of the genetic code. And what use is the ability to encode without the simultaneous facility to decode? It is no wonder that, time after time, famous proponents of evolutionary thought frankly admit that they do not know how male and female came to exist in the first place. The union of sections loudly suggests deliberate planning.

3 DESCRIBING LINKOLOGICAL CONCEPTS

Ten concepts arise as an inter-related scheme from the fact that links and linkage exist throughout the whole range of biological phenomena. Also arising from concepts of linkage is a system of notation for levels of organisation as well as other consequences when entities become newly linked or unlinked.

3.1 Concepts considered

(1) Unitary incapacitation — no single entity is (fully) functional by itself. Always there is a sense in which an entity or part is 'not good . . . . alone.' This is axiomatic. As such it stands as the basic fact of life.
(2) Reciprocal alleviation — only certain other entities can make an incapacitated entity fully functional. Through linkage between entities, potential functionality rises to become actual functionality.
(3) Integral encounters — whole entities come together in fixed ratios to alleviate each other's incapacitation. In their own right they are never fractions but are integral units.
(4) Heterogeneous composition — different entities become linked together to form a functional set. That is irrespective of the permanent or temporary nature of their linkage.
(5) Equivalent complementation—each constituent entity involved in linkage to form a functional set makes an equally valuable contribution to that set as any other entity.
(6) Periodic biostratification—each set can become linked with other sets to form an overall larger composite set, and so on, like the concatenation of 'Russian dolls.' See Table 1.
(7) Scalariform notation — owing to recurrent part-whole interrelationships involved in periodic biostratification, every entity in biology can be symbolised by a digit representing its relative position along a scale of linkages from 0 to 9.
(8) Anisogradal processes — changes in levels of periodic biostratification (and therefore also in scalariform notation) occur in many biological processes as well as in the life cycles of organisms. See Table 2 for a comparison of two different types of metabolic processes.
(9) Repercussional organisation — every part of an organism is composed of a multiplex of many component structures which coexist to contribute to many functions so that the whole is inter-

Table 1. Periodic Biostratification.

Grade	Description	Examples
9	Habitat	Marsh/pond
8	Society	Swarm/stand
7	Body	Frog/tadpole
6	Organ	Liver/heart
5	Pseudo-tissue	Spirogyra/mushroom
4	Cell	Spawn/*Amoeba*
3	Organelle (plastid)	Mitochondrion/virus
2	Macromolecule	DNA/mucus/collagen
1	Micromolecule	Oxygen/water
0	Energy	Light/heat/gravity/electron

Table 2. Anisogradal Processes.

Inter-Related Changes	Anabolism	Katabolism
No. of linked entities	increases	decreases
Resultant energy level	higher	lower
No. of resultant entities	fewer	more
Size of resultant entities	larger	smaller
Grade of periodic biostratification	rises	falls

dependent. This concept is best represented by a linkogram or network. Figure 1 shows various ways in which the same number of entities may be arranged. Irrespective of the arrangement the following formulae apply:

$$L = E + S - G$$

and

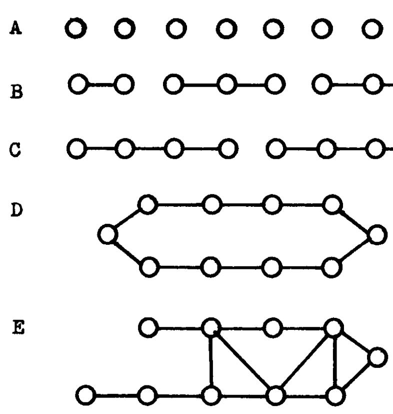
$$\frac{L + G}{E + S} = 1.0$$

as well as

$$(L + G) - (E + S) = 0.0$$

where L is the number of links, E is the number of entities, S is the number of enclosed spaces and G is the number of groups.

(10) Linkage rearrangement — occurs whenever organisms break down some links in order to obtain energy for making certain other linkages. Therefore, the physico-chemical basis of organic life depends upon the rearrangement of linkages. The reason for the phenomenon of unitary incapacitation is that it requires an entity to encounter another suitable entity, otherwise it cannot undergo linkage rearrangement. Ultimately this tenth concept summates all the



SCHEME	LINKS	ENTITIES	SPACES	GROUPS
A	0	10	0	10
B	6	10	0	4
C	8	10	0	2
D	10	10	1	1
E	13	10	4	1

Figure 1. Entitial arrangements.

other nine concepts to help discover that there is a relationship between structure and function. It may be expressed succinctly as follows:

FUNCTION IS STRUCTURE REARRANGED.

That is only so because

LINKAGE IS INVOLVED IN BOTH STRUCTURE AND FUNCTION.

3.2 Linkage levels

According to Table 1 a frog in a pond could be represented by its linkage levels as 7 in 9. Yet from another point of view it could also have been written as 7 in 1 because the bulk of the pond consists of water. But before anyone starts to get too quantitatively ambitious about the mathematics of scalariform notation, I should mention the fact that zeros cannot be multiplied, except to give zero as the product. The digits simply represent levels of linkage. However camouflage could well be shown as 7 = 9 and metamorphosis as 4 → 7 where zygote transforms into adult.

In Table 2 an example of an anabolic process is photosynthesis and respiration is an example of a katabolic process. A comparison of both processes in terms of their respective columns shows an interesting contrast between the build up of chemicals in the green plant for food and what is involved in tissue respiration during 'the breath of life.' In one sense Genesis chapter 1, verse 30 was giving early warning that photosynthesis and respiration would play opposite but complementary roles in the Carbon Cycle.

4 DEVISING A LINKOGRAM

When constructing a linkogram like the one shown in Figure 2, there is a procedure to follow before considering some of the parameters that arise.

4.1 Procedural steps

(i) Consider the many structures, functions, substances and forces that interact within the twin environments of the adult Common Frog. Construct a Link List as in Table 3.

(ii) Arrange the items mentioned in (i) as numbered entities so that no link crosses over any other link. Inevitably many drafts will be drawn.

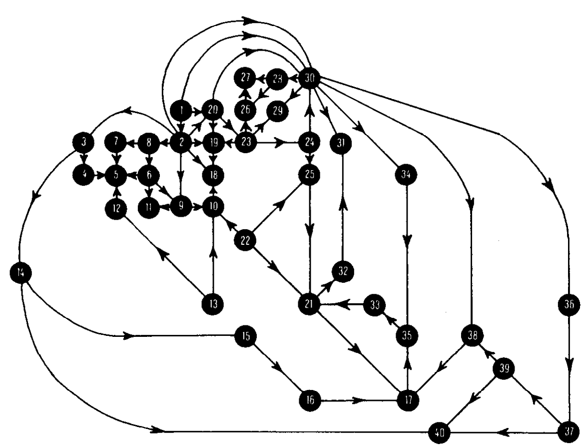


Figure 2. Linkogram of adult common frog *Rana temporaria*.

