UNDERSTANDING POPULATION IN HUMAN-ENVIRONMENT RELATIONSHIPS: SCIENCE SHAPED BY WORLD-VIEWS OR EVIDENCE:

Sustainability Science:
Can Earth's and Society's Systems Meet the Needs of 10 Billion People
NAS-NRC
Sept. 30 – Oct. 1, 2013

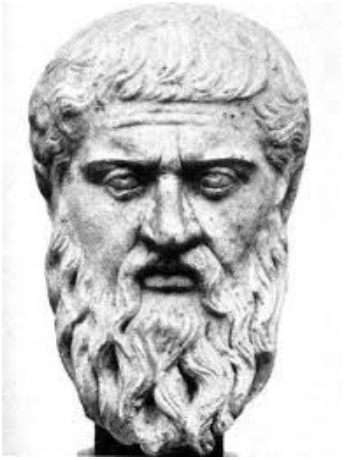
B. L. Turner II
Arizona State University

TAKE AWAY MESSAGE

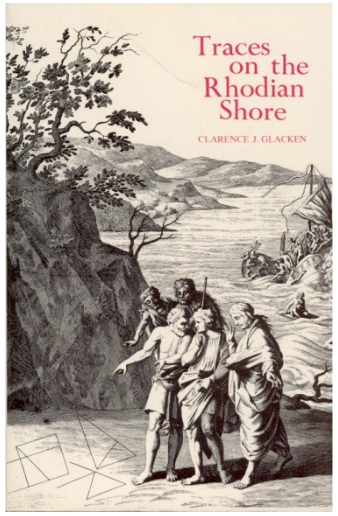
- *Role of "P" in human-environment relationships is determined as much if not more so by world views of the interpreter than by the evidence*
  - Minimal debate over the data/evidence
  - Huge disagreement over the interpretations
  - Interpretation is more a HE perspective issue than a disciplinary issue
    - emphasis on nature-Earth system vs emphasis on human condition & ingenuity



ANTIQUITY OF OBSERVATIONS



- Plato on human impact on environment of Attic
  - "What now remains compared with what then existed is like a skeleton of a sick man, all the fat and soft earth having been wasted away, and only the bare framework of the land being left."



C. J. Glacken. 1967. *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the end of the Eighteenth Century*.

FACT

- History of humankind globally → increases in P = changes in and/or declines of the stocks and flows of the environment.



mega-fauna extinction

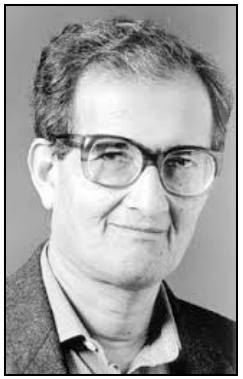


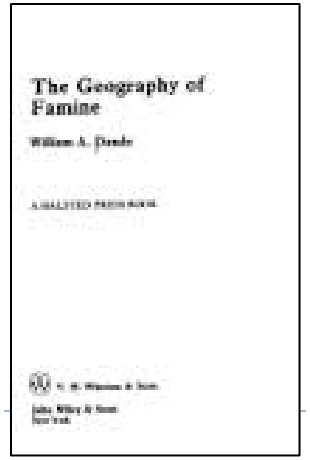
P is Negative: The Malthusian View

MALTHUS 1798



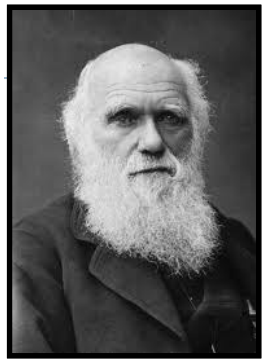
- P, unchecked, surpasses food ceiling & generates negative impacts on HE condition—*Malthusian Crisis*
  - Assumed growth rates of P exceed capacity of food production (expansion & intensification [T])
- In theory, applicable to closed systems with minimal endogenous changes in T [key: source of innovation]
- In HE history, difficult to demonstrate; almost all possible candidates are contested
  - Entitlements trump food ceiling (A. Sen)



