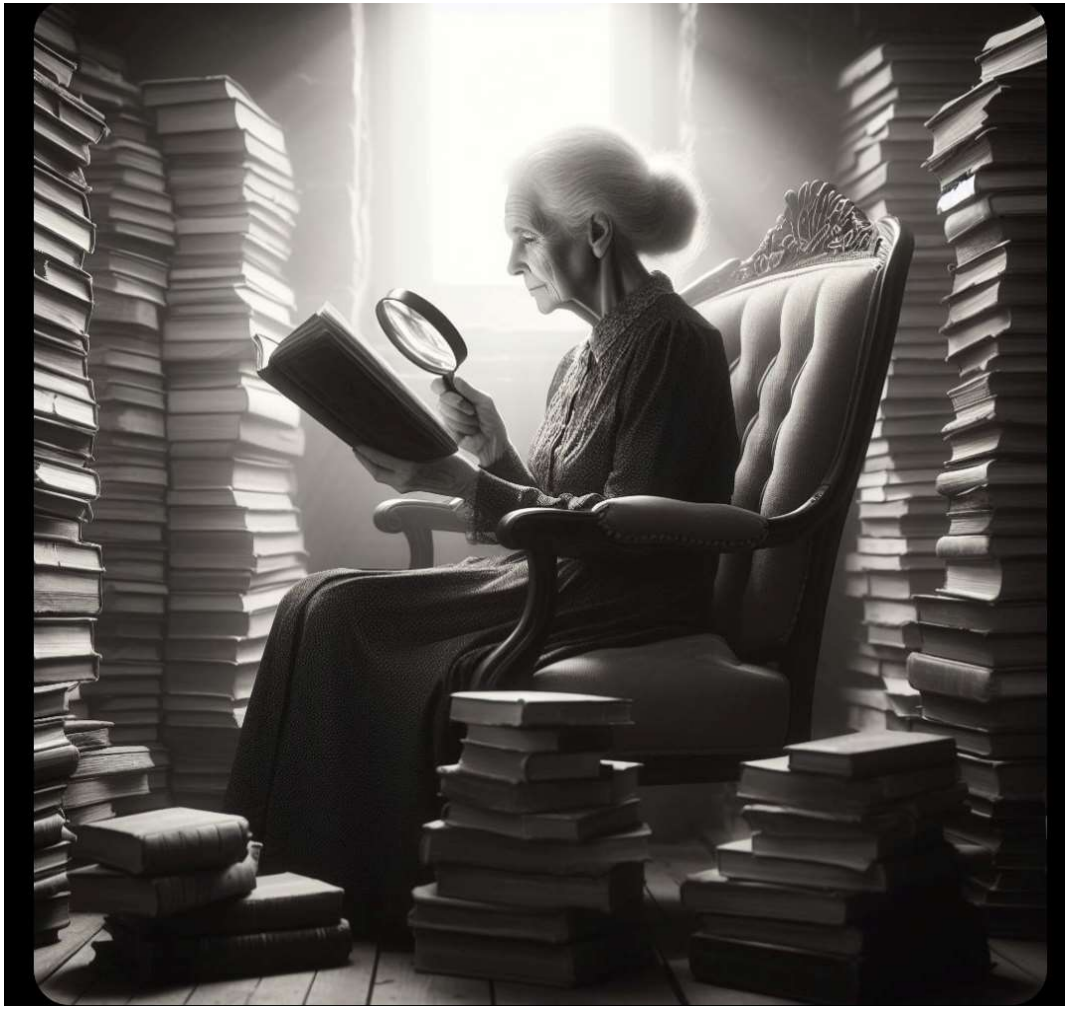
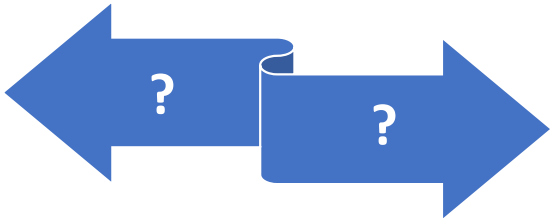


Human’s relation with books

Frank Cruickshank

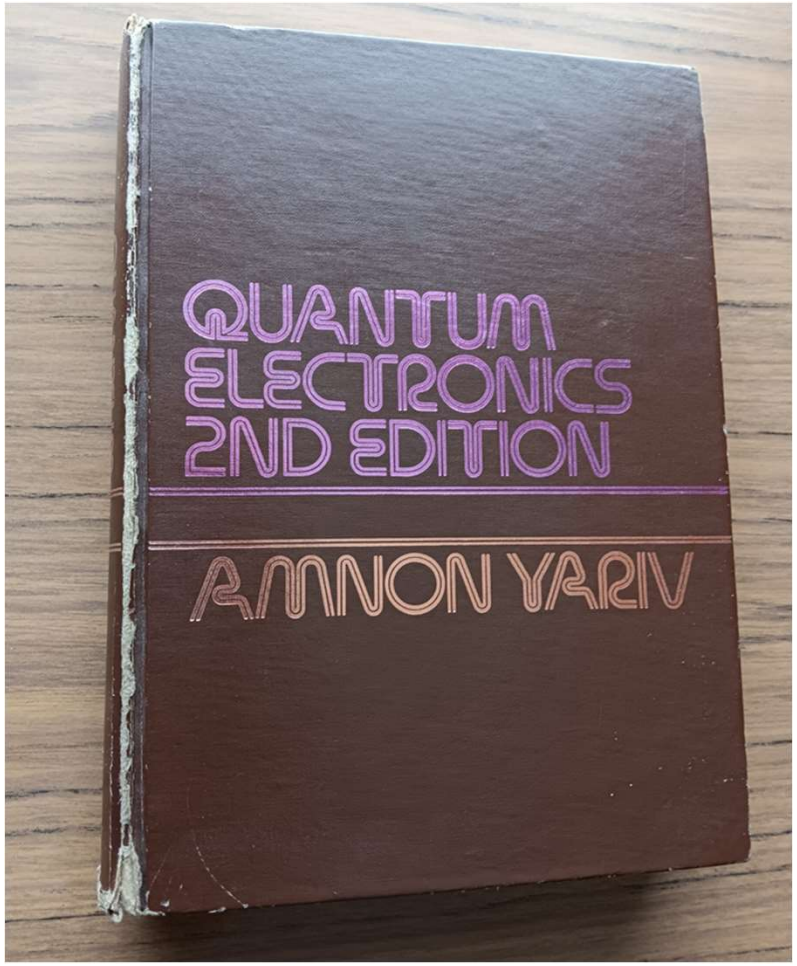


Frank wants you to guess what kind of books he usually reads

A Book that I Continue to Re-read

It’s often said, in the field of science, that once something appears in a text book, it’s out of date. However, text books are essential for someone breaking into a new field of study. They give a useful summary of the field of study, bringing one up to date quickly.