Key to Linkogram of *Rana temporaria* (Common Frog)

Entity No.	Brief Description
1	Air
2	Tiny lungs
3	*No* trachea
4	*No* neck
5	Undifferentiated vertebrae
6	*No* thorax
7	*No* abdomen
8	*No* diaphragm
9	*No* ribs
10	Pectoral girdle shields heart and absorbs shock
11	*No* rib muscles
12	Urostyle
13	Hind-legs for leaping
14	*No* larynx
15	Glottal epithelial flaps
16	Vocal pouches
17	Croak
18	Single ventricle
19	Atria receive oxygenated blood
20	Cutaneous respiration
21	Amplexus
22	Fore-limbs
23	Highly vascular skin
24	Mucus
25	Nuptial pads on males
26	Poikilothermy
27	Hibernation
28	Low ambient temperature
29	Webbed feet
30	Pond-water
31	External fertilisation
32	Gamete release
33	Identification of opposite sex
34	*No* external auditory meatus
35	Tympanic membrane on head surface
36	*No* air under water
37	*No* need for a secondary palate
38	Nostril closes
39	Vomerine teeth
40	Eye-balls are retractable to aid swallowing

Table 3. Link List.

From	To	Comment
1	2	Air being less dense than water would not allow frog to dive for cover if lungs were not small.
1	20	Air diffuses through skin to enter blood capillaries.
1	30	Specific gravity of water is much greater than that of air.
2	3	Tiny lungs are not only too puny to have a reinforced windpipe leading to them, but they are subsidiary to skin.
2	8	Tiny lungs are too small to warrant a diaphragm to ventilate them.
2	9	Tiny lungs are too small to warrant protection by ribs.
2	18	Blood from tiny lungs is not more oxygenated than blood from skin so there is no need for segregation by more than one ventricle.
2	19	Atria receive blood equally oxygenated because skin is as efficient as a respiratory surface as tiny lungs.
2	20	Tiny lungs need to have cutaneous respiration to augment their small oxygen intake.
2	30	The much greater density of water compared with air prevents frog from carrying large lung-full of air from pond surface to pond bottom.
3	4	No point in having a neck if no trachea is present. (The eye-balls on top of head have good all-round vision so do not suffer by having no neck to turn head this way and that.)
3	14	No need to have larynx as an elaborate entrance to lungs if there is no trachea present.
4	5	No neck so no cervical vertebrae differentiation in upper trunk region of vertebral column.
6	5	No thorax so no thoracic vertebrae differentiation in upper mid region of vertebral column.
6	9	No thorax (and no thoracic vertebrae) so no ribs.
6	11	No need for intercostal muscles to ventilate thoracic cavity if no thorax and no ribs.
7	5	No abdomen so no lumbar vertebrae differentiation in lower mid region of vertebral column.
8	6	No diaphragm so no boundary in trunk to separate thorax from abdomen. Therefore, no thorax.
8	7	No diaphragm so no boundary in trunk to separate thorax from abdomen. Therefore, no abdomen.
9	10	No ribs to protect heart so pectoral girdle and sternum alone gives firm protection.
9	11	No ribs present so no need for muscles to move absent bones.
10	18	Pectoral girdle and sternum protect heart.
12	5	Force of leap is transmitted via urostyle to series of undifferentiated vertebrae.
13	10	After jumping with hind-limbs, pectoral girdle absorbs shock of landing on hard ground.
13	12	Hind-limbs transmit thrust to urostyle during leaping.
14	15	No proper larynx means that vocal cords are reduced to glottal epithelial flaps.
14	40	No larynx means that swallowing must therefore be performed by muscles pulling eyeballs into head to push food in oesophagus (gullet).
15	16	Having only tiny glottal epithelial flaps means that vocal pouch is needed to generate or resonate croak.
16	17	Vocal pouch helps to transmit sound of croak over a fair distance.
17	35	Frog needs to hear croaks of other frogs so it needs an ear-drum.
19	18	Owing to atria receiving equally oxygenated blood from skin and tiny lungs they need not pass it on to two ventricles as it does not require segregation.
20	19	Skin respiration causes blood leaving skin to be as oxygenated as blood leaving tiny lungs.
20	23	Skin respiration is possible because that organ is richly supplied with blood vessels.

20	30	Oxygen dissolved in water can diffuse into skin both when frog is in the pond and when frog is on dry land provided that its skin remains moist.
21	17	If male is grabbed by another male by mistake, the caught partner will emit a croak by the pressure of the grip upon its trunk.
21	32	Squeezing trunk of caught partner helps both mating frogs to synchronise gamete release.
22	10	Fore-limbs transmit shock waves to pectoral girdle upon landing on ground.
22	21	Fore-limbs grip partner during mating.
22	25	Nuptial pads on male prevent slipping whilst gripping mate.
23	19	Rich blood supply to skin ensures that oxygen diffuses into frog.
23	24	Mucus on skin acts like phlegm to prevent copious water loss and enhance oxygen intake through moist surface.
23	26	Having rich blood supply to skin means that in cold weather the frog suffers from hypothermia.
23	29	Webbed feet enable frog in water to have increased surface area for oxygen intake.
24	25	Slimy skin necessitates males gripping females by means of nuptial pads to avoid slipping their grip.
24	30	Slime traps water as it diffuses out of skin through the same pores that oxygen diffuses inwards.
25	21	Males develop nuptial pads in breeding season for gripping partner during mating.
26	27	Being cold-blooded the frog suffers a fall in its metabolic rate and so needs to go into hibernation.
28	26	Richly vascular skin which is also moist results in rapid heat loss to cold surroundings so frog is forced to be cold-blooded rather than warm-blooded.
28	27	Metabolic rate is greatly reduced in very cold weather so frog is forced to hibernate or die.
30	28	Water when it evaporates takes a lot of heat from surface of frog's skin.
30	29	Webbed skin between toes of hind-limb helps frog to have efficient propulsion in water.
30	31	Water is the external medium in which sperms meet eggs.
30	34	Frogs would become deaf if water entered their ear-holes so they have no external auditory meatus on their heads.
30	36	When a frog catches food under water there is no air to take into its body when opening its mouth and nostrils.
30	38	When not eating, nostril valves keep water out of mouth during a dive.
32	31	Gamete release must precede external fertilisation.
33	21	Croak of male attracts female to him, but accidentally squeezing another male in the dark produces another croak from the one being squeezed.
34	35	Ear-drum lying next to skin of head avoids the need to have an ear-hole.
35	33	A frog can recognize a male frog by its croak.
36	37	As there is no air below pond surface when frog feeds in water, then there is no need for a secondary palate.
37	39	Vomerine may catch on to struggling prey and this is possible because there is no secondary palate.
37	40	No eye-socket bones and no secondary palate allow eyeballs to be retracted by muscles and so help push food into oesophagus (gullet).
38	17	Valves in nostrils help frog to develop buccal pressure for croak (at least in males).
39	38	Any live prey trying to escape via nostril valves will probably become caught by vomerine teeth.
39	40	Eye-balls pushed by muscles cause live prey to enter oesophagus (gullet).

