

The BHU Future Farming Centre

Permanent Agriculture and Horticulture

Science and Extension

www.bhu.org.nz



A New Agricultural Testament

Dr Charles Merfield

“Agriculture at a crossroads”



International Assessment of Agricultural
Knowledge, Science and Technology for
Development

IAASTD

www.agassessment.org

“Business as usual is not an option”



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AN AGRICULTURAL TESTAMENT

BY

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Indore, and Agricultural Adviser to States
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FARMERS OF
FORTY CENTURIES
OR PERMANENT AGRICULTURE
IN CHINA, KOREA AND JAPAN

By

F. H. KING, D.Sc.

FORMERLY PROFESSOR OF AGRICULTURAL PHYSICS IN THE UNIVERSITY
OF WISCONSIN AND CHIEF OF DIVISION OF SOIL MANAGEMENT,
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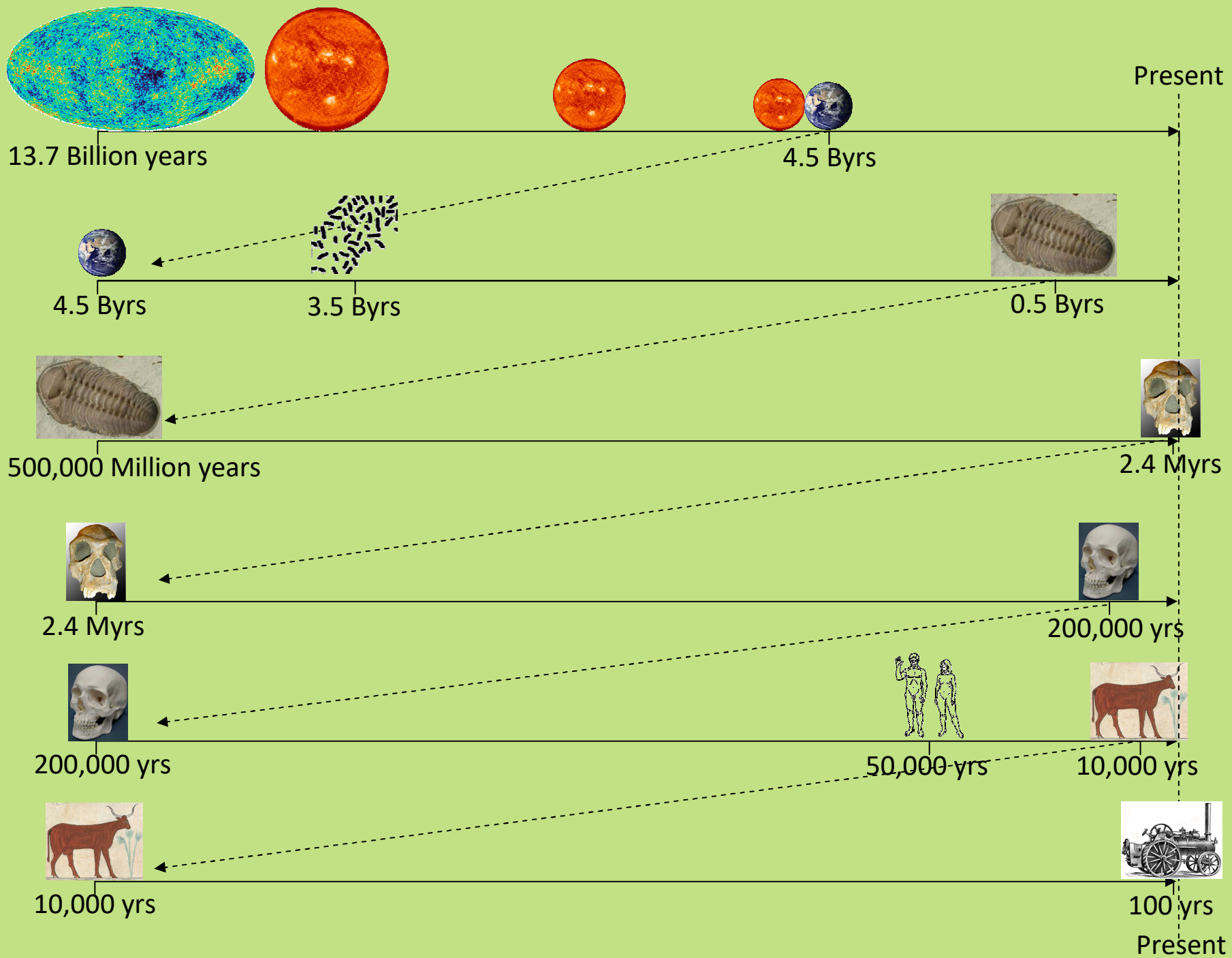