In my Chemistry career I have touched on a few different fields, the last of these being Non-Linear Optics of Crystals. Many textbooks helped me to get up to speed in this field and one such is shown here.



I bought this book new, but observe the battered appearance. I take great care of my books, but it has obviously been much used.

An alternative way of describing the linear electrooptic effect would be to relate the complex amplitude of the polarization at the sum frequency $\omega+\Omega$ to the product of the amplitudes of the optical electric field, E^{ω}, and the low-frequency electric field, E^{Ω},

$$P_j^{\omega+\Omega}=d_{jkl}^{\omega+\Omega}E_k^{\Omega}E_l^{\omega} \tag{16.0-1}$$

The tensor $\bar{d}$ defined by the last equation is related to the electrooptic tensor $\bar{r}$ by the relation

$$d_{jkl}^{\omega+\Omega}=-\frac{\varepsilon_j\varepsilon_l}{2\varepsilon_0}r_{jk}$$

where ε_j and ε_l are the principal dielectric constants along j and l at ω. The derivation of the last relation is identical to that leading to (14.8-8) except for a factor of 1/2 due to the fact that (16.0-1) applies to complex amplitudes.

The optical nonlinearities considered in what follows result when the low frequency at Ω is replaced by a second "optical" frequency, that is, one above the lattice Restrahlen band. At these frequencies the interatomic lattice motion can no longer be excited and the induced polarization at the sum frequency is due only to nonlinearities of the electronic motion. These nonlinearities are small and their study and utilization had to wait for the advent of the laser with its intense and coherent output.

The first experiment in this field took place in 1961 and involved doubling of the frequency of a ruby laser in a quartz crystal (Ref. 1).

16.1 The Nonlinear Optical Susceptibility Tensor

Consider the nonlinear coupling of two optical fields. The first, having its electric field along the j direction, is given by

$$E_j^{\omega_1}(t)=\mathrm{Re}(E_j^{\omega_1}e^{i\omega_1 t})=\tfrac{1}{2}(E_j^{\omega_1}e^{i\omega_1 t}+\text{c.c.}) \tag{16.1-1}$$

while the second field at ω_2 is

$$E_k^{\omega_2}(t)=\mathrm{Re}(E_k^{\omega_2}e^{i\omega_2 t}) \tag{16.1-2}$$

If the medium is nonlinear, then the presence of these field components can give rise to polarizations at frequencies $n\omega_1+m\omega_2$ where n and m are any integers. Taking the polarization component at $\omega_3=\omega_1+\omega_2$ along the i direction as

$$P_i^{\omega_3=\omega_1+\omega_2}(t)=\mathrm{Re}(P_i^{\omega_3}e^{i\omega_3 t}) \tag{16.1-3}$$

the nonlinear susceptibility tensor $d_{ijk}^{\omega_3=\omega_1+\omega_2}$ is defined by the following relations between the complex field amplitudes

$$P_i^{\omega_3}=d_{ijk}^{\omega_3=\omega_1+\omega_2}E_j^{\omega_1}E_k^{\omega_2} \tag{16.1-4}$$

where we sum over repeated indices.

In a similar manner we can define the difference frequency susceptibility tensor $d_{ijk}^{\omega_3=\omega_1-\omega_2}$ by

$$P_i^{\omega_3}=d_{ijk}^{\omega_3=\omega_1-\omega_2}E_j^{\omega_1}E_k^{-\omega_2} \tag{16.1-5}$$

where according to (16.1-1) $E_k^{-\omega_2}=(E_k^{\omega_2})^*$.

Only noncentrosymmetric crystals can possess a nonvanishing d_{ijk} tensor. This follows from the requirement that in a centrosymmetric crystal a reversal of the signs of $E_j^{\omega_1}$ and $E_k^{\omega_2}$ must cause a reversal in the sign of $P_i^{\omega_1+\omega_2}$ and not affect the amplitude. Using (16.1-4) we get

$$d_{ijk}^{\omega_3=\omega_1+\omega_2}E_j^{\omega_1}E_k^{\omega_2}=-d_{ijk}^{\omega_3=\omega_1+\omega_2}(-E_j^{\omega_1})(-E_k^{\omega_2})$$

so that $d_{ijk}=0$. Lack of an inversion symmetry is also the prerequisite for piezoelectricity so that all piezoelectric crystals can be expected to display second-order ($P\propto E^2$) nonlinear optical properties. The same argument can be used to show that all crystals as well as liquids and gases can display third-order optical nonlinearities.

In most of the nonlinear experiments the crystal is transparent over a region that includes ω_1, ω_2, and ω_3. This implies a lack of hysteresis in the dependence of **P** on **E**, that is, that **P** is a single-valued function of **E**. We can consequently express the nonlinear polarization by

$$P_i(t)=d_{ik}E_j(t)E_k(t) \tag{16.1-6}$$

where d_{ik} is *independent of frequency*.