TOTAL = 65

(iii) Decide to stop when the scheme is in danger of filling up with criss-cross links and try to space out entities so that their final arrangement looks pleasing to the eye.

(iv) Check over the final version of the linkogram in case one entity has become omitted. Then note the final number of entities.

(v) Count the number of links in the linkogram. Here the first formula or equation mentioned in the Ninth Concept within section 3.1 of this article should help to double check the total number of links.

(vi) Finally decide upon the function or couple of functions to which each entity principally may be ascribed. These may be represented as in Figure 3 which is optional, but their inclusion in the final column of Table 4 is obligatory.

4.2 Some parameters

When the details of the linkogram are set out as shown in Table 3, each entity is found to have the following fundamental parameters:

(a) Valency. This is the total number of links in contact with a particular entity, irrespective of the direction in which they are pointing.

(b) Polarity. This takes into account the direction in which particular links are pointing. Those links pointing towards an entity under consideration are entered in the column headed 'IN.' Similarly, those links pointing away from an entity under consideration are entered in the column headed 'OUT.'

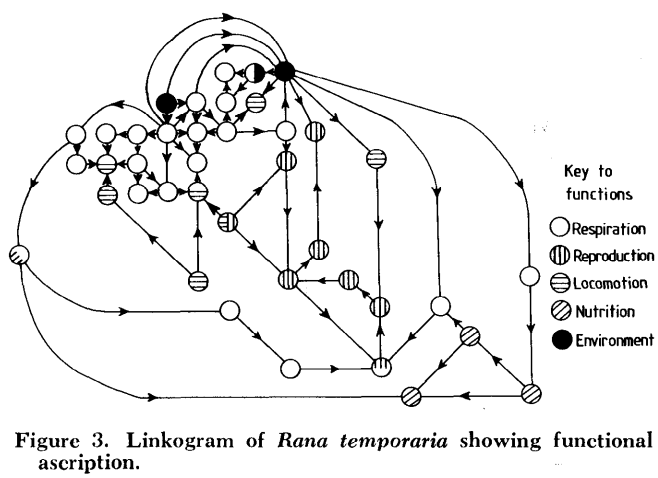


Figure 3. Linkogram of *Rana temporaria* showing functional ascription.

(c) Fluency. This is an arithmetical value which expresses the difference between the number of 'IN' arrows regarded as positive and the number of 'OUT' arrows as negative. Incidentally, the outflow is negative only with respect to a particular entity. In reality such negativity really amounts to a positive contribution made by that particular entity to the overall scheme expressed as the linkogram. After all entities have had their fluency entered into Table 4, then look for the entity having the greatest negative fluency and then write the value '1' in the next column headed 'Seriality.' Figure 4 shows how fluency calibrated on the left vertical axis converts into seriality calibrated on the right vertical axis.

(d) Seriality. The relationship between fluency and seriality was described in (c) above. Now it only remains to explain two ways in which the parameter of seriality is more useful than the parameter of fluency. One way is

Table 4. A Linkological Evaluation of *Rana temporaria*.

Entities		Linkage								
Ref. No.	Brief Description	Valency	Polarity In	Polarity Out	Fluency	Seriality	Retro-fluency	Retro-seriality	Function
1	Air	3	0	3	−3	4	+3	8	Env.
2	Tiny lungs	8	1	7	−6	1	+6	11	Resp.
3	*No* trachea	3	1	2	−1	6	+1	6	Resp.
4	*No* neck	2	1	1	0	7	0	5	Resp.
5	Undifferentiated vertebrae	4	4	0	+4	11	−4	1	Resp/Loco.
6	*No* thorax	4	1	3	−2	5	+2	7	Resp.
7	*No* abdomen	2	1	1	0	7	0	5	Resp.
8	*No* diaphragm	3	1	2	−1	6	+1	6	Resp.
9	*No* ribs	4	2	2	0	7	0	5	Resp.
10	Pectoral girdle	4	3	1	+2	9	−2	3	Resp/Loco.
11	*No* intercostal muscles	2	2	0	+2	9	−2	3	Resp.
12	Urostyle	2	1	1	0	7	0	5	Loco.
13	Hind-legs	2	0	2	−2	5	+2	7	Loco.
14	*No* larynx	3	1	2	−1	6	+1	6	Resp/Nut.
15	Glottal epithelial flaps	2	1	1	0	7	0	5	Resp.
16	Vocal pouches	2	1	1	0	7	0	5	Resp.
17	Croak	4	3	1	+2	9	−2	3	Resp/Repr.
18	Single ventricle	3	3	0	+3	10	−3	2	Resp.
19	Atria receive oxygenated blood	4	3	1	+2	9	−2	3	Resp.
20	Cutaneous respiration	5	2	3	−1	6	+1	6	Resp.
21	Amplexus	5	3	2	+1	8	−1	4	Repro.
22	Fore-limbs	3	0	3	−3	4	+3	8	Repr/Loco.
23	Highly vascular skin	5	1	4	−3	4	+3	8	Resp.
24	Mucus	3	1	2	−1	6	+1	6	Resp.
25	Nuptial pads on males	3	2	1	+1	8	−1	4	Repro.
26	Poikilothermy	3	2	1	+1	8	−1	4	Resp.
27	Hibernation	2	2	0	+2	9	−2	3	Resp.
28	Low ambient temperature	3	1	2	−1	6	+1	6	Env/Resp.
29	Webbed feet	2	2	0	+2	9	−2	3	Loco.
30	Water	10	4	6	−2	5	+2	7	Env.
31	External fertilization	2	2	0	+2	9	−2	3	Repro.
32	Gamete release	2	1	1	0	7	0	5	Repro.
33	Identifies opposite sex	2	1	1	0	7	0	5	Repro.
34	*No* external auditory meatus	2	1	1	0	7	0	5	Loco.
35	Tympanic membrane on head skin	3	2	1	+1	8	−1	4	Repro.
36	*No* air under water	2	1	1	0	7	0	5	Resp.
37	*No* need for a secondary palate	3	1	2	−1	6	+1	6	Nut.
38	Nostril valve	3	2	1	+1	8	−1	4	Resp.
39	Vomerine teeth	3	1	2	−1	6	+1	6	Nut.
40	Eye-balls retract	3	3	0	+3	10	−3	2	Nut.

when an entity having a fluency rating of zero needs to be shown as being worth one more than another entity having a fluency rating of minus one. Another way is when calculating the functional complementation for the entities within a linkogram. Although the procedure is explained in more detail in (h) below, it does involve multiplying the number of entities having the same function by their seriality because if their fluency were to be multiplied, then any entity having a fluency of zero would inevitably make the product of that sum also come to zero. But a glance at Figure 4 will show that any entity of fluency zero is rated as having a seriality of 7.