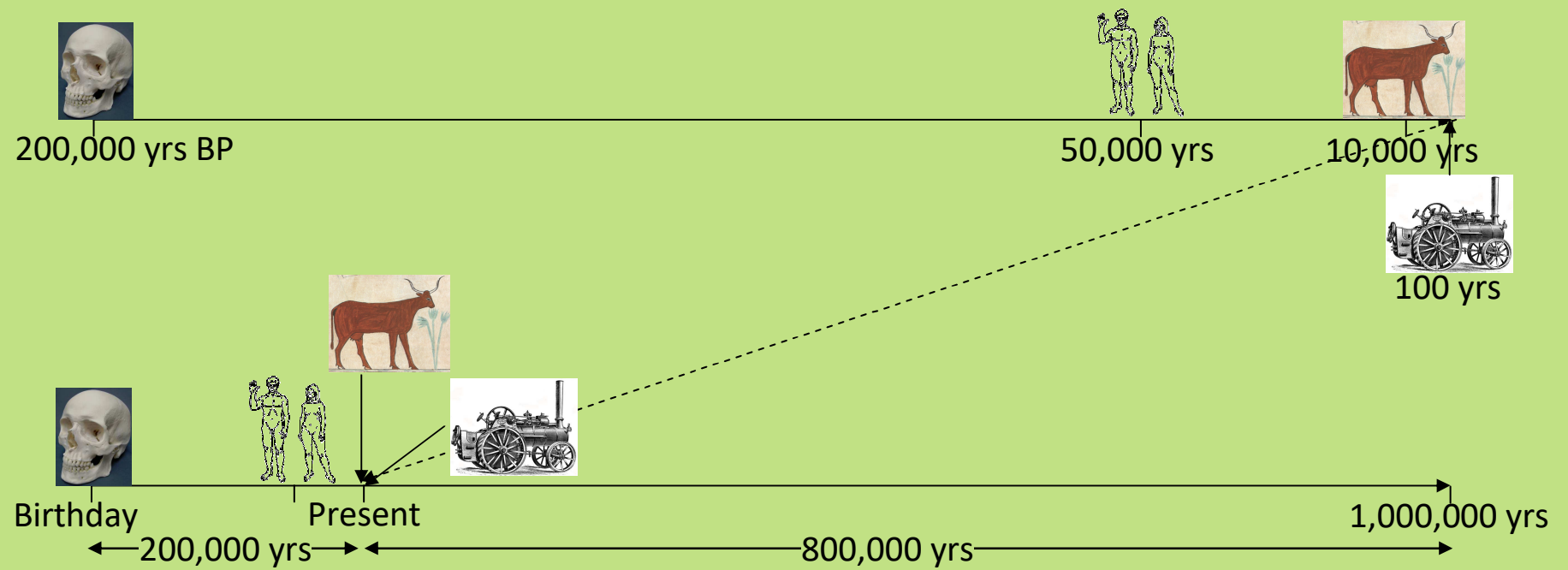
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Permanence?



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David R. Montgomery

Montgomery



dirt

The Erosion of Civilizations

The Erosion of Civilizations



The first ethic of agriculture

“The primary task of agriculture is good husbandry of the soil, such that soil ‘quality’ / ‘health’ is maintained or improved at timescales of millennia”



The earth machine

The Second Law of Thermodynamics:
In a closed system entropy always increases with time