Since no physical significance can be attached to an exchange of E_j and E_k in (16.1-6), it follows that $d_{ik}=d_{ki}$. We therefore can replace the subscripts kj by a single symbol according to the piezoelectric contraction

$$xx=1 \qquad yy=2 \qquad zz=3$$

$$yz=zy=4 \qquad xz=zx=5 \qquad xy=yx=6$$

The resulting d_{il} tensor forms a 3×6 matrix that operates on the $\mathbf{E}^2$ column tensor to yield **P** according to

$$\begin{vmatrix}P_x\\P_y\\P_z\end{vmatrix}=\begin{vmatrix}d_{11}&d_{12}&d_{13}&d_{14}&d_{15}&d_{16}\\d_{21}&d_{22}&d_{23}&d_{24}&d_{25}&d_{26}\\d_{31}&d_{32}&d_{33}&d_{34}&d_{35}&d_{36}\end{vmatrix}\begin{vmatrix}E_x^2\\E_y^2\\E_z^2\\2E_yE_z\\2E_xE_z\\2E_xE_y\end{vmatrix} \tag{16.1-7}$$

where the superfluous (for the lossless case) frequency superscripts in d_{ik} have been deleted.

The contracted d_{il} tensor obeys the same symmetry restrictions as the piezoelectric tensor, and in crystals of a given point-group symmetry it has the same form. The tensor forms are given in Table 16.1. In KH_2PO_4 (KDP), for

Table 16.1. The Form of the Nonlinear Optical Tensor d_{ijk} as Defined by (16.1-4), after Reference 2

Key to Notation

- Zero modulus
- Nonzero modulus
- Equal moduli
- Moduli numerically equal, but opposite in sign

Centrosymmetrical Classes
(all moduli vanish)

Noncentrosymmetrical Classes

Triclinic

Class 1 (18)

Monoclinic

Class 2 ($2 \parallel x_1$ (standard orientation)) (8)

Class 2 ($2 \parallel x_2$) (8)

Class m ($m \perp x_2$ (standard orientation)) (10)

Class m ($m \perp x_1$) (10)

Orthorhombic

Class 222 (3)

Class $mm2$ (5)

Tetragonal

Class 4 (4)

Class $\bar{4}$ (4)

Class 422 (1)

Class $4mm$ (3)

Table 16.1 (*cont'd*)

Tetragonal (cont'd)

Class $\bar{4}2m$ ($2 \parallel x_1$) (2)

Cubic

Class 432 (0)
All moduli vanish

Classes $\bar{4}3m$ and 23 (1)

Trigonal

Class 3 (6)

Class 32 (2)

Class $3m$ ($m \perp x_1$ (standard orientation)) (4)

Class $3m$ ($m \perp x_2$) (4)

Hexagonal

Class 6 (4)
same as class 4

Class $6mm$ (3)
same as class $4mm$

Class 622 (1)
same as class 422

Class 6 (2)

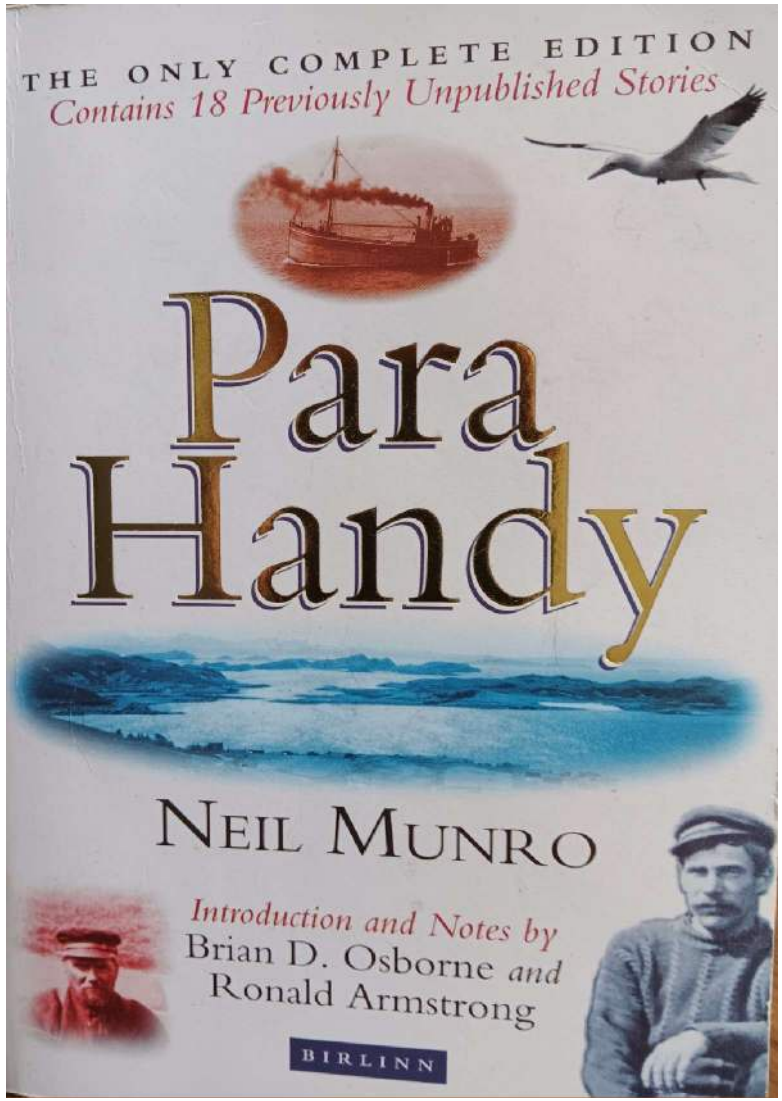
Class $\bar{6}m2$ ($m \perp x_1$ (standard orientation)) (1)

Class $\bar{6}m2$ ($m \perp x_2$) (1)

Note the coffee stains! Lots of coffee were needed here!

Now, you will be glad to hear that this book is NOT my topic for today.

