

A New Perspective on Extinctions: The Search for a Common Formula.

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Abstract: This paper introduces a new theory to explain and to estimate the size and frequency of extinctions over the entire period of 600 my of the fossil record. The current explanation is excellent. There seems to be a common pattern or formula. We will demonstrate in what way death is a fact of life: there is a constant margin of 10 pct, and about seven peaks with at least 25 pct of extinction victims. Those peaks occur each 85 million years, but their frequency has increased over time. In principle, the predictability of the next peak is limited, because of chaos (within the solar system and the ecosystem on Earth), the unpredictability of mutations in Nature, of innovations by Man, and let alone the disastrous impacts of asteroids. It also depends on the concept of whether life is cyclical or linear. Therefore, some predictions have a low likelihood of occurrence. In the traditional theory or Old Vision there are many extinctions and even mass extinctions, each with various theories believed to be their cause. There is no single theory explaining all extinctions. Man was witness to and perhaps later on even guilty of extinctions. Even as early as in the Ice Ages he tried to find facts and continued later on in the Age of Science. But we still do not see extinctions in their right perspective, and it would be very useful to change this.

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1. Introduction:

A New Perspective. We may say that there are many factors behind the increases and decreases of the number of species. We will try to bring them together in a simple diagram; see figure 1. The main causes are as follows:

1. Chaos in the solar system and changes in the position of the axis of the Globe, both causing changes in the radiation on the surface of Earth,
2. Climate,
3. Volcanism,
4. Tectonics, with changes of the surface of the Earth,
5. Impacts (I) of asteroids, with often catastrophic effects.

All the above five factors are in a very complicated relationship.

We see the influence of many factors on extinctions (L) and on the number of species (N), or on the numbers of mutations (M).

Mutation (M) does increase the number of species (N). Increasing the number of species leads to more competition and, as a consequence, some species will become extinct. This is called extinction by natural selection.

Mutation also plays a very different role in

the growth process of an ecosystem and subsequently on extinctions. If there are sufficient mutations the growth is stable; see figure 2. What is established is similar to a Ecological Hierarchy, with the highest developed species of the particular period placed on top.

If the mutations fall back something remarkable happens: the Hierarchy deteriorates, especially from the top; see figure 3. The highest developed species disappear forever, and show a special form of extinction (Noort, 1995). This idea was based on the Chaos Theory, in the early nineties not yet accepted as a useful theory like it is today (Bennett, 2010).

If we look at the diagram closely. The relations at the "bottom" of the scheme appears not that complicated - we could say:

$$L = f(N, M, I).$$

This model leads to a simple equation for testing purposes:

$$L = aN + bM + cI + u$$

in which 'u' is a statistical rest term.

There are some variations on this formula by using dM instead of M and a case of interaction between Impact and Mutation. If Earth is far from

the sun, it is close to the asteroid belt. Thus, L could increase by impacts, but the radiation of the sun there is also lower and causes fewer mutations, which may also increase L. The two factors then act together, and we could regard this as an interaction by using the third term (dM.I) instead of I alone. In total we have six possible equations. *It is remarkable that for Evolution we could not formulate such a simple equation because it has not the "at the end of the line"-position as Extinction has. in figure.1.*

2. Falsification, The case of foraminifers. Because we have statistical facts about L, N, M, and I we could test the hypothesis; however it is beneficial to commence with an illustration by words only, and for only one species.

We use the foraminifers in Egypt as an example. There were two species: *Gumbelitra cretacea* A and B. In the situation of figure 2 we notice that type A is a rather marginal animal, therefore positioned at the bottom of the Hierarchy. The larger, more productive type B has just about reached its position at the top. The difference between the two is related to mutations M and with the journey of A and B along the side of the Ecological Hierarchy - this is natural selection; the struggle between species (N).

Subsequently, a change in conditions occurred (see figure 3) and the mutations fell back. As a consequence (from Chaos-Theory) the more dominant variant has moved down the Hierarchy, but nothing happened to the marginal types. What we see here is similar to a revolution: the highest fell down and the lowest remained in position. We know that 65 my ago, considerable damage to the fauna occurred due to the impact of an asteroid (I). What might we expect to find after such an occurrence? Below the boundary we should see type A and B - and B is dominating. Above the boundary we will see only type A; B must have disappeared, become extinct. Further on, there must be radioactive iridium from the impact. In fact we see all this indeed in the Sinai area. (Elewa and Dakrory, 2008)

So we applied our concept and found no contradictions to the facts. However, this is of course just one case, therefore we continue with the general case to explain all extinctions.

