Seminar on *The Balance of Nature*

12.S593 Spring 2021 G (2-0-4); *Instructor*: Daniel H. Rothman; *TA*: Constantin Arnscheidt

**Overview**

The natural world has long been perceived to be an expression of an exquisite equilibrium—the “balance of nature.” Although the notion of balance seems obviously at odds with the episodic evolution of Earth and life, its modern cousin—the pervasive assumption of steady states in the Earth system—is alive and well, despite its likely irrelevance. Why is this so? And what are the alternatives? In the first half of this seminar, we examine the history of the idea of the balance of nature, with particular attention to changing views of mass extinction. We then consider alternative models in which the coevolution of many components results in periods of punctuated change away from equilibrium. We close with an examination of an attempt to explain coevolutionary change toward equilibrium—the Gaia hypothesis.

**Organization**

The initial meeting will be organizational, at 2:30 PM on Wednesday February 17. We’ll meet Wednesdays from 2:30–4:00 thereafter. Interested students with scheduling conflicts should send their schedule to the instructor at dhr@mit.edu; we’ll make accommodations if we can. We’ll meet synchronously by Zoom; the Zoom link is available on Canvas.

**Participation, format, and expectations**

Each week we will discuss the assigned readings. Rather than designating discussion leaders, we will each participate in discussions on an equal basis. No one is expected to have any special expertise in any of the subjects; instead, we will all come prepared to learn from each other. Participation is open to all, including undergraduates. Interested students should register (in advance, if possible) for 12.S593, Special Seminar in EAPS. Grading is P/D/F.

**Syllabus**

Each week’s readings are listed below. All material will be available on Canvas or obtainable electronically from the MIT Library. The syllabus is tentative; any updates will be posted on Canvas.

**History**

1. Notions of the balance of nature, from antiquity to the present

2. Balance, extinction, and early views of diversity in science and society


3. Cuvier’s catastrophes and the discovery of extinction


4. Misreading the fossil record: extinctions are gradual, not catastrophic


5. Catastrophism’s revival: nuclear winter and the KT impact


6. The sixth extinction: data and the development of the idea


Models

7. Punctuated equilibria


8. Coevolution I


9. Coevolution II


10. Coevolution III


**Gaia**

11. The initial hypothesis


12. Gaia mathematized


13. Gaia today