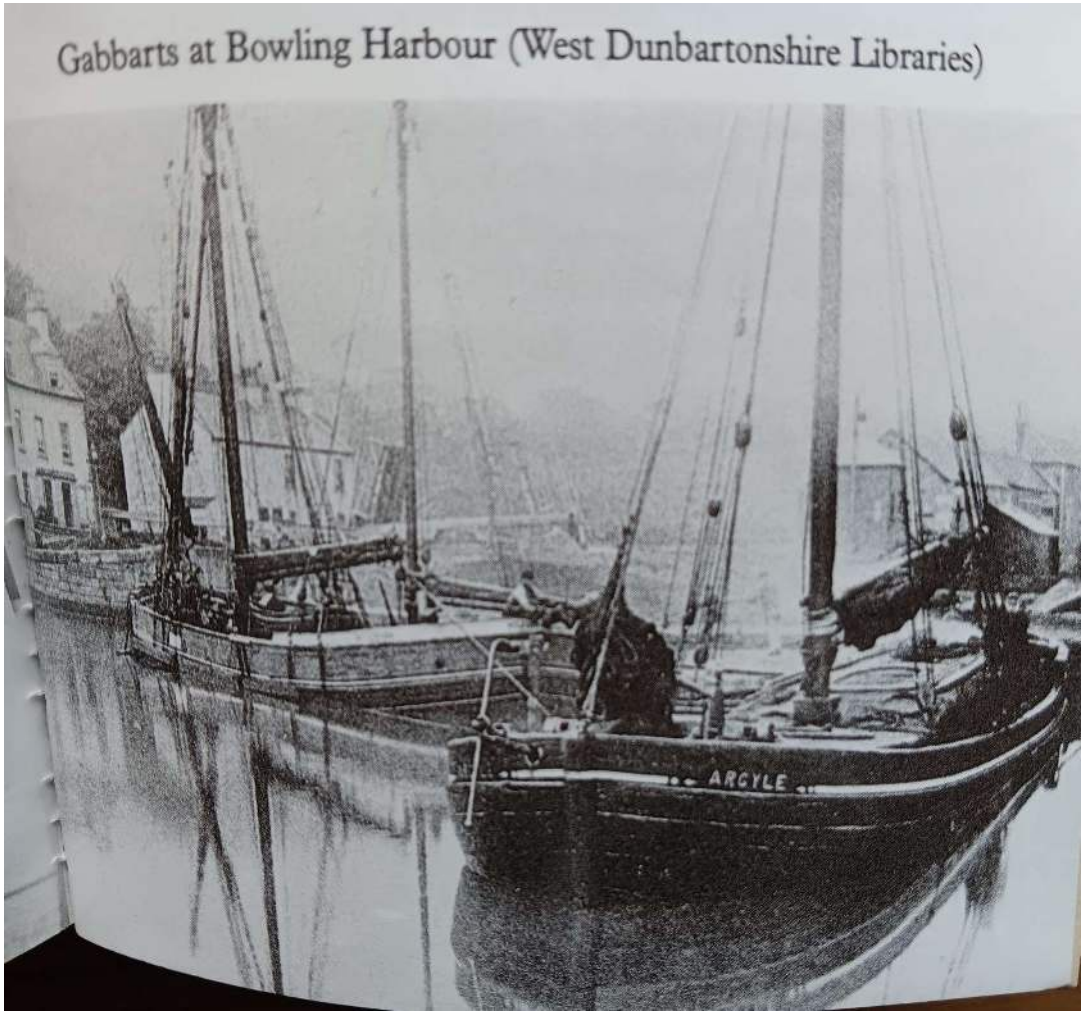
As well as coffee, it is essential to have a break from such books and find a relaxing text that takes you into another world, far less demanding. A world where problems are simple and the text is easily digested. Preferably something with a bit of good humour. My choice of such a book is


THE ONLY COMPLETE EDITION
Contains 18 Previously Unpublished Stories
Para Handy
NEIL MUNRO
Introduction and Notes by
Brian D. Osborne and
Ronald Armstrong
BIRLINN

MR NEIL MUNRO.

Para Handy (a corruption of the Gaelic for Peter, Son of Sandy) was skipper of a Puffer and tales of his life were written by Neil Munro (under the pen name of Hugh Foulis) in the Glasgow Evening News, from 16th January, 1905.

In parallel with Sir Arthur Conan Doyle, Neil wished to be known for his more serious work, generally about the decline of the old order in the highlands. However, the popularity of his short stories remains high to this day, just as for Sherlock Holmes.