3. The general case: statistical tests. We have seen that there are various hypotheses. Yet how can we discriminate amongst them? The philosopher Karl Popper proved that the only direction to take was falsification. Very good

possibilities were e.g. regression and correlation analysis or tests.

The tests are all based on statistical data. We will test our six linear regressions-equations. The test must provide answers, e.g.: do the coefficients a, b, and c have the right sign and are they statistically different from zero; and also whether the correlation coefficient is high enough to justify an explanatory case?

The results of statistical testing are in table 1. Each of the six columns is such a regression -equation with an estimate of the regression coefficients and their standard error, between ().

In order to be statistically significant the coefficient must at least be two times larger than the error, according to the wellknown t-test. This is indeed the case for all equations, and in addition they have the expected sign.

The measure of explanation is R square; providing the percentages of explanation. The measure of relationship is given by the correlation coefficient. This one is high, given the degrees of freedom.

The statistical table 2 indicates a high interpretive character of the presented model of extinctions.

Conclusion:

The presented idea of a general explanation is not in contradiction with facts, because the coefficients have the expected sign and differ statistically from zero indeed. The correlation coefficient is high. Therefore we can justify a statistically acceptable relationship, based on the process of falsification.

4. Forward and Backward predictions.

The statistical formula can now be used for estimating the size of extinctions over the whole period of 600 million years, see figure 4. These estimates can be named backward predictions.

We see that there is no basis for the concept that the number of species did not change over time (Jacobs, 2002), because there is a continuous margin of extinctions (about 10 pct) and 7 peaks of at least 25 pct. of victims.

The frequency of the Peaks was, on average, one in 85 million years, but the frequency increased gradually over time. The longer the period between peaks (t), the more families and

species may grow, or in other words: the longer that period, the more victims (v) may be expected by the end of the period and vice versa. Based on figure 4 we have found a weak relationship between v and t :

$$v = 3.01 + 0.13t$$

In table form and real scales:

myv =22pct	t=0
myv=31pct	t=45
myv=40pct	t=90

One of the persistent problems in the evolutionary theory consists of the missing links. People have an idea of a continuous trend in evolution, with *Homo sapiens* at the top. As a consequence they are unsuccessfully looking for the links between the successive dominant types. Even Darwin made that point, yet he should not have been so concerned. At the end of a period the Ecological Hierarchy caves in and many dominant species disappear forever, the marginal types take their places and some of them become the dominant types in the following period. So there is no special link between the successive dominants, and this holds true for all peaks. We see that there is not only evolution, but also revolution. Revolution prevents any link between the dominant types of the various periods; this is also found during many types of research. Missing links of this type form additional proof for our theory.

It is also repeated continuously that the strongest always wins in evolution (Jacobs, 2002). This is not true. The productive type is the winner of each period between two peaks. It is the type with the highest growth coefficient (k) that will belong to the top region of the Hierarchy. Furthermore it is clear that the dominants do not live forever as a species; no one survived up to these days; not even the Methusalae (a term introduced by Ward for species like stromatolites), living almost without competition (see figures 2 and 3, with $w=0$). There is no continuous line for the History of Life, but only an upward tendency through a 'zigzag line'.

There are now two forward predictions of the next peak:

1. Ward estimated an imminent extinction which will bring life to a halt. He implicitly sees life as linear, see W in figure 4
2. Noort predicted by extrapolation of the found statistical relationship, using the expected number of years for a peak to occur. This is now somewhat less than 85 years (say 60 my) and the peak may either be somewhat higher than the lowest up to now, or somewhat lower than the highest up to now. See $N1$ and $N2$ in figure 4. A good 'guestimate' is the average of both. Therefore, in about 60 my after peak number 11 we could have the next one with about 35% of victims. Life here is considered cyclical: life changes all the time, but it does not disappear forever.

The difference between the two estimates is considerable. For W we have the shortest period ever and also the highest 'victims rate'. It is possible that the period is much shorter than for its 'rival estimate' and also that its victims rate is much higher, but the likelihood of occurrence is then lower as well.