(e) Functionality. Each entity is ascribed as supporting a particular function. In any case when an entity supports many functions then only the principal two are recorded in the final column in Table 4, as was mentioned in (vi) of section 4.1 of this article.

(f) Totals. Some important relationships become apparent when the columns in Table 4 are added up. The value of the total valency is exactly twice that of each of the polarity column totals. Also the number of 'IN' links should equal the number of 'OUT' links when those columns are added. Equally obvious is the fact that the total number of fluency values should be zero because the negative values exactly cancel out the positive values. Finally, the total seriality equals 280 and when divided by the number of entities (forty) gives the quotient 7.

(g) Termini. When the entities are arranged along the line of the linkogram shown in Figure 4 in order of diminishing fluency (and seriality), they form a sigmoid curve in this particular case. Entity number 5 appears first because it has a fluency of +4 (= seriality of 11) and entity number 2 has the least fluency of −6 (= seriality of only 1). Such extreme entities are termed termini. At this stage it would be inappropriate and ambiguous to identify which was the 'source' entity and which was the 'sink' entity. Let it suffice to call them termini.

(h) Functional complementation. This derived parameter is based upon two co-ordinate values. One is the 'entitial incidence' which is the total number of entities having the same functional ascription. (Incidentally, those entities sharing two functions count as half per function.) The other co-ordinate is the 'linkage seriality,' which is simply the total seriality value of the entities having the same functional ascription. When those two values are turned into percentages and plotted as shown in Figure 5 there is a high degree of positive correlation between them. A glance at Table 5 will show how the data included in Table 6 were obtained. An examination of the percentages in each column along the rows labelled entitiality and seriality reveals that both parameters are within 2% of each other per function.

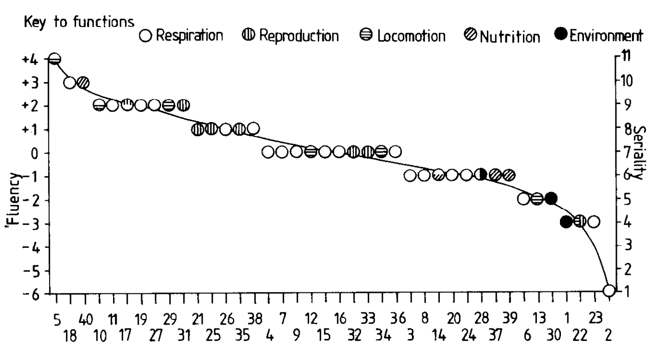


Figure 4. Linkogive of *Rana temporaria* showing flow from source to sink.

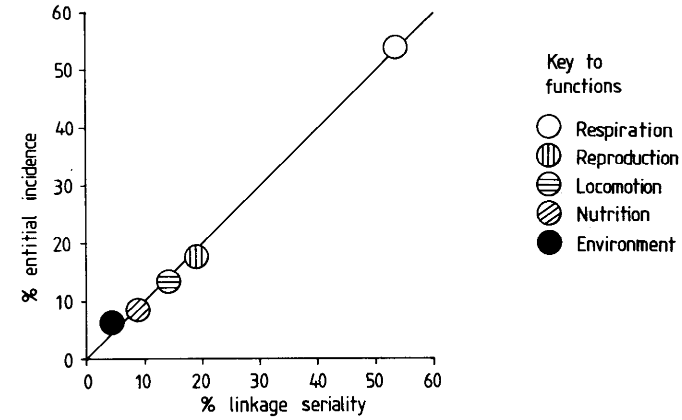


Figure 5. Plot of functional complementation expressed within *Rana temporaria* linkogram.

(i) Retrofluency. As already mentioned in (c) above, the output from an entity is really a contribution to the whole linkogram scheme representing the organism. Therefore, when the 'OUT' links are viewed as positive, simply change the arithmetical sign of the fluency rating to transform it into the retrofluency rating.

(j) Retroseriality. In terms of retrofluency, the entity having the most negative rating will be given a retroseriality rating of one. Also the entity with the most positive retrofluency will have the greatest retroseriality. In effect the conversion from fluency to retrofluency and from seriality to retroseriality means that at a stroke the highest entity on the linkogive becomes the lowest entity afterwards and what was the lowest becomes the highest. So the mathematical notions of 'source' and 'sink' become transposed. Therefore, in (g) above it was reckoned best to simply term them 'termini.'

In addition to the fundamental parameters described in (a) to (j) above, others exist as derivations from them. Figure 6 shows a tree-like scheme of those linkological parameters which play some part in evaluating the design linkage exhibited by the plan of the adult Common Frog. The concept of incoming seriality and out-

Table 5. Complementation.

	Ent. No.	Val.	In	Out	Ser.	Serin.	Sereff.	R/ser.	R/in.	R/eff.
RESPIRATION										
	2	8	1	7	1	4	49	11	8	35
	3	3	1	2	6	1	13	6	11	11
	4	2	1	1	7	6	11	5	6	1
	5*	2	2	0	5½	13	0	½	11	0
	6	4	1	3	5	6	27	7	6	9
	7	2	1	1	7	6	11	5	6	1
	8	3	1	2	6	1	12	6	11	12
	9	4	2	2	7	6	18	5	18	6
	10*	2	1½	½	4½	8	5	1½	10	1
	11	2	2	0	9	12	0	3	12	0
	14*	1½	½	1	3	3	8½	3	3	3½
	15	2	1	1	7	6	7	5	6	5
	16	2	1	1	7	7	9	5	5	3
	17*	2	1½	½	4½	11½	4	1½	6½	2
	18	3	3	0	10	19	0	2	17	0
	19	4	3	1	9	11	10	3	25	2
	20	5	2	3	6	5	18	6	19	18
	23	5	1	4	4	6	32	8	6	16
	24	3	1	2	6	4	13	6	8	11
	26	3	2	1	8	10	9	4	14	3
	27	2	2	0	9	14	0	3	10	0
	28*	1½	½	1	3	2½	8½	3	3½	3½
	36	2	1	1	7	5	6	5	7	6
	38	3	2	1	8	11	9	4	13	3
Totals	21½	71	35	36	149½	178	280	108½	242	152
REPRODUCTION										
	17*	2	1½	½	4½	11½	4	1½	6½	2
	21	5	3	2	8	19	16	4	17	8
	22*	1½	0	1½	2	0	12½	3½	0	5½
	25	3	2	1	8	10	8	5	14	4
	31	2	2	0	9	12	0	3	12	0
	32	2	1	1	7	8	9	5	4	3
	33	2	1	1	7	8	8	5	4	4
	35	3	2	1	8	16	7	4	8	5
Totals	7	20½	12½	8	53½	84½	64½	31	65½	31½
LOCOMOTION										
	5*	2	2	0	5½	13	0	½	11	0
	10*	2	1½	½	4½	8	5	1½	10	1
	12	2	1	1	7	5	11	5	7	1
	13	2	0	2	5	0	16	7	0	8
	22*	1½	0	1½	2	0	12½	3½	0	5½
	29	2	2	0	9	9	0	3	15	0
	34	2	1	1	7	5	8	5	7	4
Totals	5½	13½	7½	6	40	40	52½	25½	50	19½
NUTRITION										
	14*	1½	½	1	3	3	8½	3	3	3½
	37	3	1	2	6	7	16	6	5	8
	39	3	1	2	6	6	18	6	6	6
	40	3	3	0	10	18	0	2	18	0
Totals	3½	10½	5½	5	25	34	42½	17	32	17½
ENVIRONMENT										
	1	3	0	3	4	0	12	8	0	24
	28*	1½	½	1	3	2½	8½	3	3½	3½
	30	10	4	6	5	17	46	7	31	26
Totals	2½	14½	4½	10	12	19½	66½	18	34½	53½
GRAND TOTALS	40	130	65	65	280	356	506	200	424	274