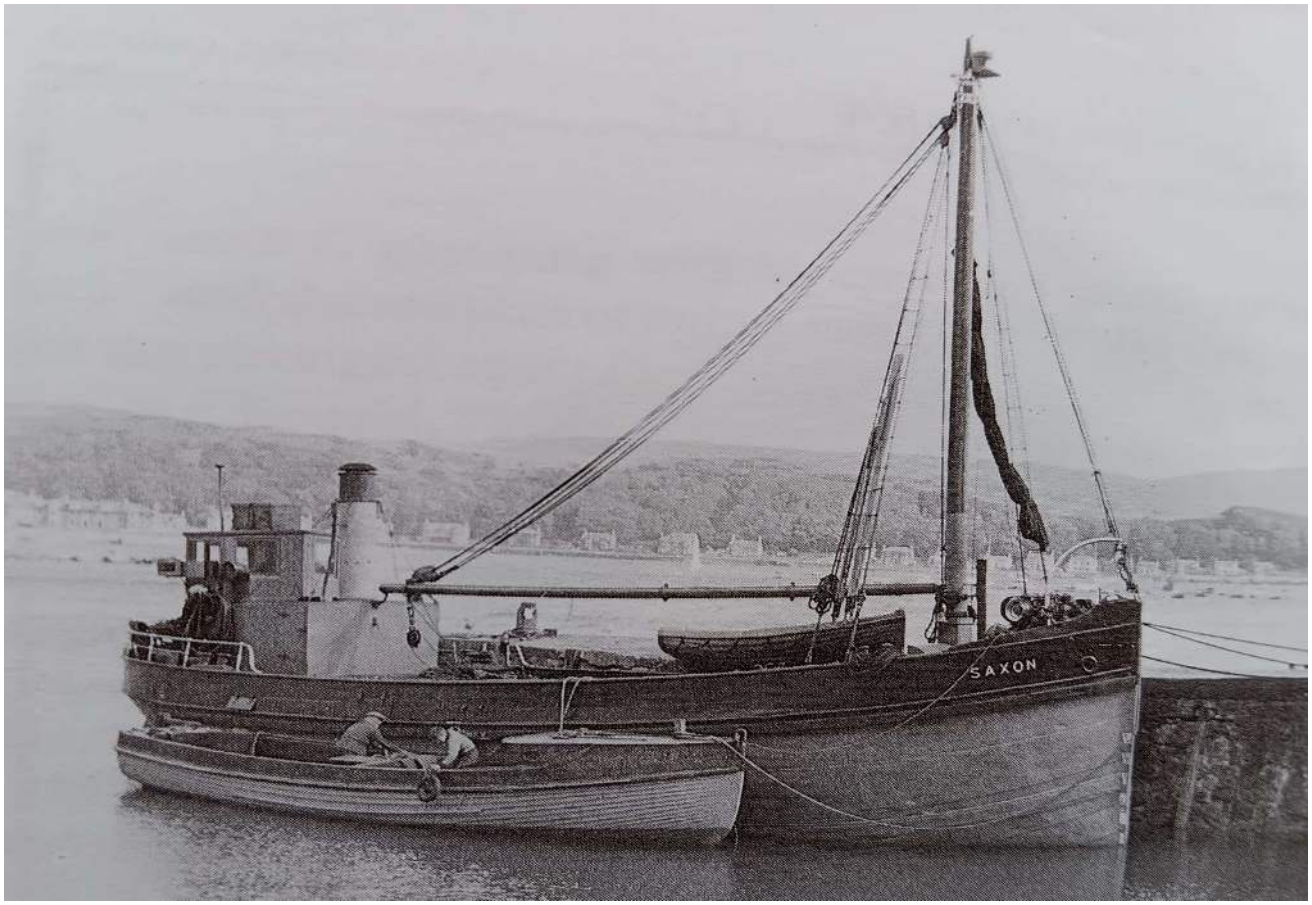
Gabbarts

Before the arrival of the Puffer steamers, goods were often carried by Gabbarts, small sailing vessels often mentioned in the stories.

In these stories, we are led into the world of Glasgow and the western isles around 1900 – 1920 with some 99 short stories of the “High Jinks” of the crew of the puffer, “Vital Spark”.

This era is presented as a gentle period in history, largely ignoring the hardships and privations of the populations of Glasgow and the western isles.

Puffers were often built in Kirkintilloch and were so called because they sent the single cylinder steam engine exhaust up the funnel, similar to a locomotive, rather than condensing it to increase efficiency.
Sadly, no original plans of these steam vessels remain.



“The smertest boat in the tred”

Confusingly, for model makers and others, the design of the Puffer is not consistent, even to the positioning of the wheelhouse fore- or aft of the funnel! Early versions had no wheelhouse, with the helmsman facing the weather!

The Crew

Skipper Para Handy (Peter MacFarlane)

(A short, thick set man with a red beard , a hard round felt hat, seaman's jersey and blue pilot jacket and trousers)

Engineer Dan Macphail

Mate Dougie Cameron (Campbell?)

Deckhand & The Tar (Colin Turner)
Cook Sunny Jim (Davie Green, cousin of the Tar)

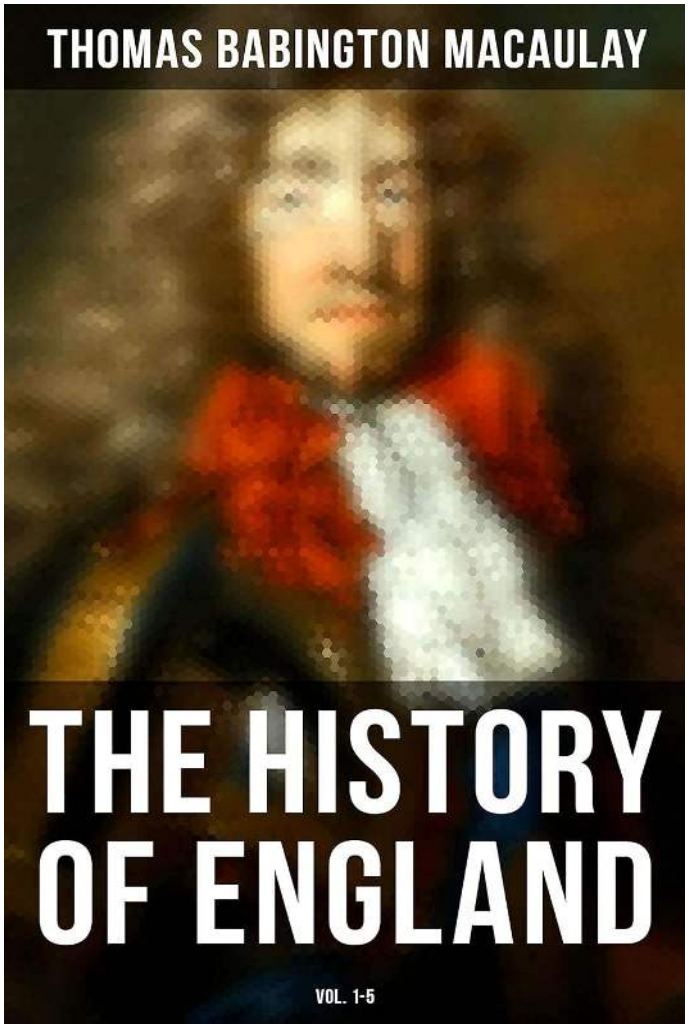
One merit of this book is that the 99 stories are short, typically 3 – 5 pages, so that you can dip into it and read for long or short times without breaking any narrative. There does not have to be any chronological order to the stories.

In many cases the stories are almost the Skipper's monologue and their charm lies in the banter between crew members, their chaffing of each other and the misquotations from the bible with references to the schism in the kirk (1843) which was still burned into the minds of the western isles population.

Para Handy likes to compare the Vital Spark with the larger, much more luxurious, Clyde steamers. In fact, of course the Puffers were essentially sea-going "lorries", carrying all kinds of cargo from stone, coal and grain, to furniture and agricultural machinery. Passengers were not usually carried.

The stories expose a way of life of the Firth of Clyde, Arran, Loch Fyne and Mull, where comradeship was more important than wealth.