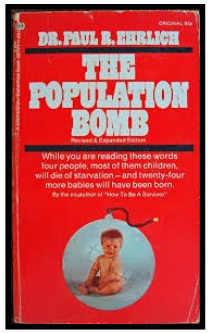


W. A. Dando (1980)

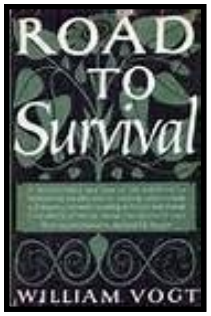
MALTHUS IMPACT ON BIOLOGY

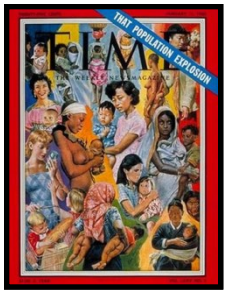


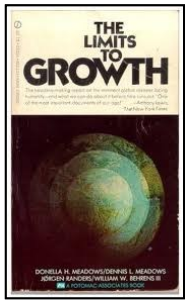
- Adopted in biological/ecological sciences
  - strong evidence supporting basic Malthusian principle
- Developed into concept of Carrying Capacity (CC): maximum P size sustained by environment indefinitely
- P & CC applied back to HE relationships
  - Multiple times; especially mid- to late- 20th C = "neo-Malthusians or Cassandras







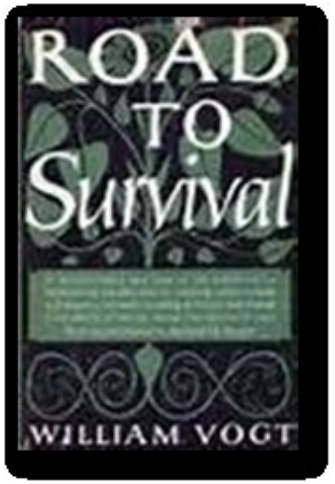


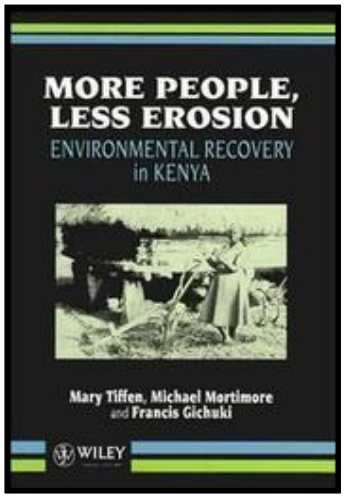




CARRYING CAPACITY

- Applied to agricultural systems
  - African subsistence systems (British FO) to planet as a whole
- Problem for HE systems
  - Productive capacity is changed by technology as well as governance and knowledge systems [SESs are not closed]
  - Difficult to demonstrate CC applicable to HE system
    - Extremely so the more "built" the environment
  - CC largely abandoned in social and most policy sciences
- If applicable, it is at the Earth system level, e.g., total NPP appropriated by humans or HANNP (between 23 to 45%)
- Better to use as a heuristic





FACT

- Humankind has increased CC of Earth systems for provisioning our species & has been successful at resource substitution
  - But at the cost of other species and environmental services at large.



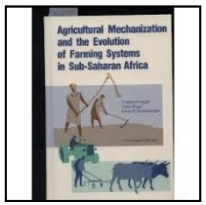


P is Positive: The Boserupian View

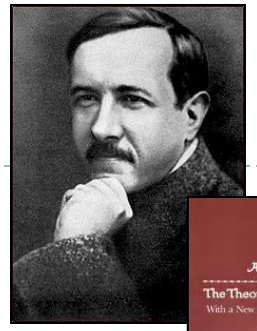
CHAYANOV-BOSERUP

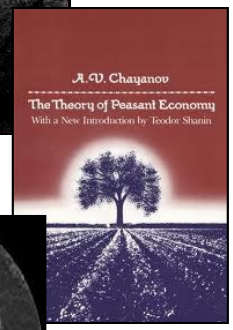
- P (land pressures from) stimulates agricultural growth—the food ceiling
  - Altered to: "demand" stimulates growth
  - Well demonstrated for "subsistence production"; more complex but applicable for other production