The constant margin of 10% seems to be an average of all the periods in this frame; and the peaks (v) become higher as the period (t) becomes longer than the average. A short period with a high victims rate does not appear to have a very high likelihood of occurrence.

Conclusion:

It is possible to see all extinctions in one perspective and to falsify the many hypotheses. In principle the equations can also be used for predictions, the backward predictions are excellent, but the forward predictions have strong natural limitations. Time and size of the next extinction is not possible to estimate, the impressive prediction by W has a lower likelihood of occurrence than the guestimate N .

Figure 1 Diagram of causes and effects on extinction

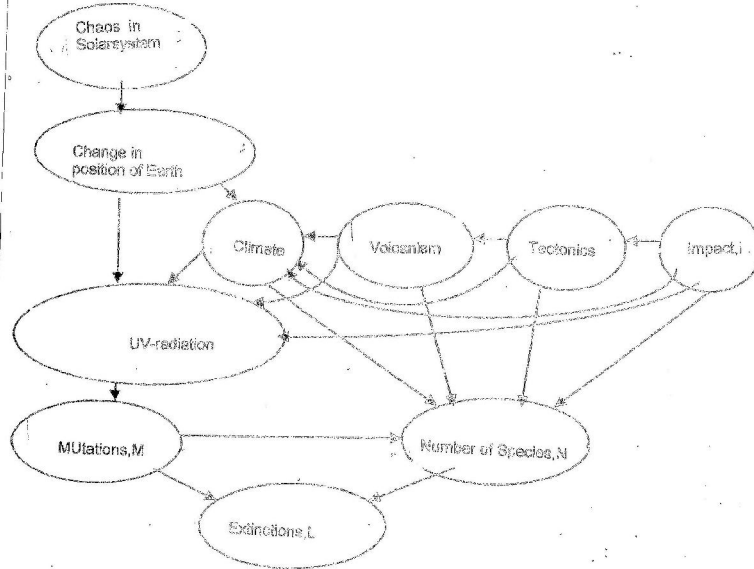


Fig. 1

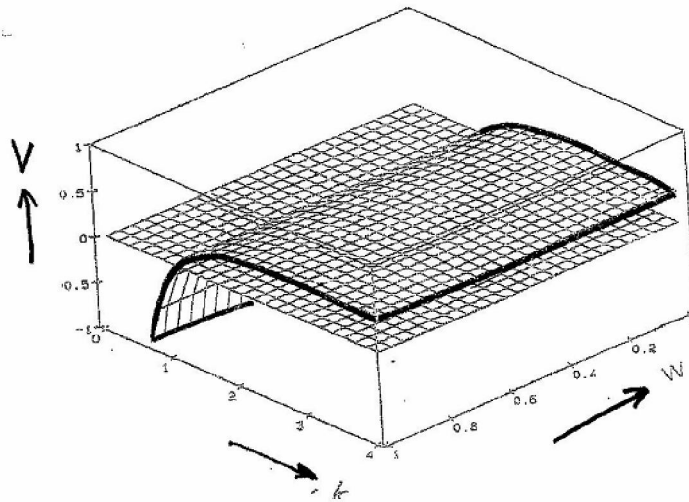


Figure 2 The Stable Ecological Hierarchy in case of increasing mutations

V=vitality, k= coefficient of growth, w=degree of competition
 w=0=monopoly, w=1=pure competition, (Noort, 1995).