3.85×10^{24}
Joules yr^{-1}



'White' light =
lower entropy



3.85×10^{24}
Joules yr^{-1}



'Heat'
(infrared light) =
higher entropy

An open system can decrease its entropy by exporting
it to the wider system

Matter cycles



H 1 Hydrogen																	He 2 Helium	
Li 3 Lithium	Be 4 Beryllium																	Ne 10 Neon
Na 11 Sodium	Mg 12 Magnesium																	Ar 18 Argon
K 19 Potassium	Ca 20 Calcium	Sc 21 Scandium	Ti 22 Titanium	V 23 Vanadium	Cr 24 Chromium	Mn 25 Manganese	Fe 26 Iron	Co 27 Cobalt	Ni 28 Nickel	Cu 29 Copper	Zn 30 Zinc	Ga 31 Gallium	Ge 32 Germanium	As 33 Arsenic	Se 34 Selenium	Br 35 Bromine	Kr 36 Krypton	
Rb 37 Rubidium	Sr 38 Strontium	Y 39 Yttrium	Zr 40 Zirconium	Nb 41 Niobium	Mo 42 Molybdenum	Tc 43 Technetium	Ru 44 Ruthenium	Rh 45 Rhodium	Pd 46 Palladium	Ag 47 Silver	Cd 48 Cadmium	In 49 Indium	Sn 50 Tin	Sb 51 Antimony	Te 52 Tellurium	I 53 Iodine	Xe 54 Xenon	
Cs 55 Cesium	Ba 56 Barium	* La 57 Lanthanum	71 Lu	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	At 85 Astatine	
Fr 87 Francium	Ra 88 Radium	89-102 ***	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub					114 Uuq	
																		116 Uut

* Lanthanide series

La 57 Lanthanum	Ce 58 Cerium	Pr 59 Praseodymium	Nd 60 Neodymium	Pm 61 Promethium	Sm 62 Samarium	Eu 63 Europium	Gd 64 Gadolinium	Tb 65 Terbium	Dy 66 Dysprosium	Ho 67 Holmium	Er 68 Erbium	Tm 69 Thulium	Yb 70 Ytterbium
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* Actinide series

Ac 89 Actinium	Th 90 Thorium	Pa 91 Protactinium	U 92 Uranium	Np 93 Neptunium	Pu 94 Plutonium	Am 95 Americium	Cm 96 Curium	Bk 97 Berkelium	Cf 98 Californium	Es 99 Einsteinium	Fm 100 Fermium	Md 101 Mendelevium	No 102 Nobelium
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Industrial ag / green revolution

Industrial agriculture / the green revolution are based on four key technologies

- Fertilisers, especially Haber-Bosch nitrogen
- Pesticides
- Irrigation
- Genetic changes to crops and stock to maximise yields when using the above



The elements of life

hydrogen 1 H 1.0079																		helium 2 He 4.0026					
lithium 3 Li 6.941	beryllium 4 Be 9.0122																	boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305																	aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.39	gallium 31 Ga 69.723	germanium 32 Ge 72.61	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.80						
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.94	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29						
caesium 55 Cs 132.91	barium 56 Ba 137.33	57-70 ★	lutetium 71 Lu 174.97	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]					
francium 87 Fr [223]	radium 88 Ra [226]	89-102 ★ ★																					

*Lanthanide series

* * Actinide series

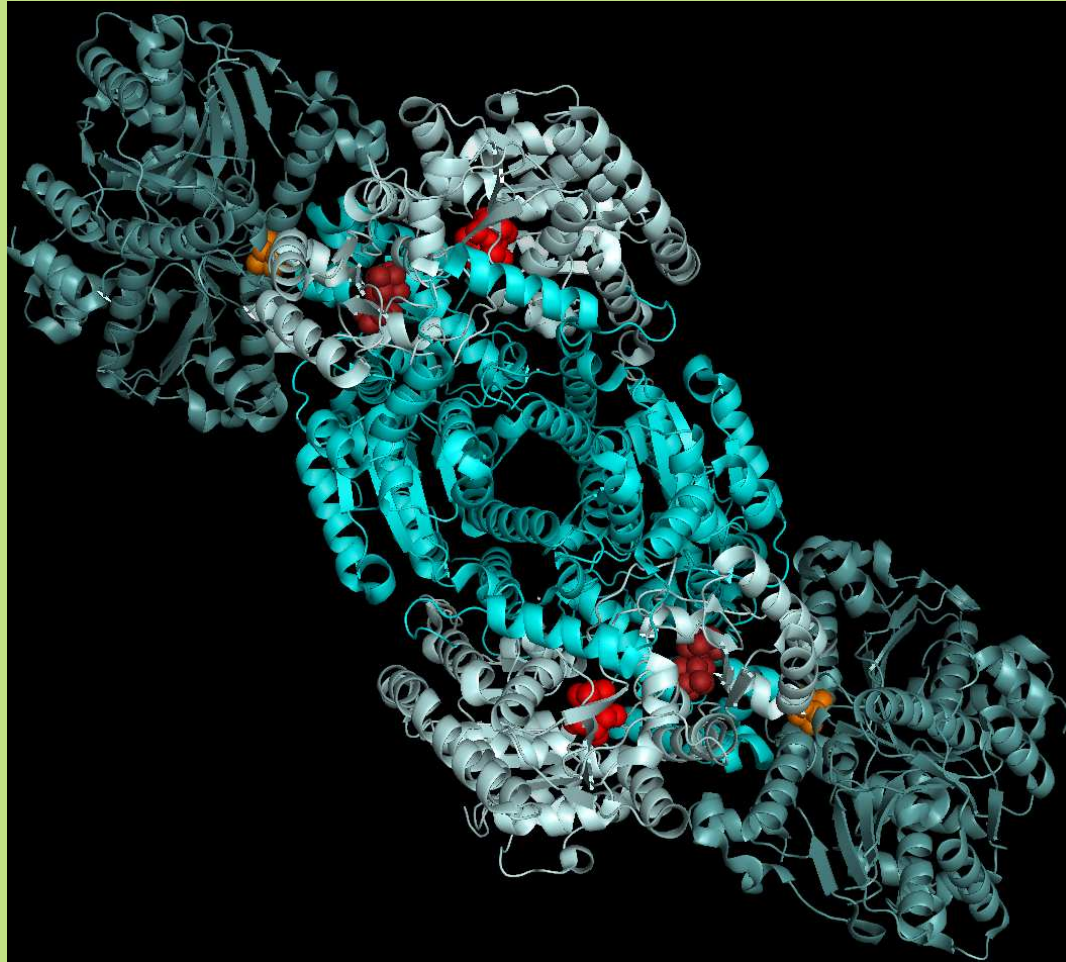
lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	neptunium 93 Np [237]	plutonium 94 Pu [244]								