Kenneth Muir



Ken Muir

The History of England from the accession of James II By Thomas Babington Macaulay

The History of England from the accession of James II

1685 – 1702 - 2,500 pages for 17 years

Scottish & Irish history extensively covered

Very popular. 130,000 copies sold in Britain in first 25 years
In USA only outsold by the Bible

James II supplanted by his daughter Mary and her husband William

William led a coalition of powers to resist the aggression of Louis XIV

Siege of Londonderry
Battle fo the Boyne
Bonnie Dundee
Massacre of Glencoe

National Debt
Bank of England
Reform of Coinage
Captain Kidd

The History of England from the accession of James II

Grandfather: Rev. John Macauley Minister of Cardross 1774 - 1789

Father: Zachary Macaulay
1784 – 1789 Jamaica
1790s Governor of Sierra Leone
Abolition of slave trade 1807

Author Thomas Babington Macauley (1800 - 1859)
MP 1830 – 1834 India Supreme Council 1834 – 1838
MP and cabinet minister 1838 – 1847
History 1848 Vol I & II 1855 Vol III IV 1861 § 24 & 25
Rector Glasgow University 1849
Peerage 1857

The History of England from the accession of James II

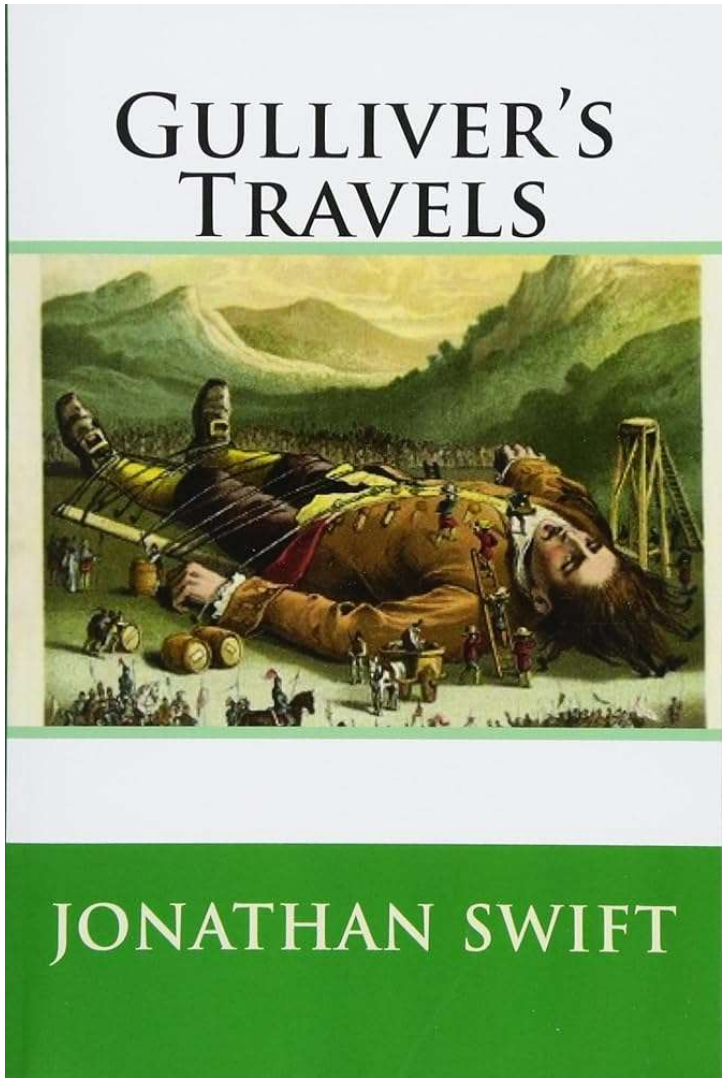
His *History* is unsurpassed among the work of English historians, save, perhaps, by *The History of the Decline and Fall of the Roman Empire* of Edward Gibbon

His style, clear, emphatic, and insensitive came to be for half a century the characteristic in higher journalism and exposition of all kinds.

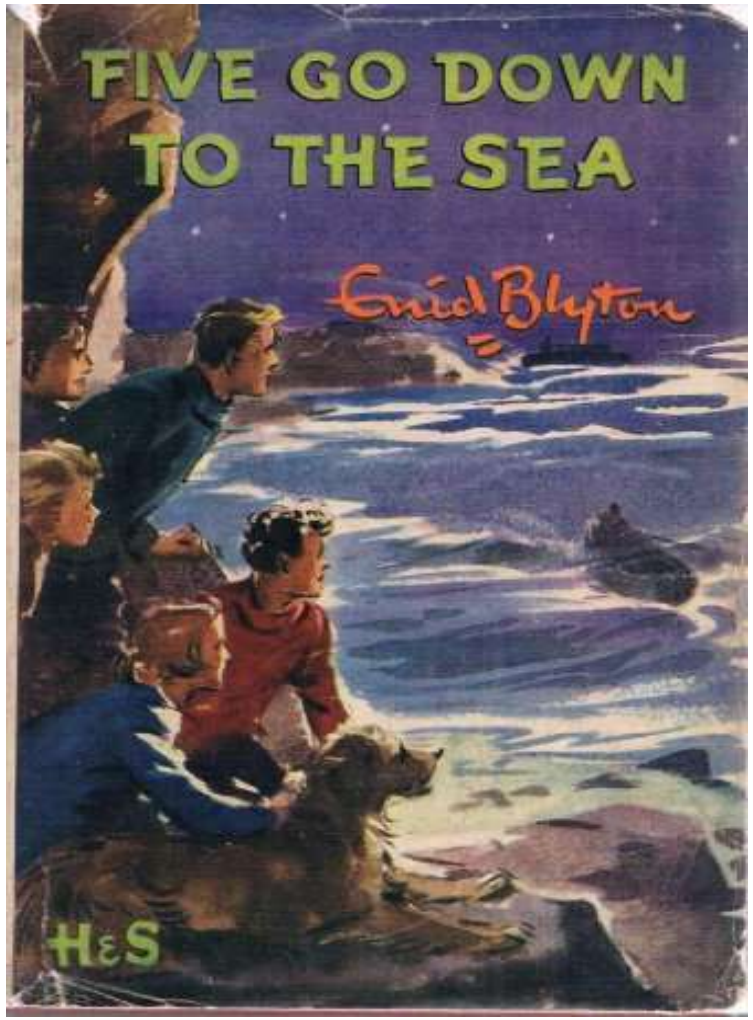
Marx "Macaulay a systematic falsifier of history"
W.S.Churchill “It is beyond our hopes to overtake Lord Macaulay. We can only hope that Truth will follow swiftly enough to fasten the label 'Liar' to his genteel coat-tails."