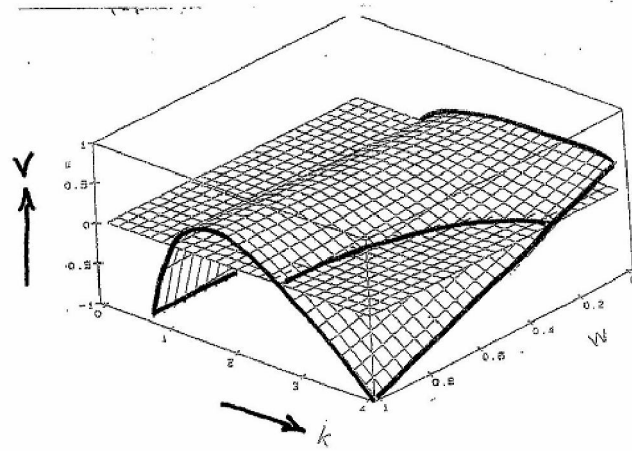
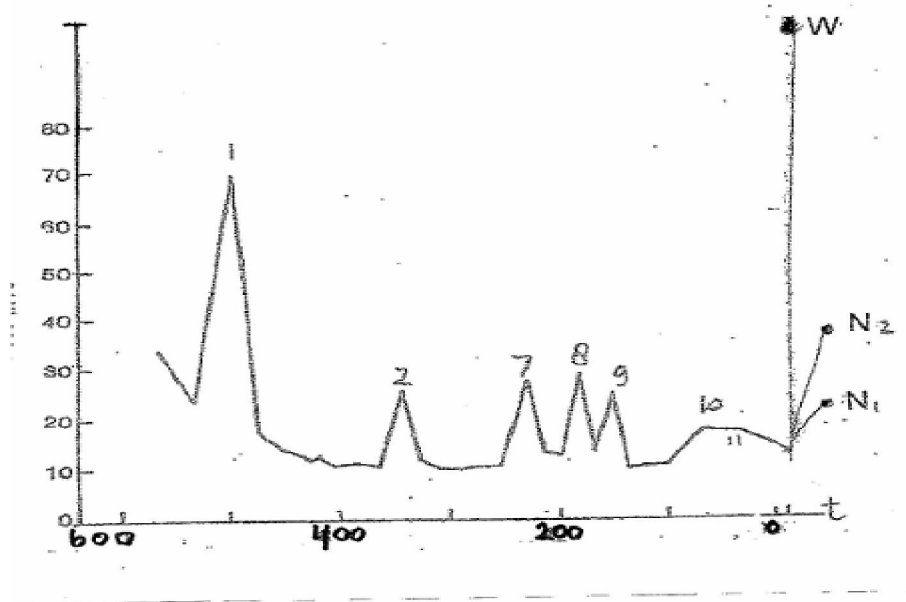


Figure 3 The unstable Ecological Hierarchy, in case of decreasing number of mutations, (Noort, 1995)



1=Cambrian, 2=Devonian, 7=Permian, 8=Triassic, 9=Jurassic
 10= Cretaceous, 11= Palaeocene; Mass Extinctions

Figure 4 Estimates of extinctions in the last 600 my and two predictions of the next mass extinction.

Table 1 | Statistical results.

Equation:	(1)	(1a)	(2)	(2a)	(3)	(3a)
Variable.						
<i>N</i>	0.076 (0.035)	0.057 (0.054)	0.079 (0.036)	0.230 (0.057)	0.184 (0.049)	0.220 (0.044)
<i>M</i>	0.120 (0.073)	0.071 (0.148)				
ΔM			0.043 (1.23)			
ΔM^a				0.427 (0.185)	0.433 (0.149)	-0.166 (0.283)
<i>I</i>	53.74 (13.89)	47.36 (19.54)	53.03 (14.84)		40.31 (14.26)	62.14 (15.25)
ΔMI						0.763 (0.322)
<i>MI</i>		0.021 (0.191)				
R-square	0.59	0.57	0.60	0.56	0.74	0.83
Degrees of freedom	24	24	23	13	12	11

^{a)} $\Delta M < 0$ only

Table 1 | Table of statistical results : six equations,their coefficients,the standard errors and correlation coefficients.
The t-test requires that the coefficients are at least 2 x their standard errors.

R	Rsquare	% explained	Interpretive power
<0.3	<0.1	<10	very weak
0.3 -0.5	0.1 - 0.25	10 - 25	weak
0.5 -0.7	0.25 - 0.5	25 - 50	rather weak
0.7 - 0.85	0.5 - 0.75	50 - 75	strong
0.85 - 0.95	0.75- 0.9	75 - 80	very strong

-----Our first estimate in the first column of table 4 was Rsquare =0.59 ,So this table says: strong relationship!
We may also speak of statistical significance.

Table 3.