*Denotes an entity ascribed to two functions so only half values have been shown per line.

Table 6. Parametrical Analysis of Functions.

Symbols	Parameters	Functions									
		Respiration		Reproduction		Locomotion		Nutrition		Environment	
		No.	%	No.	%	No.	%	No.	%	No.	%
e	ENTITIALITY (40)	21½	53.75	7	17.50	5½	13.75	3½	8.75	2½	6.25
Pn	ENDOPOLARITY (65)	35	53.85	12½	19.23	7½	11.54	5½	8.46	4½	6.92
Px	ECTOPOLARITY (65)	36	55.38	8	12.31	6	9.23	5	7.69	10	15.38
v	VALENCY (130)	71	54.62	20½	15.77	13½	10.38	10½	8.08	14½	11.15
r	RETRO-SERIALITY (200)	108½	54.25	31	15.5	25½	12.75	17	8.5	18	9.0
r_e	RETROEFFLUX (274)	152	55.47	31½	11.5	19½	7.12	17½	6.39	53½	19.52
s	SERIALITY (280)	149½	53.39	53½	19.11	40	14.28	25	8.93	12	4.29
s_i	SERINFLUX (356)	178	50.0	84½	23.73	40	11.24	34	9.55	19½	5.48
r_i	RETROINFLUX (424)	242	57.07	65½	15.45	50	11.79	32	7.55	34½	8.14
s_e	SEREFFLUX (506)	280	55.34	64½	12.75	52½	10.38	42½	8.4	66½	13.14
r_c	RETROCOFLUX (698)	394	56.44	97	13.9	69½	9.96	49½	7.09	88	12.61
s_c	SERCOFLUX (862)	458	53.13	149	17.29	92½	10.73	76½	8.87	86	9.98

going seriality is carried a step further. With respect to each entity those incoming links are rated with the seriality of the entities they sprang from. That is termed serinflux. The 65 incoming links add up to a total of 356. Conversely the 65 outgoing links connect with other entities having a total of 506, which is termed serefflux. The combined total of serinflux and serefflux is termed sercoflux. Similarly the terms retroinflux, retroefflux and retrocoflux apply to the retroseriality ratings of the entities concerned. (Incidentally, the combined values of sercoflux and retrocoflux add up to a sum termed the 'toticoflux,' which, when divided by the valency, always gives an answer that is the sum of the zero fluency in terms of seriality and the zero retrofluency in terms of retroseriality. So even the toticoflux per function divided by the valency per function will give the same quotient referred to in the previous sentence).

Figure 7 shows eleven of the twelve parameters listed in Table 6. The line code for each function plotted is different to distinguish one function from another. Only endopolarity was omitted in order to aid clarity because it plotted at the same distance along the x-axis as ectopolarity.

Finally, in this section of the article some attention should be paid to the cluster of parameters near the top of Figure 6. The parameters stem from valency. Adjacency is simply the number of entities within the linkogram that are in juxtaposition having links connecting them. They amount to 65. Entlink is found by adding up all cases where entities have links one with another. It is a total of incidence at positions in an array such as a table and in this case amounted to 287. Link represented 'link connectivity by the shortest possible path' within the linkogram between each entity and all other entities to which connection is possible. Its value came to 816. Then route multiplicity was a consideration of the many ways in which a path existed between each entity and all other entities with which it has connections. Tracing out countless routes on a 'light-table' was very tedious and most prone to inaccuracies. So when I made the score 532, I expect to be corrected in the future. Very roughly 532 is almost equal to the difference between 816 & 287. Therefore, one day a more elaborate relationship may be found, but in the meantime, it seems a good rule of thumb to suggest that ROUTE MULTIPLICITY is approximately equal to LINK CONNECTIVITY minus ENTLINK.

5 DESTINATIONS WITHIN THE LINKOGRAM

The linkogram of the adult Common Frog, shown in Figure 2, contains a number of routes that end in entities having positive fluency. These entities may be regarded as 'destinations' or target entities within the linkogram scheme. All the examples described in this main section of the article arise from the same common origin. That origin is not a primitive fossil ancestor to the frog, but rather it is a present functioning structure—namely, the tiny (paired) lungs (entity number 2). From that entity (2) may be derived the many specialised adult frog features that interact in a consequential manner. They result in a network exhibiting multiplexual reciprocal alleviations. Such 'design-linkage' was expressed by St. Paul in Ephesians chapter 4, verse 16 as follows:

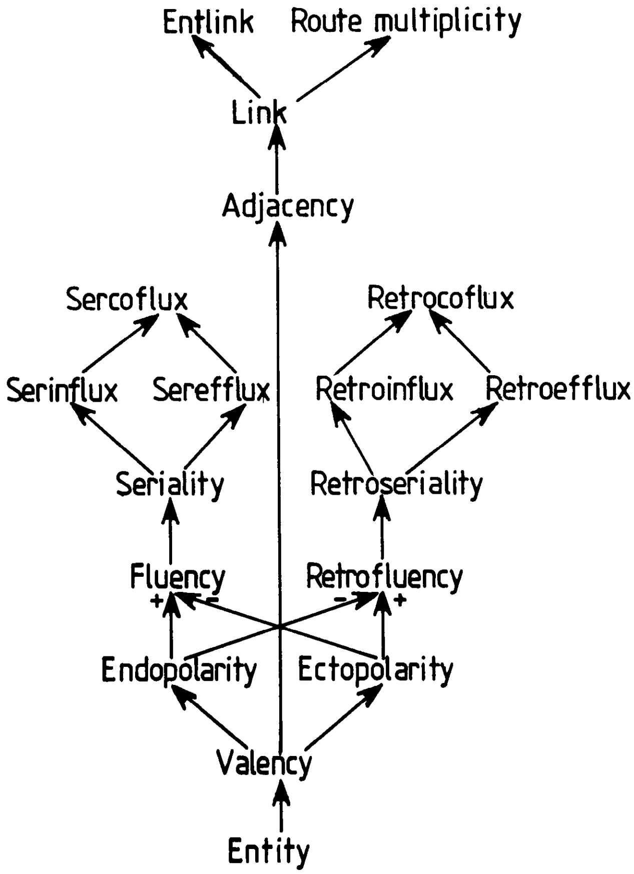


Figure 6. A parametrical 'phylogeny.'