His undisguised political partisanship, his arrogant assumption that English bourgeois standards of culture and progress were to be forever the norm for less favoured nations, and the materialism of his judgments of value and taste have all come under heavy fire

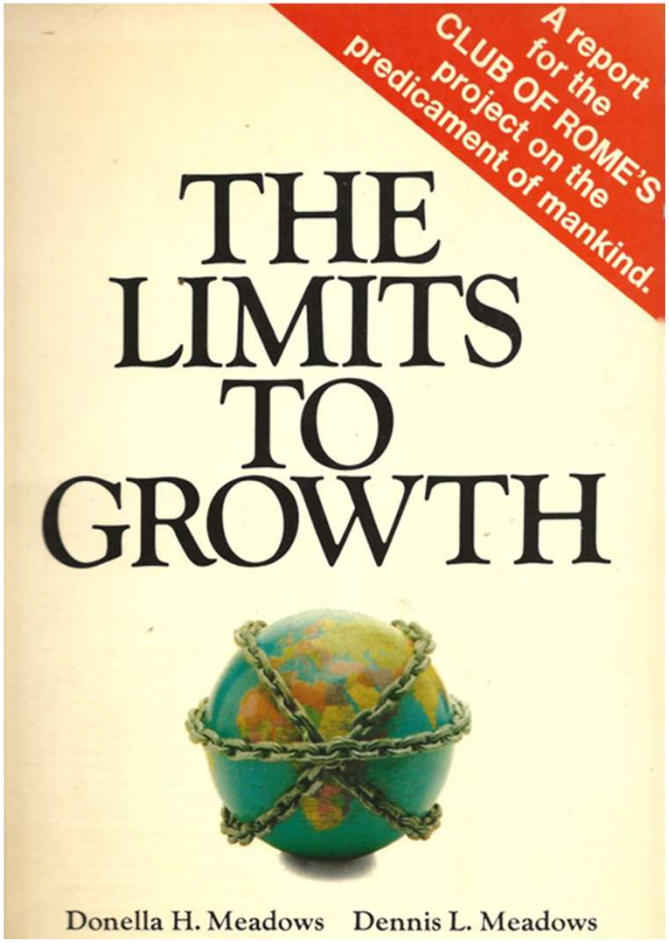
Mel Burt



Rob Littlejohn

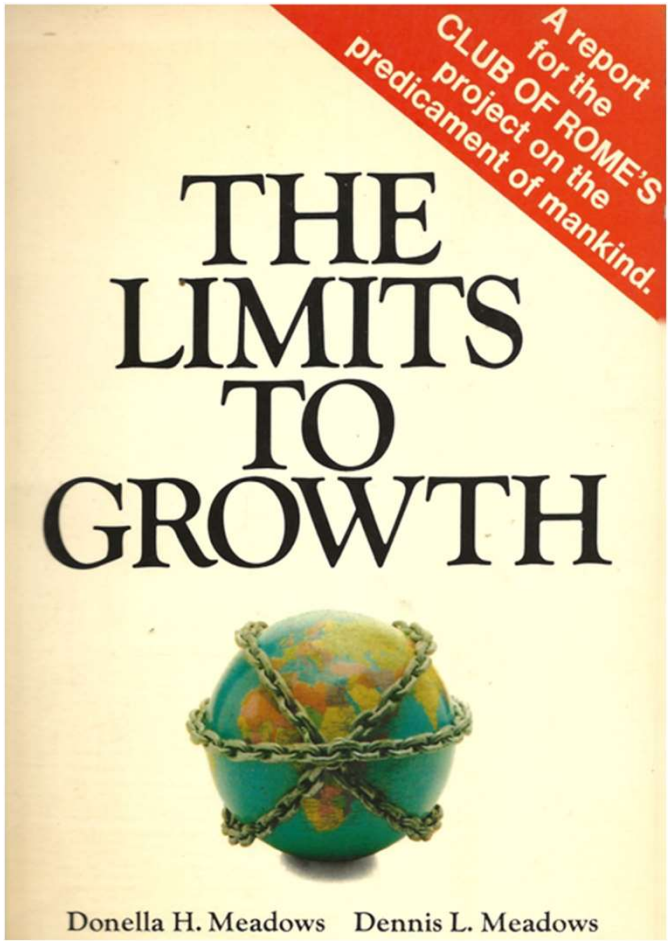


Stephen Rodgers



Stephen Rodgers

- ***What the book is about, and the main points***
- ***Why it interested me***
- ***Views from half a century later***



Book "The Limits to Growth" published 1972

A report on the project instigated by the Club of Rome;
--> concern about the predicament of mankind