Nitrogen



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Nitrogenase

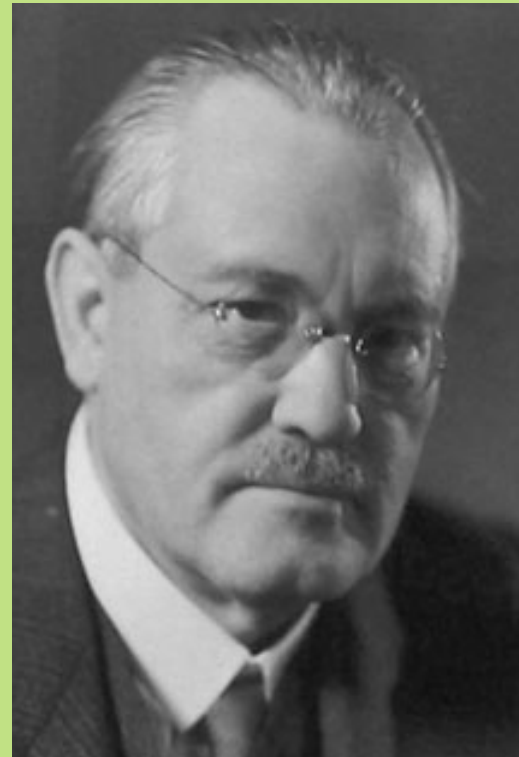


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Haber-Bosch nitrogen



Fritz Haber



Carl Bosch



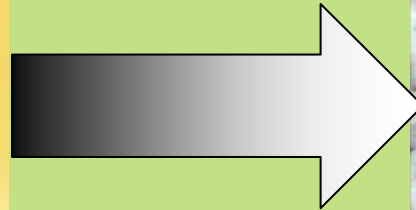
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Thomas Malthus