> ". . . THE WHOLE BODY FITLY JOINED TOGETHER AND COMPACTED BY THAT WHICH EVERY JOINT SUPPLIETH, ACCORDING TO THE EFFECTUAL WORKING IN THE MEASURE OF EVERY PART . . ."

5.1 Single ventricle

(The numbers in the parentheses are not references, as is common; they refer to the entities in the linkograms, as already mentioned.)

Because air (1) has a density that is considerably less than that of water (30), the adult frog would have to expend a lot of energy if it tried to dive to the bottom of the pond whilst carrying lungfuls of air. Such organs would inevitably act as internal 'water-wings' to keep the frog at the pond surface. So the frog only has lungs that are tiny (2). By themselves such puny organs are unable to cope with the respiratory requirements of the frog.

Clearly, such tiny lungs, although good for diving, are 'not good . . . alone' for helping the frog to breathe. Consequently, another surface must exist for the purpose of gaseous exchange in order to enrich the oxygen content of the blood and remove its carbon dioxide. Hence, the skin has been commandeered to perform cutaneous respiration (20). But to work efficiently the skin must have a rich blood supply and, in fact, it is highly vascular (23).

Of course, having skin that is also a respiratory organ in addition to its many other functions has several repercussions. One of those is that the blood from the skin is oxygenated to about the same extent as that from the lungs. Therefore, the frog's heart atria receive oxygenated blood (19). So there is no need to segregate the blood from each source into separate ventricles. Consequently, unlike our own heart, which has one ventricle for oxygenated blood and another one for de-oxygenated blood, the frog's heart has but a single ventricle (18).

As though travelling along a rail network we have journeyed from the main-line terminus to which I am likening entity (2), through stations such as entities (20), (23) and (19) in order to arrive at our destination which is, in this case, entity (18).

5.2 Similar vertebrae

Cutaneous respiration (20) enables the adult frog to cope with breathing without having to rely much upon its tiny lungs (2). So there is no necessity for the frog to keep its air-way open by means of a windpipe reinforced with incomplete rings of cartilage. Consequently, the frog has no trachea (3). As a repercussion of that the frog has no proper neck (4) and, therefore, does not need to have its upper trunk vertebrae differentiated into a cervical region.

Another repercussion of having tiny lungs (2) is that they are hardly worth protecting with ribs so there are no ribs (9). Neither are there any intercostal muscles (11) nor diaphragm (8) to help ventilate the tiny lungs. So in having no ribs to articulate with trunk vertebrae means that there is no thoracic region of its 'backbone.' Also, owing to the absence of a diaphragm (8), which acts as a boundary between chest and belly, there is, strictly speaking, no thorax (6) and no abdomen (7). (Incidentally, the so-called 'anterior abdominal vein' should, therefore, be renamed 'anterior lower trunk vein.')

Owing to there being no proper abdomen (7) then there is no over-riding need for the frog's vertebral column to be differentiated into lumbar and sacral regions. In such a way our own route has brought us to the destination of the frog having undifferentiated vertebrae (5). However, that is not to say that an expert could not distinguish between one trunk vertebra and another or that the last one does not have well-developed transverse processes for articulation with the ilia.

A study of Figure 2 will reveal that the journey from the mainline terminus (namely, entity number 2) to the destination of undifferentiated or similar vertebrae (namely, entity number 5) could have taken a variety of routes. One route is via entities (3) and (4). Another route is via entities (8) and (6). Yet a third route is via entities (8) and (7).

5.3 Submerged hibernation

Owing to the by now familiar link between tiny lungs (2) and cutaneous respiration (20) having gaseous exchange enhanced owing to the frog's skin being highly vascular (23), there is an inevitable consequence in cold weather. It is that the frog loses heat rapidly from its body when ambient temperature becomes low