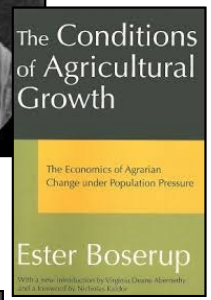


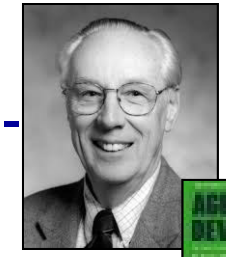
- Induced innovation thesis
  - To save labor or save land, depending T & land-labor ratio
  - Empirically demonstrated







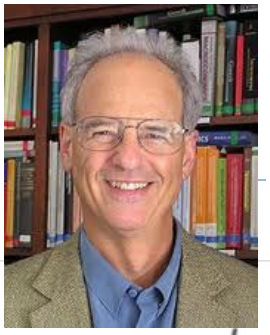




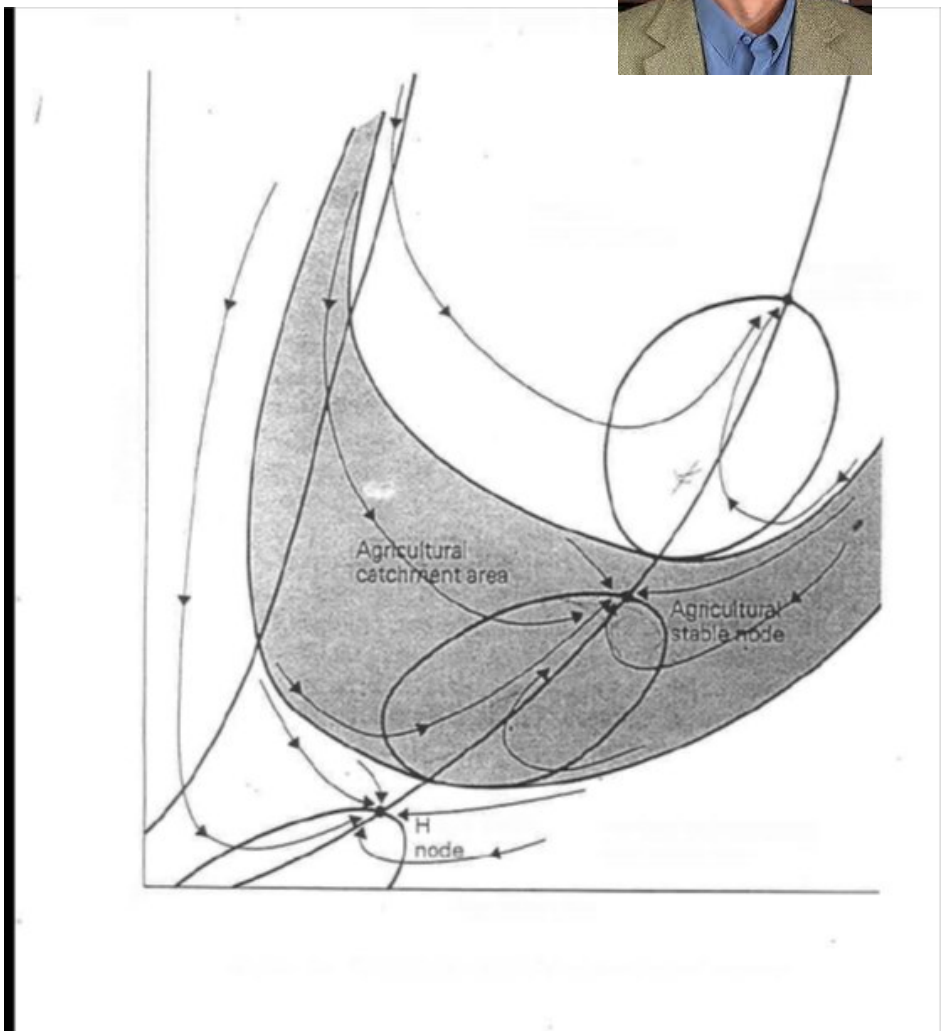


Reconciling Malthus and Boserup

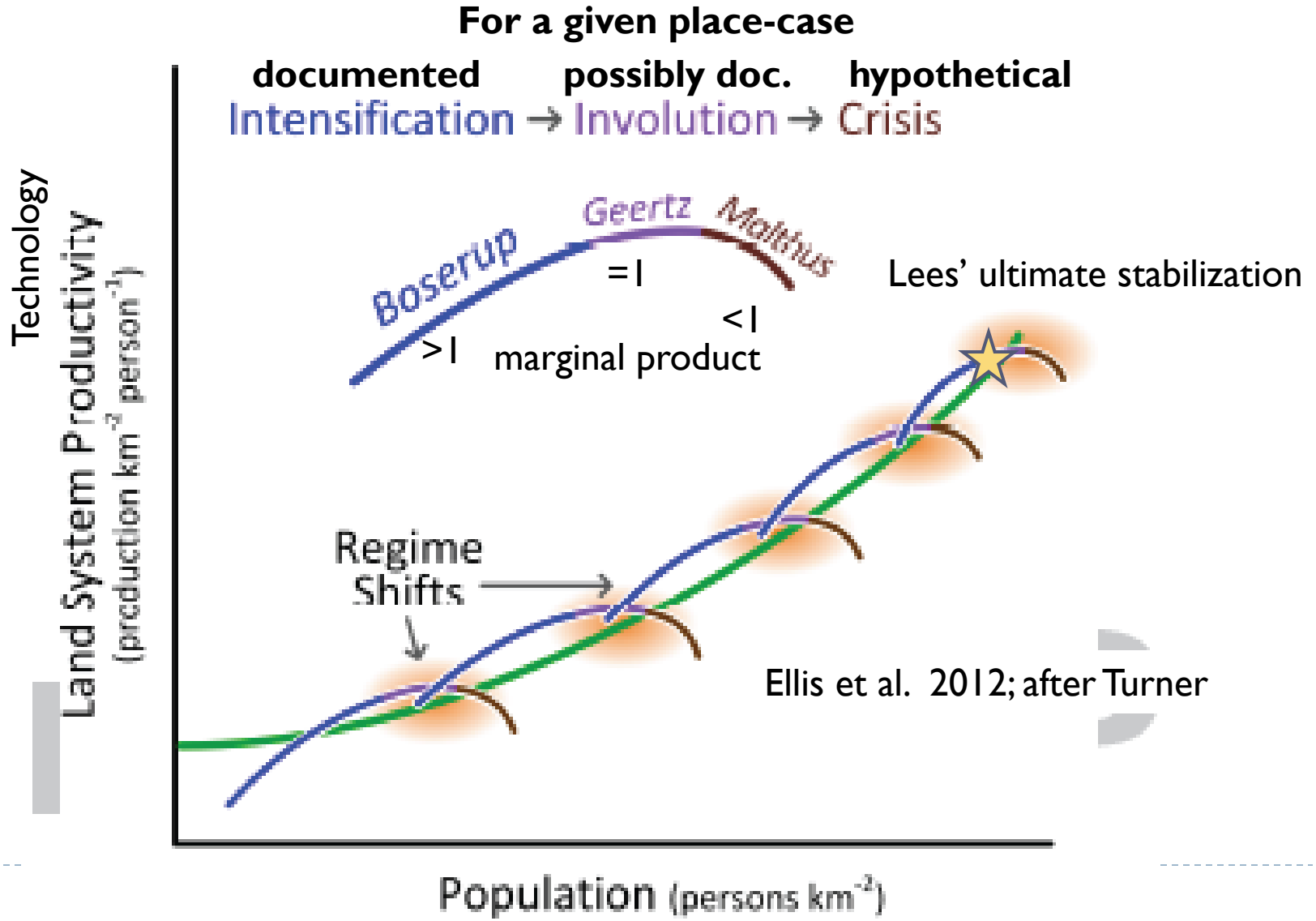
Postulated P-T Relationship



- Phase diagram (R. D. Lee 1986)
- Malthus and Boserup can be reconciled
  - Boserup space "limited"
  - Malthusian forces tend to put us in Boserup space
  - Ultimate stabilization in phase of high technology & high population



Postulated P-T Relationship



FACT

- History of humankind globally → increasing material (incl. health) well-being

LIFE EXPECTANCY THROUGH THE AGES

Early humans did not generally live long enough to develop heart disease, cancer or loss of mental function. A snapshot of how life expectancy has changed, and the big killers of each era:

AVERAGE LIFE EXPECTANCY

30 years



Neanderthals (30,000 years ago): Died of injuries caused by rock falls, hunting accidents and conflicts. Food scarcity led to malnutrition. These hunter-gatherer groups contracted diseases that spread from animals. Rabies, tuberculosis, brucellosis, yellow fever and encephalitis were widespread.

38

Neolithic (8500 BC to 3500 BC): Agriculture, irrigation and urbanization brought problems associated with settled populations, such as fecal contamination of water and diseases such as cholera, smallpox, typhoid, polio and influenza. Malaria and other diseases carried by mosquitoes and insects, which fed on domesticated animals, appeared.



35 **Classical Greece and Rome** (500 BC to 500 AD): Tuberculosis, typhoid fever, smallpox and scarlet fever spread among the denser urban populations. Malnutrition, gastroenteritis and violence were also big killers.

48 EARLY MEDIEVAL **38** LATE MEDIEVAL

Medieval period (500 AD to 1500 AD): Life expectancy grew with urbanization, but famine caused by crop failures and bubonic plague were the big killers. The Black Death (1347-1351) wiped out 25 million people in Europe and 60 million in Asia, returning several times, culminating in the Great Plague of London (1664-1666). By 1500, life expectancy had dropped back to 38.



40

Victorian (1850s to 1900): Typhus, typhoid fever, rickets, diphtheria, tuberculosis, scarlet fever and cholera raged in crowded cities.



MEN **70** WOMEN **75**

1900s: Better health care, sanitation and living conditions boosted life expectancy to 70 for men and 75 for women by 1950.

CANADA: MEN **82** WOMEN **85**

Today: Cancer, heart disease and stroke are the biggest killers in the developed world. Our longer lifespan also comes with unprecedented loss of mental function and mobility problems.

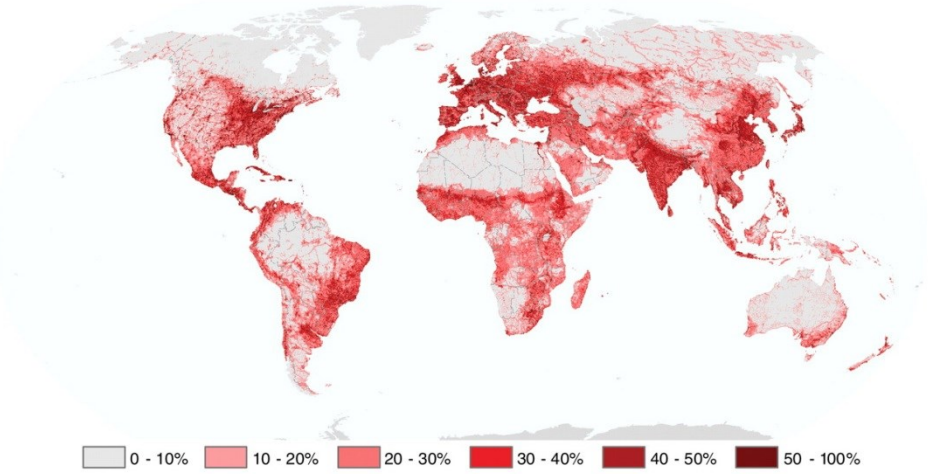
RESEARCH BY RICK SZNAJDER/TORONTO STAR LIBRARY

