

THE ECONOMY OF NATURE AND STRUCTURE IN EVOLUTION

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**What is preserved across
historical instances of
scientific theory change?**

STRUCTURAL REALISM

There *was* an important element of continuity in the shift from Fresnel to Maxwell - and this was much more than a simple question of carrying over the successful *empirical* content into the new theory. At the same time it was rather less than a carrying over of the full theoretical content or full theoretical mechanisms (even in "approximate") form. (Worrall 1989, 117)

There was continuity or accumulation in the shift, but the continuity is one of *form* or *structure*, not of content. [...] Roughly speaking, it seems right to say that Fresnel completely misidentified the *nature* of light, but nonetheless it is no miracle that his theory enjoyed the empirical predictive success that it did; it is no miracle because Fresnel's theory, as science later saw it, attributed to light the right *structure*.

(Worrall 1989, 117)



BIOLOGICAL STRUCTURALISM

- McMullin (1984): **gene** as structural concept
- French (2011, 2012, 2014): **biological models** as structural, grounded in **natural selection**

**Claim: Economy of nature
as an underappreciated
structural element in the
history of biology**



Economic and theological contexts

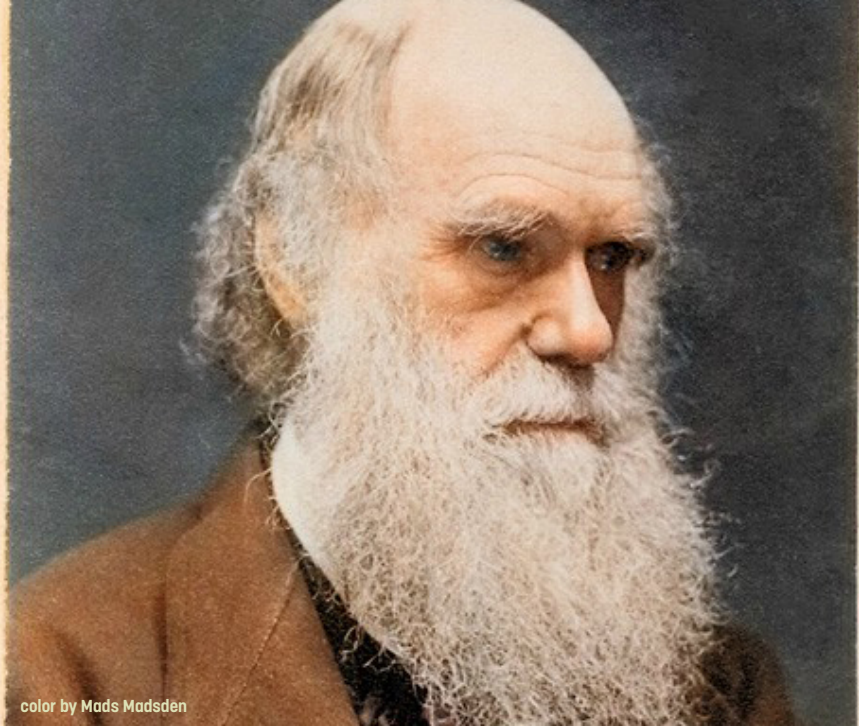
**The animal is formed by circumstances: this explains
the inner perfection and its expediency with regard
to external conditions. (Goethe)**

There is a law universal in Nature, tending to render every reproductive being the best possibly suited to its condition that its kind, or organized matter, is susceptible of, which appears intended to model the physical and mental or instinctive powers, to their highest perfection, and to continue them so. (Patrick Matthew)

Thus we see Nature resemble a well regulated state in which every individual has his proper employment and subsistence, and a proper gradation of offices and officers is appointed to correct and restrain every detrimental excess. (Linnaeus, *Police of Nature*)

By the Oeconomy of Nature, we understand the all-wise disposition of the Creator in relation to natural things.... Whoever duly turns his attention to the things on this our terraqueous globe, must necessarily confess, that they are so connected, so chained together, that they all aim at the same end, and to this end a vast number of intermediate ends are subservient. (*Oeconomy of Nature*)

**A structure of *places* against
which we should understand
the distribution of life on earth**



color by Mads Madsen

**If proof were wanted let any singular change of
climate [occur] here ... the pressure is always
ready ... a thousand wedges are being forced into the
œconomy of nature. (*Sketch, 7-8*)**

I need hardly observe that the slow and gradual appearance of new forms follows from our theory, for to form a new species, an old one must not only be plastic in its organization, becoming so probably from changes in the conditions of its existence, but a place in the natural economy of the district must [be made,] come to exist, for the selection of some new modification of its structure, better fitted to the surrounding conditions than are the other individuals of the same or other species. (*Sketch*, 145)