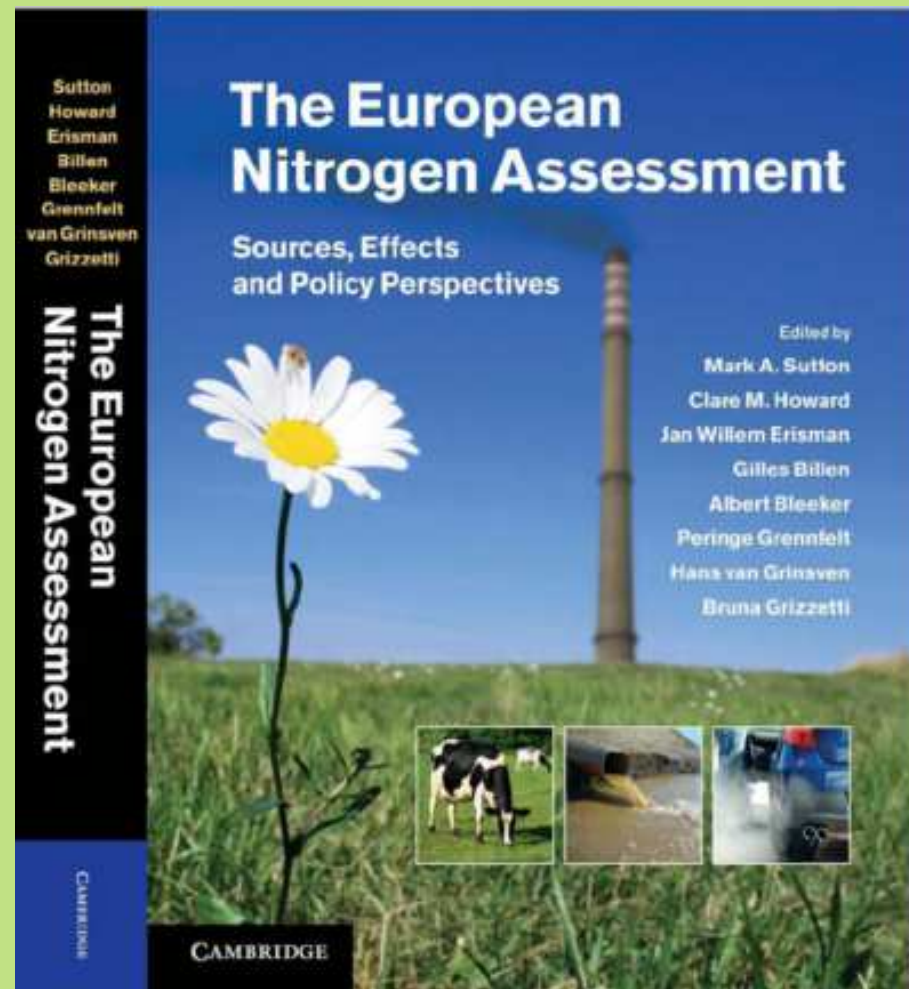
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Nitrogen - made from thin air?



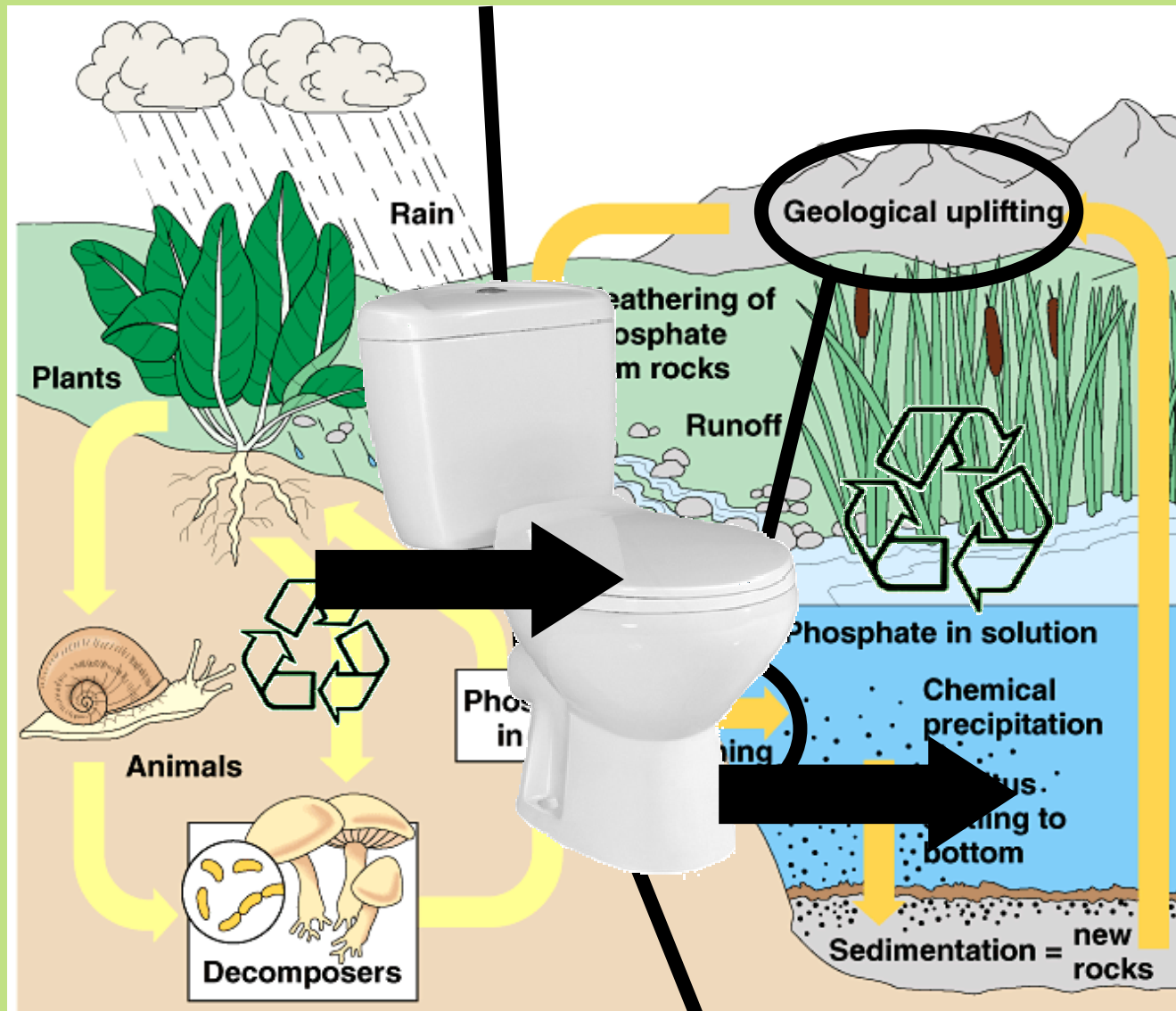
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The nitrogen deluge