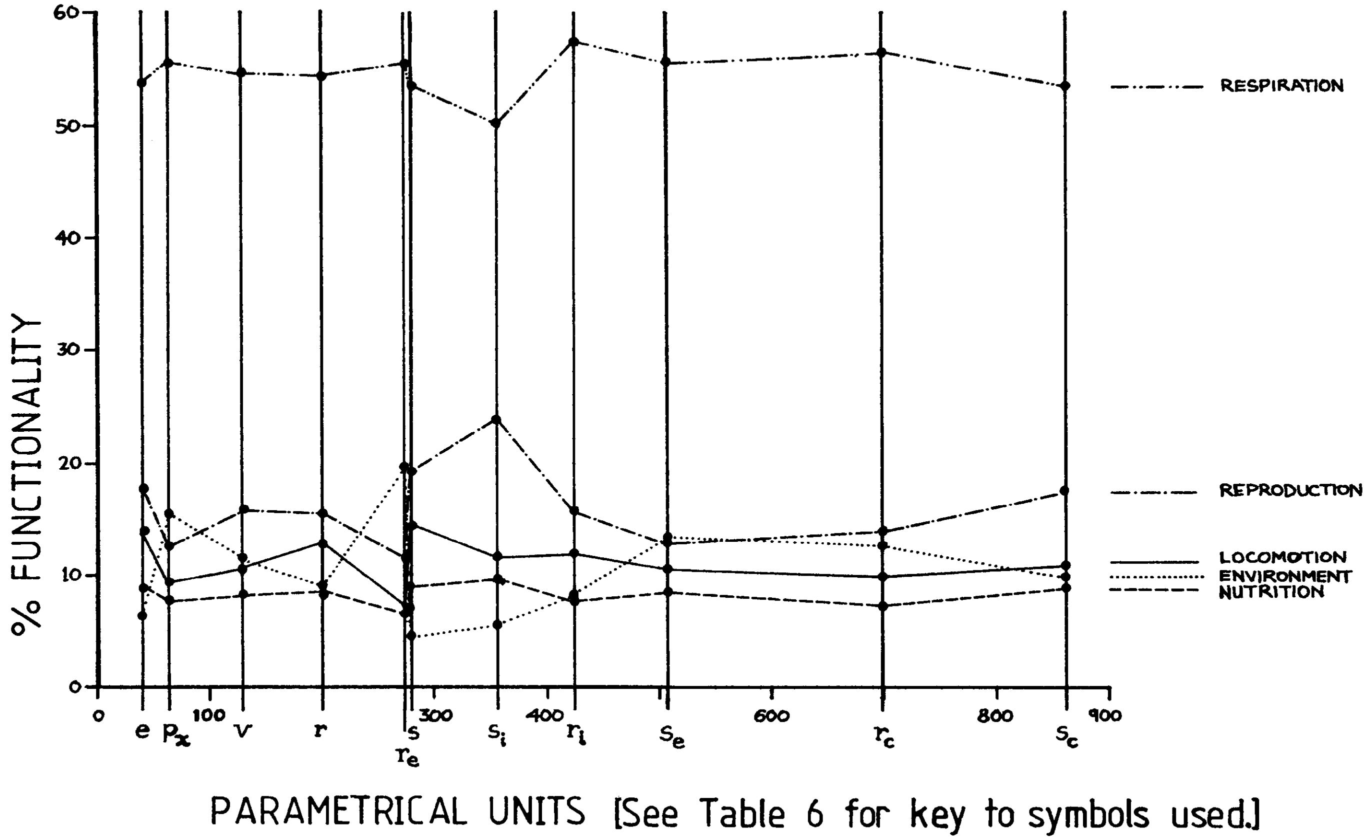


Figure 7. *Rana temporaria* **linkogram evaluation.**

(28). Although the frog is poikilothermic (i.e., 'cold-blooded') (26) it soon loses any metabolically generated heat to the surrounding pond-water. The small size of the frog's body aggravates its predicament by giving it a high surface area to volume ratio, and the result is that activity becomes much slower as winter approaches. Eventually the frog buries into the pond bottom to hibernate (27). Only when the pond-water becomes warmer in spring-time will the frog awaken from its torpor.

Two routes exist between tiny lungs (2) and hibernation (27). One is via entities (23) and (26) and the alternative is via entities (20), (30) and (28).

5.4 Successful breeding

The presence of mucus on the skin of the frog helps to enhance cutaneous respiration in much the same way as phlegm in the lung operates. But it prevents breeding partners from holding on to each other. That problem is remedied by the male having a nuptial pad (25) to help him to retain his grip on the female during amplexus (21). Together the partners release their gametes (32) into the pond-water where external fertilization (31) can occur. But in the event of the male losing his grip on the female, their bodies would be further apart and so reduce the chance of a sperm entering an egg before the jelly formed over the spawn.

Before any amplexus can occur, the male frog must attract a female. Even in the darkest night, his croak (17) can be heard by other frogs. Not only must the female hear the croak of the male, but also the male must be able to hear the splash as the female enters the pond-water. Clearly, if water got into frogs' ear-holes they would become deafened and not be able to home in towards each other in the dark. Therefore, the frog has no external auditory meatus (34) for water to enter, so its hearing is not impaired. Instead, the frog has its ear drum close against the skin of its head (35) and as only the male croaks, one male would soon know if he accidentally squeezed the trunk of another male in the dark! That explains the link between entity (21) and entities (35) and (33).

5.5 Sinking eyeballs

In section 5.2 it was mentioned that tiny lungs (2) inevitably gave rise to there being no trachea (3) and so the larynx is largely absent (14). Not only does the frog need vocal pouches (16) to enhance the vibrations of its glottal epithelial flaps (15) and so croak if it is male, but not having a proper larynx leads to another complication. How can the frog swallow? In our bodies the larynx rises when we swallow for two reasons. One is to block off the glottis, which is the entrance leading to the windpipe, and so stop food entering our lungs. The other is to come down after rising in order for the larynx to initiate the swallowing reflex.

In the case of the frog, instead of the larynx pushing food down its gullet or oesophagus, muscles retract the eyeballs to help push food down during swallowing (40). However, the eyeballs can only sink because the frog has no floor to its eye-socket in its skull and also has no secondary palate (37) which would act to prevent eyeball pressure upon food. Also, its not having a secondary palate could mean that any prey could try to escape from the mouth cavity via the nostrils. To prevent such a thing happening, the frog has vomerine teeth (39) and nostril valves (38) to contain its food, even though no teeth exist in the jaws to cut food into pieces. Furthermore, there is no air under the water, so a frog feeding below the pond surface would not benefit from having a nasal cavity kept separate from its buccal cavity by a secondary palate. That is the reason for the inclusion of entity number (36) in the linkogram shown in Figure 2.

5.6 Shock absorbing

In section 5.2 the linkage leading from the tiny lungs (2) through to there being no ribs (9) in the frog was described. Having no ribs (9) means that there is no protection for the upper trunk organs. Although the lungs are puny and do not need special protection, the heart exists and merits skeletal cover. Entities (18) and (19) represent the heart in Figure 2. Therefore, the pectoral girdle is extensively present in the frog to compensate for the lack of ribs. So having a pectoral girdle (10) not only shields the heart, but also helps to absorb the considerable shock when the frog lands upon its front legs (22) after its leap when the hind legs (13) transmitted their thrust via ilia and urostyle (12) to the last trunk vertebra.

6 DRAFTING SOME CONCLUSIONS

Many tautological relationships between various linkological parameters have been stated in sections 3 and 4 of this article. Obviously to devise a linkogram of any aspect of biological phenomenon is tedious but unexpectedly rewarding because of two reasons. One is that when you think that you have exhausted the possibilities of making sense of the problem under review, new ideas spring to mind. For instance between entity (4) and entity (14) could have been fitted a new entity receiving links from those two. That new entity is the front-hinged tongue. Not only does it make up for a lack of larynx for any rearward attachment, but it compensates for a lack of neck by giving the frog further reach to catch its prey. Also another new entity could have been the fact that frogs lack webs between the toes of their front limbs. Having a highly vascular skin could result in much loss of blood upon landing if the web existed and became torn! The second rewarding reason is that the linkogram approach brings out the 'tailor made' aspect within the design-linkage that special creation put there.

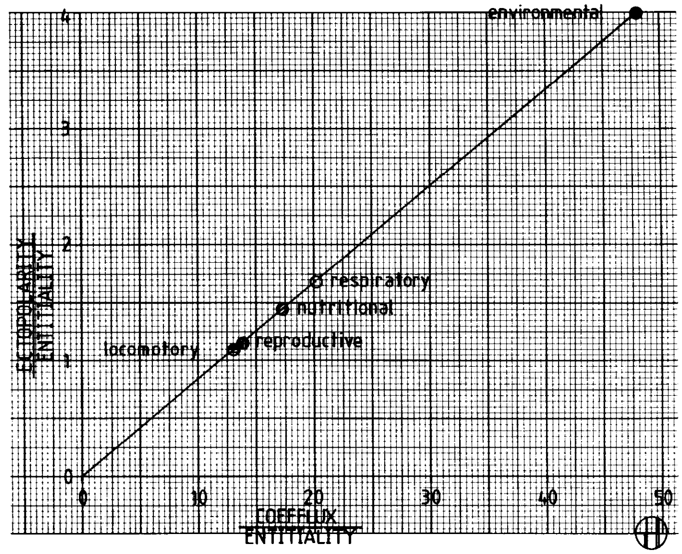


Figure 8. Plot of seriation I.