**An empty *place* in the economy
of nature as prerequisite for
evolutionary change**

The face of Nature may be compared to a yielding surface, with ten thousand sharp wedges packed close together and driven inwards by incessant blows, sometimes one wedge being struck, and then another with greater force. (*Origin, 67*)

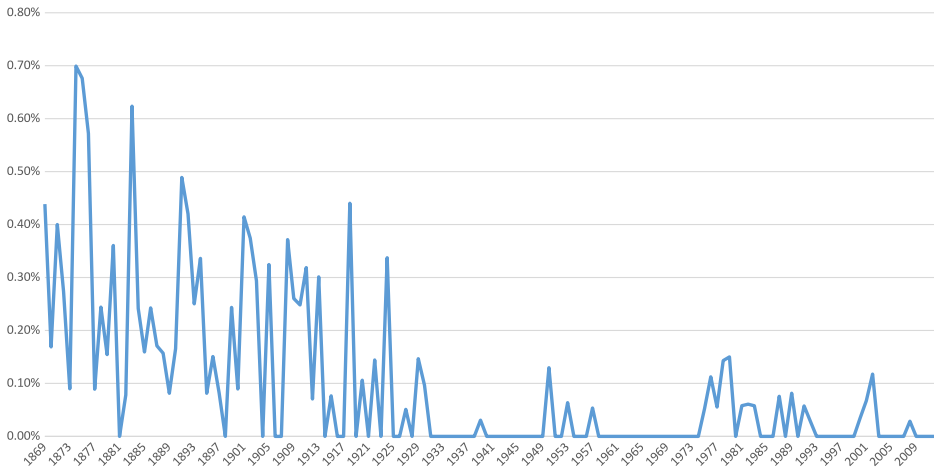
**Where'd the
metaphor go?**

The truth of the principle, that the greatest amount of life can be supported by great diversification of structure, is seen under many natural circumstances. In an extremely small area, especially if freely open to immigration, and where the contest between individual and individual must be severe, we always find great diversity in its inhabitants. (*Origin*, 114)

**Principle of divergence still
divulges information about the
underlying structure present
in nature**

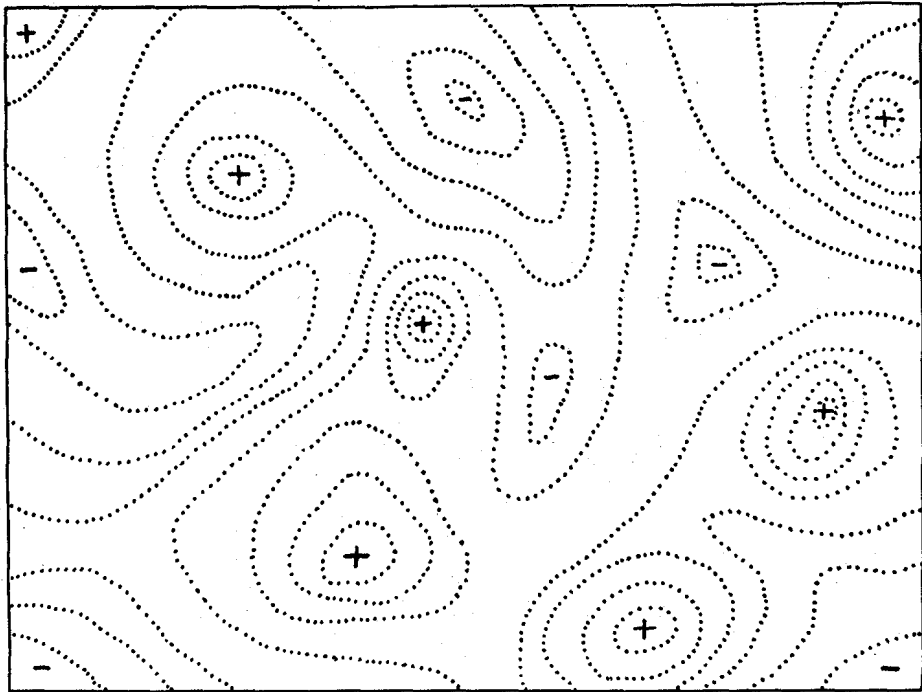
AFTER DARWIN

Fraction of Documents



**Hypothesis: Structural role
formerly occupied by the
economy of nature taken up by
genetics**

**The true role of the environment in evolution
could not be understood until the nature of
small mutations and of selection were fully
comprehended (Mayr 1966, 3)**



**WHAT'S
NEXT?**

[From an eco-evo-devo perspective, biology must] uncover the relationships within and among different levels of biological organization ... [from the molecular-organismic divide to] levels of organization external to the individual organism [which] extend to higher levels, such as groups, populations, and communities. (Abouheif et al. 2014, 119)

**Take-home: Economy of nature
is a significant structural
element throughout the
history of evolutionary theory**

QUESTIONS?

Thanks to my collaborator, Daniel G. Swaim,
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