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The lithospheric nutrients



Fossil fertilisers



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The post-pesticide era

“Please tell the farmers there is **no** cavalry coming over the hill.”

Dr Anne Thompson, Head of Development and
Registration at Dow AgroSciences



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The post-pesticide era

As those of us in research understand, current threats mean that we do NOT have all the answers. This is particularly the case in Europe where we are losing active ingredients and demands for the environment require significant adjustment in agriculture, perhaps even so far as to what I call a **post-herbicide era.**”

Dr Jon Marshal, Editor of Weed Research, in the editorial of the celebratory 50 year edition (Weed Research, 2010. 50(1))



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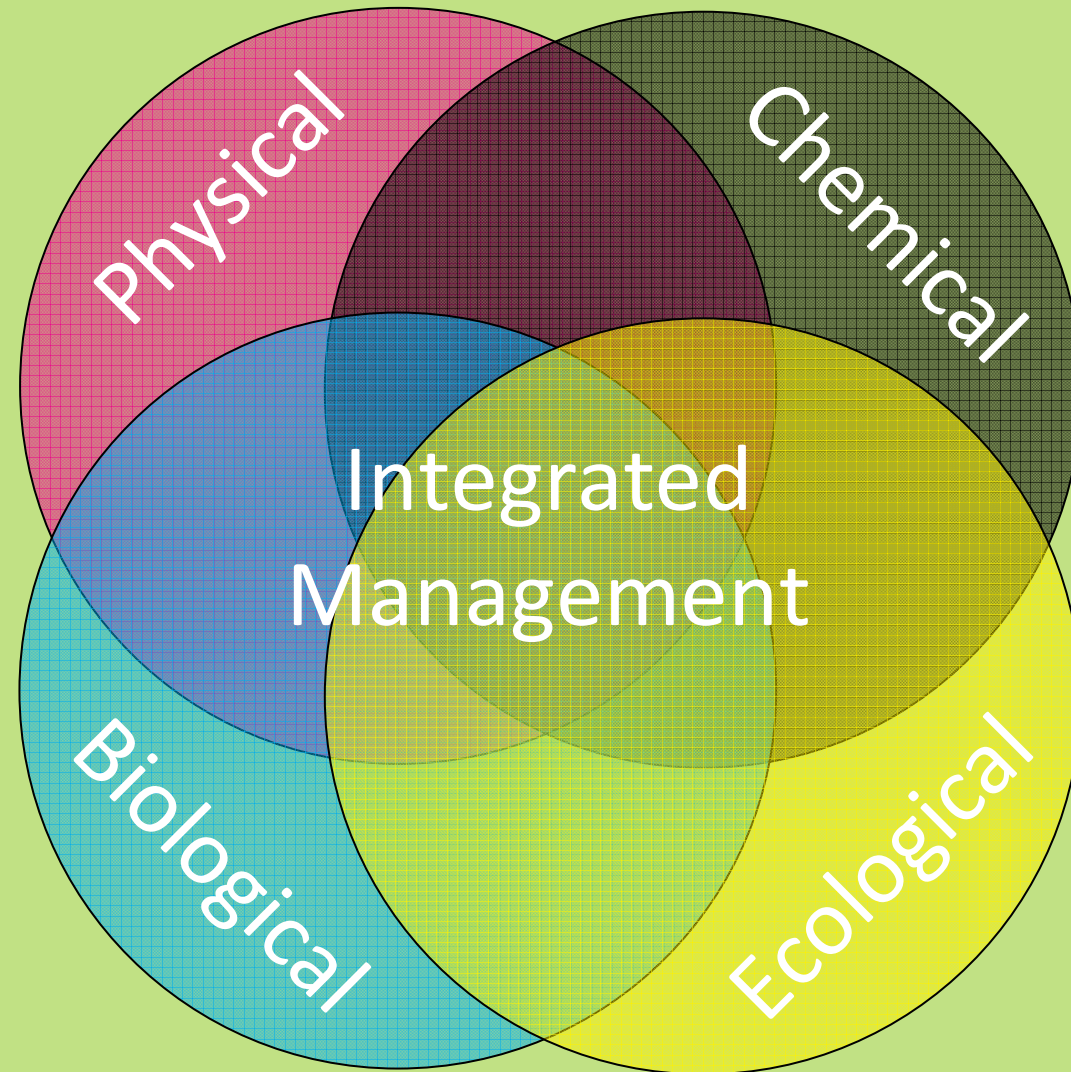
The post-pesticide era