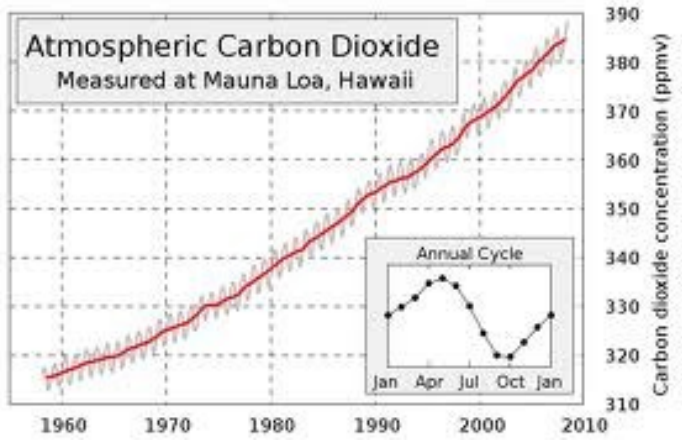
SOURCES: JOURNAL OF POPULATION RESEARCH, PRINCETON UNIVERSITY, STANFORD UNIVERSITY, WORLD HEALTH ORGANIZATION



FACT

- History of humankind globally → global average increases in human material well-being in concert with increases in changes and degradation of Earth environmental systems.

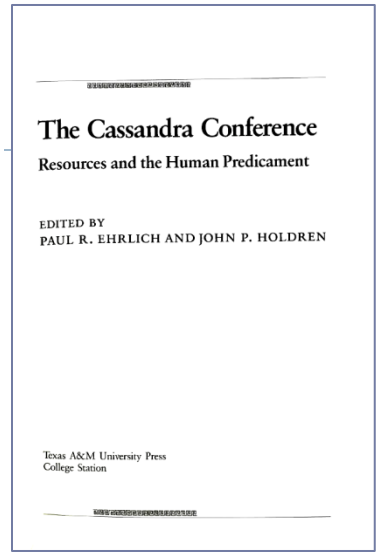


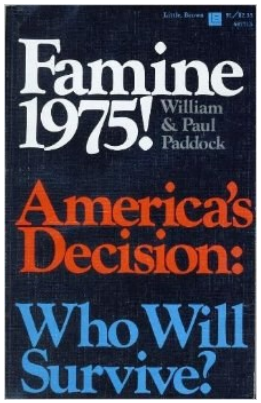


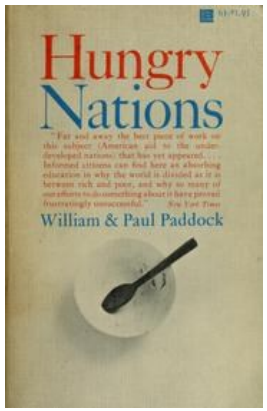
CASSANDRA & CORNUCOPIAN POSITIONS

CASSANDRA POSITION

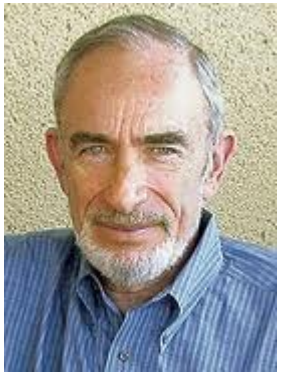
- Major concern about stresses placed on environment and resources over the long run
  - Advanced from neo-Malthusian view
  - Accounts for all factors generating demand (e.g., affluence, entitlements)
  - IPAT is essential to its views