Population explosion and earth's resources

Growth – geometric

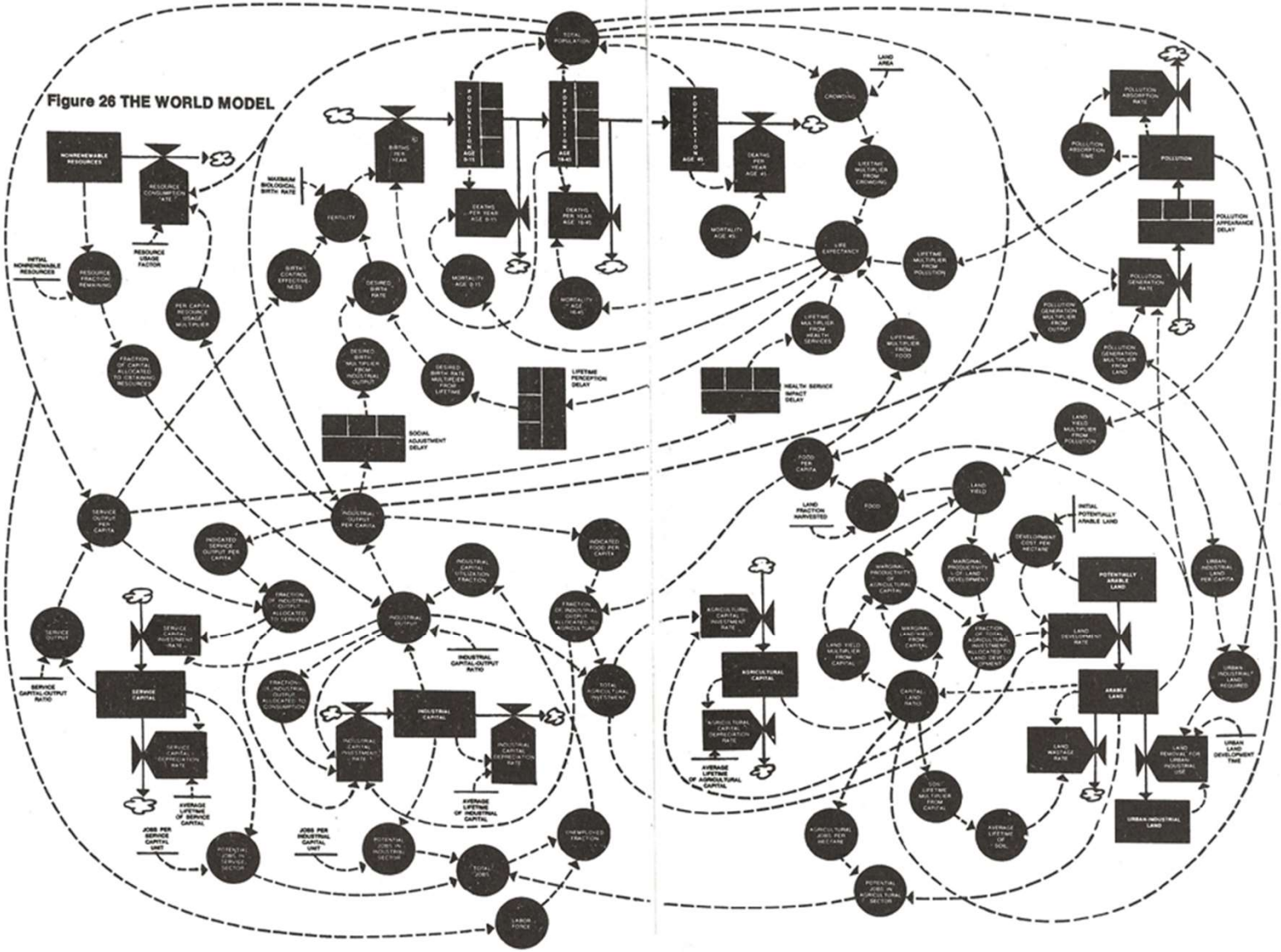
Minerals
Agricultural production
Industrial production
Pollution

Physical factors – eg arable land, mineral resources, forests, oceans
… (*Social factors – eg social stability, education, employment*)

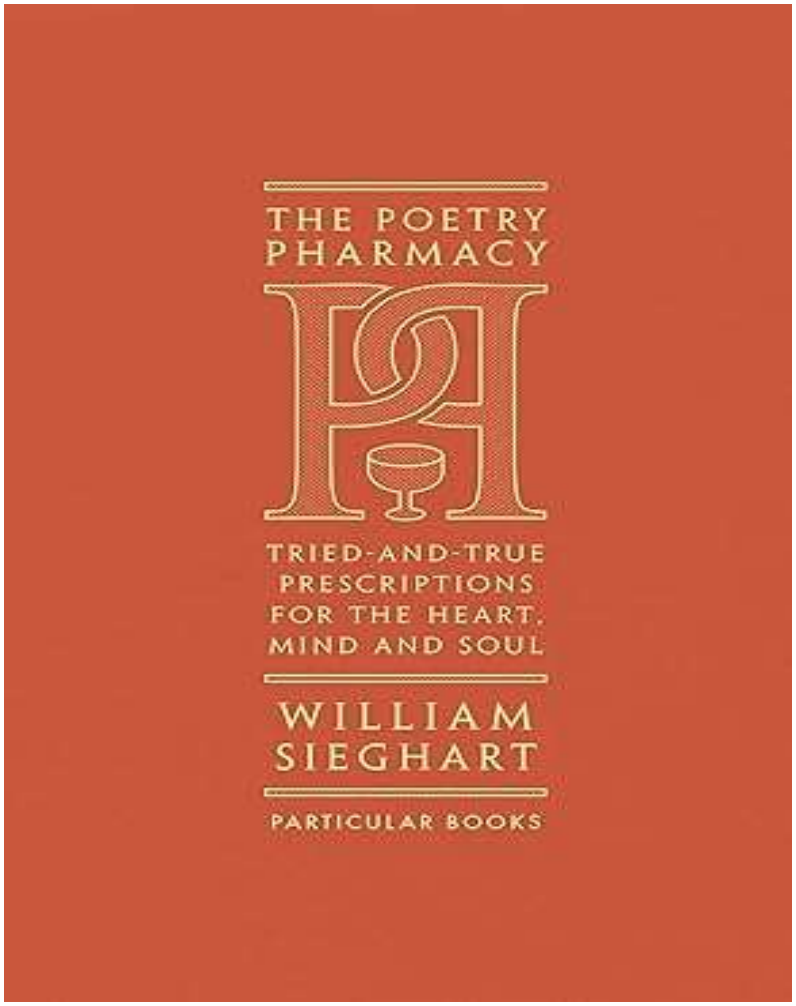
System Dynamics – feedback loops, complex interactions

Study at MIT – formal mathematical world model over long term
Imperfect, oversimplied, unfinished but USEFUL

Figure 26 THE WORLD MODEL



Michael Hitchman



You spend time on books

You gain wisdom

Happy Reading!