Pesticides are caught in a 'pincer movement'

- Evolved resistance
- Lack of new chemistry
- Societal / governmental re-evaluation of herbicides cost:benefit analysis



The Integrated Management Framework



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Bio-Protection



Bio-Protection

Bioprotection science for New Zealand



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The post industrial agriculture era



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Ethics, science and agriculture

- Ethics ↔ Morals
- Ethics:
 - is a major branch of philosophy, encompassing right conduct and good life.
- Morality:
 - a code of conduct held to be authoritative in matters of right and wrong: created and defined by, societies, philosophies, religions, and individuals.



Ethics, science and agriculture

It is unscientific not to use slaves on farms, their use increases yields and profits.



Francis Bacon 1561 – 1626



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John D Barrow



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The ethics of pesticides

- REACH is the European Community Regulation on chemicals and their safe use. It deals with the **R**egistration, **E**valuation, **A**uthorisation and **R**estriction of **C**hemical substances.
- The law entered into force on 1 June 2007



"What I find most absurd is the claim that the EU proposals are not based on science. Whole teams of national and European scientific experts are involved. Where a specific pesticide is classified as being carcinogenic it's because there is substantive scientific evidence linking that substance with cancer."

Professor Vyvyan Howard, toxico-pathologist at the University of Ulster and a member of the [UK] Government's official advisory committee on pesticides, 2009.



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Scientism

Organic agriculture prohibits things such as xenobiotic pesticides that have been developed and proven to be effective using science, therefore, organic agriculture is unscientific, or anti-science.

Nonsense!



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Ethics consistent with reality