IPAT

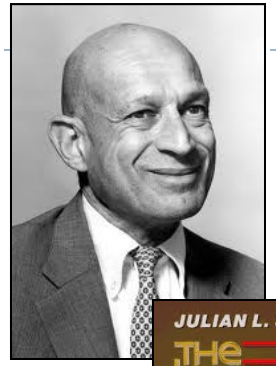


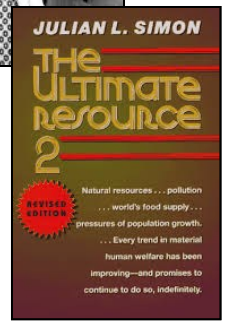
IPAT REMAINS IN MIX

- I = P x A x T or some variant conceded as an "identity"
- PAT as ***cause*** is highly contested
  - PAT track with resource use-environmental change over the long run and at the global scale
  - often do not track over short run and sub-global scales
  - critiqued as
    - too proximate (superficial), diverting attention from distal (deeper) causes
    - blaming the victims (relevant to developing world)
- P & A proxies for resource demand
  - P = biological need
  - A = cultural-technological wants & delivery capacity

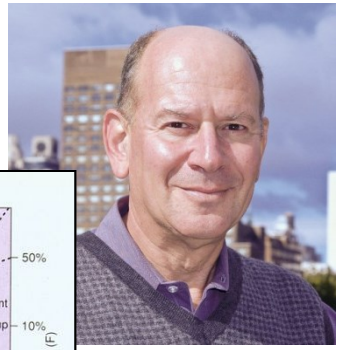


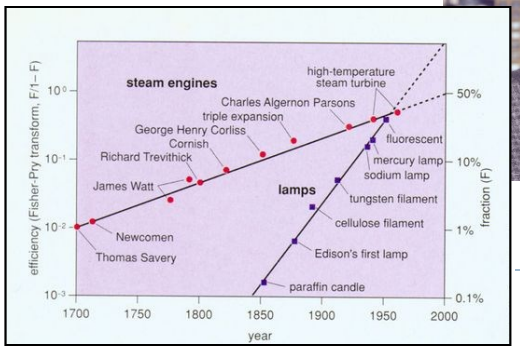
CORNUCOPIAN POSITION

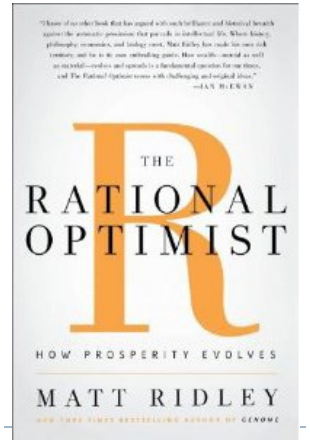


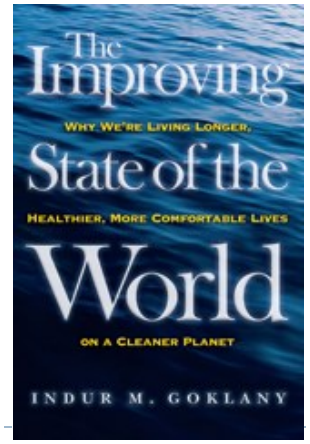


- Aka Technological Fix or Pollyanna
  - holds that increases in P (demand) leads to technological innovation and substitution
    - increase in access to and decline in relative price of materials
    - almost all indicators of human well-being have increased
  - Some recognition of negative consequences on E