6.1 Challenging computer programmers

How wonderful it would be if a computer program was constructed to produce an array such as the tables and figures included within this present article. One useful starting point would be to use the Link List shown in Table 3 as the initial data. Even more time-saving would be the ability of a program to display a selection of linkogram diagrams from that initial data. Not only could panels of experts decide which scheme looked aesthetically most pleasing, but also identify which linkages submitted by creationists were likely to reveal cause for praise and admiration to the Originator of Species rather than to the human submitter.

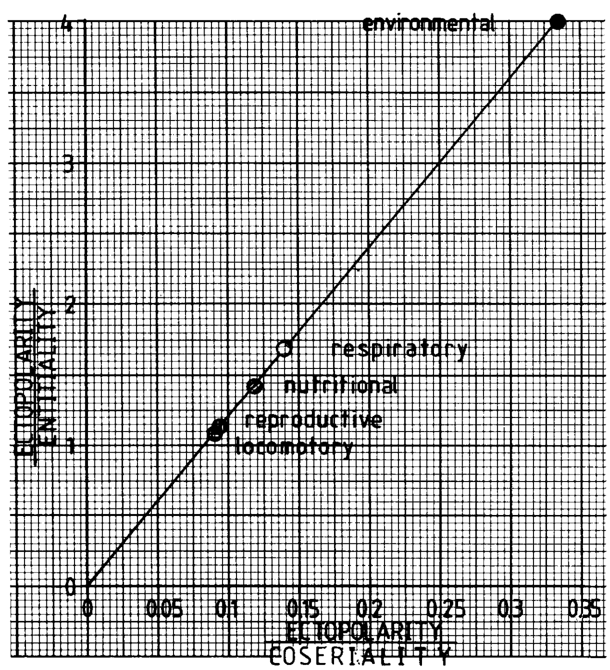


Figure 9. Plot of seriation II.

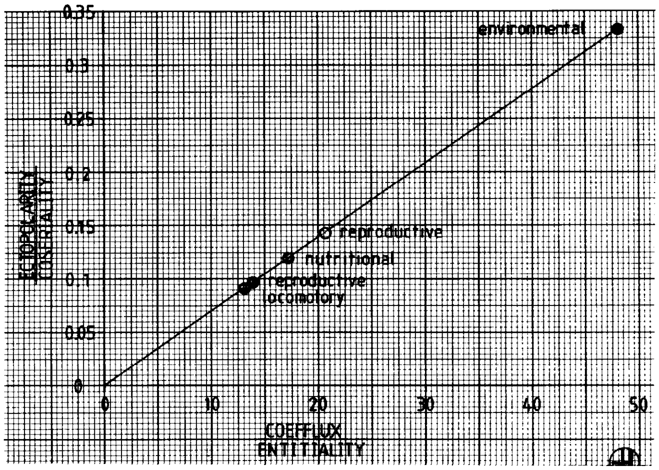


Figure 10. Plot of seriality III.

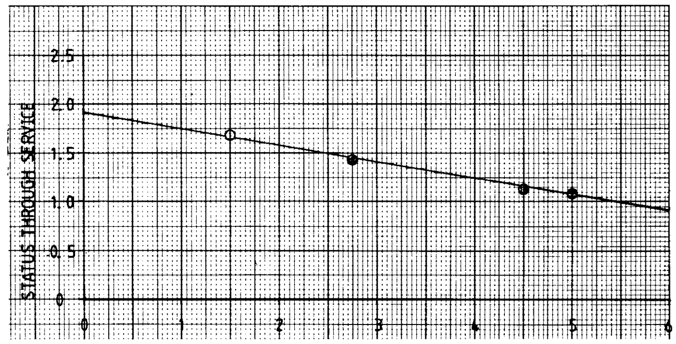


Figure 11. Days of the Creation. The plot of linkological seriation with revealed Creation.

6.2 Coining an aphorism

In the quest for a way to determine the extent to which each function contributed to the linkogram representation of the Common Frog a discovery was made. It was that those entities having the greatest number of 'OUT' links compared with their relatively small number of entities ascribed to a particular function produced the greatest contribution, Therefore, Figure 8 is a plot of functions in terms of their ECTOPOLARITY divided by their ENTITIALITY on the y-axis and their COEFFLUX divided by their ENTITIALITY on the x-axis. You see, both axes are measuring the same thing which boils down to 'STATUS THROUGH SERVICE.' But that is only one way of plotting what I have termed seriation. Figures 9 and 10 show other methods of obtaining the rank order of contribution of each function under study.

Figure 11 represents something of a climax in that it shows a high degree of correlation between functional seriation and the revealed sequence of Special Creation as recorded in Genesis chapter one. In other words, the higher the value of their contribution towards the overall 'design linkage' of the adult Common Frog, the earlier certain items were created or mentioned in the Days of the Creation. However, the value of 4.0 for environmental seriality was difficult to apportion. That was owing to the frog being equally 'at home' in jumping through air (made in Day 2) when traveling over dry ground (formed in Day 3) as well as swimming or diving in pond-water (that could not have predated Day 3). So that plot was omitted.

Realising that the y-axis co-ordinate of each function's seriality is the same as shown in Figure 8, it only remains to explain how their x-axis co-ordinates were calculated. Air for respiration was formed on Day 2, but as we do not know the exact time of its creation, let us plot it half-way through that day to give a value of 1.5. (Here I am assuming that God evaluated what He had just made for as long as it took Him to create). Vegetation for nutrition (see verse 30 and the Introduction of this article) was formed on Day 3. If the first half of that day was occupied with forming dry land, then the second half was taken up with the creation of plants. So, other things being equal, plants were made mid-way through the second half of Day 3 and therefore have a value of 2.75. Next, assuming that frogs were created on Day 5 and that God told them to multiply, a value of 4.5 can be given to reproduction (for frogs). Finally, assuming that the sexes were created close by each other in the same pond, after amplexus the couple would by twilight be migrating to another pond. Therefore, I would place locomotion at the end of Day 5 close to the start of the evening belonging to Day 6. So locomotion in frogs receives a value of 5.0.

Whatever faults and imprecise facts this study of the adult Common Frog's form and function contains, they cannot detract from my aim to show that the organism is a suite of parts programmed to be perfectly adapted both to other parts within its own body and also to its food and to its partner of the opposite sex outside of itself. To try to devise a scheme to show the sequence of evolution for the adult Common Frog would, I believe, be a much harder task than this linkological evaluation. Could it be that here is evidence that creation has leap-frogged evolution?

Reference

1. Romer, A. S. 1966. Vertebrate paleontology. University of Chicago Press. P. 100.

NOTICE OF BOOK

(Continued from page 233)

tical use. He suggests that a more fruitful course, about the turn of the century, would have been to investigate the nature of light, and its relation to space the aether, or whatever one may choose to call it. Of course, it is not yet too late to try such an approach; and, to be sure, several investigators are doing just that.