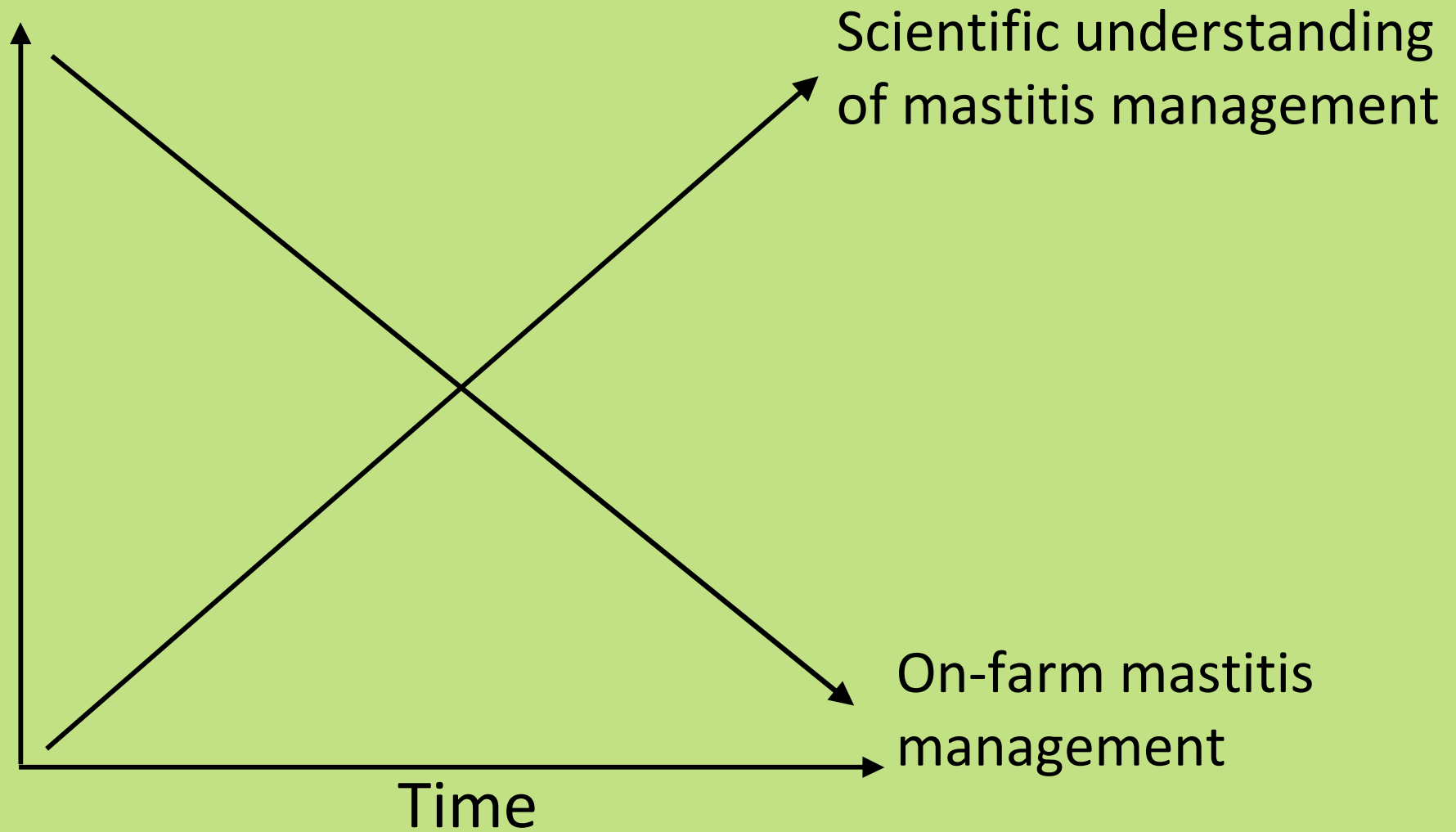
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Agricultural science: Fit for purpose?

- Agricultural science = science for farming and agriculture!
- 'Towards Future Challenges of Agricultural Research in Europe'



Mastitis



Why agricultural science is different

- Farmers as implementers
- Agricultural science is a social science



Why agricultural science is different

- Expert on both science and farming
- Agricultural science is a political act



The Future Farming Centre

- Wear its morals on its sleeve
- Dedicated to science for agriculture and farmers
- A strong participatory extension system at the heart of research
- Primary science output to farmers



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The Future Farming Centre

- Broad scope: whole of farm system-based approach
- Life cycle analysis
- All roads lead to the soil - good husbandry
- Soil management - untangling the ethics and science
- Nitrogen management - better integration of N fixing and N 'consuming' crops



The Future Farming Centre

- Min-till: Plan B for no-till and reduction of 'full-till'
- Not just big ideas - specific farmers problems will be addressed as well
- Tomato potato psyllid - insect mesh covers
- Parasite management of stock - TST + bioactive forages



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- Phytophthora on avocados
- Fermenting household organic waste for land application
- Non-chemical weed management - from the fundamentals of weed biology to big engineering ideas
- Plus urgent need for extension



The Future Farming Centre

- Need to understand the history and philosophy of agriculture
- Independence from business to maintain impartiality
- Critic and conscience of agriculture



Conclusion

Live, like you'll die tomorrow;
Farm, like you'll live forever



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Thank you



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Image attributions / sources

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Impossibility and the limits of Science, John Barrow, scan of book cover