Appendix 1 First and last known occurrences of main animal groups

Series	Duration (million years)	Total fam- ilies	First occurrence		Last occurrence	
			Fam- ilies in per cent	Fam- ilies per million years	Fam- ilies in per cent	Fam- ilies per million years
Neogene	32.5	856	17	.52	10	.30
Palaeogene	32.5	834	44	1.35	15	.46
Upper Cretaceous	35.0	629	26	.74	26	.74
Lower Cretaceous	35.0	520	35	1.00	11	.31
Upper Jurassic	15	377	15	1.00	11	.73
Middle Jurassic	15	346	14	.93	7	.47
Lower Jurassic	15	328	50	3.33	10	.66
Upper Triassic	16.6	278	19	1.14	35	2.11
Middle Triassic	16.6	254	25	1.50	10	.60
Lower Triassic	16.6	235	36	2.17	18	1.08
Upper Permian	25.0	303	21	.84	50	2.00
Lower Permian	25.0	330	15	.60	27	1.08
Upper Pennsylvanian	10.0	315	11	1.10	11	1.10
Middle Pennsylvanian	10.0	318	5	.50	5	.50
Lower Pennsylvanian	10.0	308	6	.60	3	.30
Upper Mississippian	17.5	318	8	.46	9	.51
Lower Mississippian	17.5	315	28	1.60	7	.40
Upper Devonian	20.0	327	14	.70	30	1.50
Middle Devonian	20.0	326	15	.75	13	.65
Lower Devonian	20.0	298	21	1.05	7	.35
Upper Silurian	6.6	272	8	1.21	13	1.96
Middle Silurian	6.6	265	13	1.96	5	.75
Lower Silurian	6.6	243	28	4.24	5	.75
Upper Ordovician	25.0	228	10	.40	24	.96
Middle Ordovician	25.0	221	33	1.32	7	.28
Lower Ordovician	25.0	192	76	3.04	23	.92
Upper Cambrian	33.3	97	34	1.02	52	1.56
Middle Cambrian	33.3	82	50	1.50	22	.66
Lower Cambrian	33.3	55	100	3.00	25	.75

Table 4.

Geo Scale		A Correlated History of Earth				Bio Scale
[GEOLOGICAL COLUMNS]			[BIOLOGICAL COLUMNS]			
Tectonics: (Maps, 1 Events...)	Stratigraphy: (Era, Period...)	Classics and 1 Astroblemes age	Plants, Fungi: Prokaryotes, Protozoists	Invertebrates Animals	Vertebrates Animals	
	Quaternary	2				
	Tertiary		⊙	⊙	⊙	
	Cretaceous		⊙	⊙	⊙	
		141				
	Jurassic	202	⊙	⊙	⊙	
	Triassic	230	⊙	⊙	⊙	
	Permian		⊙	⊙	⊙	
		260				
	Carbonif.		⊙	⊙	⊙	
		263				
	Devonian	300	⊙	⊙	⊙	
	Silurian	330	⊙	⊙	⊙	
	Ordovician	310	⊙	⊙	⊙	
	Cambrian	344	⊙	⊙	⊙	
Proterozoic Eon 2500		Astro Key				
Archean Eon 4500		Classics Key		Bios Key	(C)	

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References

Bennett, K; The Chaos-theory of Evolution, New Scientist, Oct. 2010
Chaloner, W.G. and Hallam, A.; Evolution and Extinction, Cambridge, 1989
Darwin, Charles; Het ontstaan van soorten, 2009 Elewa A.M.T. (ed.): Mass Extinction. Springer-Verlag Publishers, Heidelberg.
Jacobs, G; De sterksten zullen overleven, Amsterdam,2002.
Morris, Ian; The Western Science Conquered the World, New Scientist, October 2010
Newell, N.D.(1967); Revolutions in the History of Life, Geol.Soc. of America, Special Paper,
Noort, P.C. van den; Complexity and Survival,

Eburon, Delft, 1995

Noort, P.C. van den; Evolution, Mass-extinction and the Chaotics in the Solar System, in: Speculations in Science and Technology, Vol. 17.1995
Noort, P.C.van den; Soortenrijkdom op de zeer lange termijn, Doorwerth, 2010
Pleitgen, H.O. & Richter, P.H. The Beauty of Fractals, Berlin,1986.
Ward, P.; De aarde neemt wraak, Scientific American no.1, 2007
Willers, M.; The Bedside Book of Algebra, ISBN 978-90-8998

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