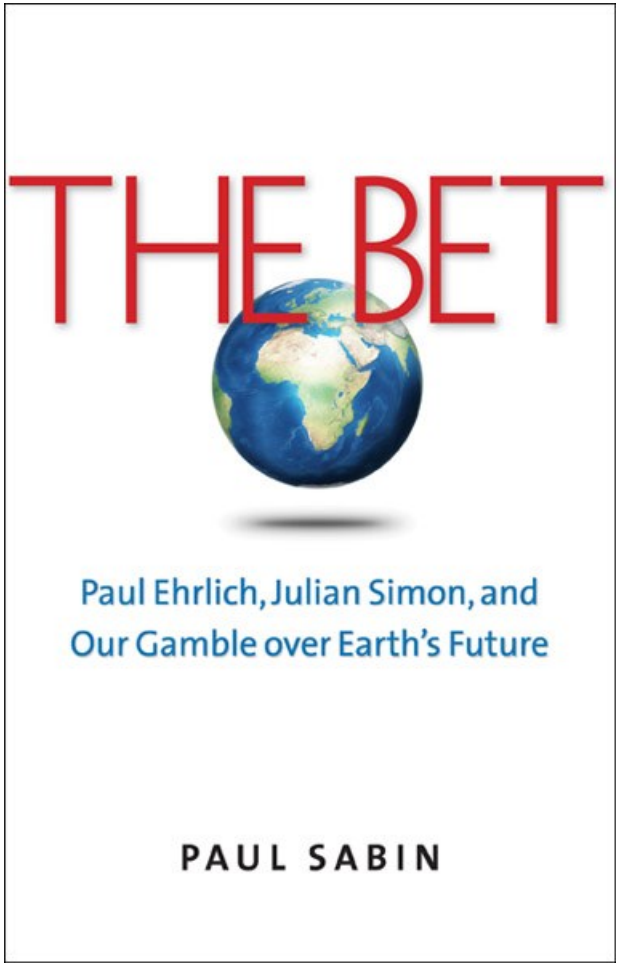






THE BET TAKEN & NOT

- BET I: 1980
  - After 10 yrs of exponential P growth (+ significant increases in global affluence), 5 selected minerals were cheaper in 1990 than in 1980!
    - Technological fix wins → NY Times
  - Bet was stunt
    - Markets not simple link between demand & resource cost
    - Predicated on start date (Simon wins 11x wins if 1981-84, 87-93; Ehrlich wins 16x if 87-89, 1994-2007), although historical trends favor Simon
- BET II: 1992
- SIMON → indicators of human well-being
- EHRLICH & SCHNEIDER → state of Earth system
  - 1992-94 to 2002-04 increases world ave. temperature, greenhouse gasses, tropospheric ozone (i.e., biogeochemical cycle change)
  - *Critical shift from economic conditions to state of the biogeophysical system*



2013

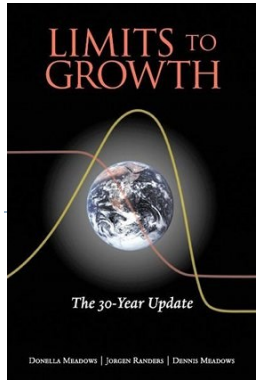
DEBATE SHIFT: EARTH SYSTEM SUSTAINABILITY & SUSTAINABLE DEVELOPMENT

- To total human impact on Earth system(s)
  - from stocks or natural resources alone (many with mkt. values)
  - to stocks + flows of elements/nutrients (biogeochemical cycling) that maintain Earth systems (most with no mkt. values; many difficult to establish shadow prices)
  - *debate shifts from $ value to magnitude & implications of changes in structure and function of biosphere*
  - Earth system as a complex system, shifts attention to nonlinear and abrupt changes (uncertainty & surprise)
    - Focus on uncertainty principle
- Shift to SES as a complex adaptive system
  - Caveat: relationships demonstrated for environmental subsystem *assumed* (but unproven and challenged) to operate for human subsystem and system at large
- [Overly] captured in global climate change
  - Plus ecosystem & biodiversity change → environmental services



CASSANDRA PERSISTENCE

- P is one but not necessarily the most important consumption or demand factor given apparent global-level demographic transition [?] relative to increasing affluence [?]
- Earth System complexity invoked
  - Some reproductive and consumption externalities are not self-correcting
- Consistent with tipping points, planetary boundaries, uncertainty principle
- Caution required about assessments of these points (planetary boundaries)



Pervasive Externalities at the Population, Consumption, and Environment Nexus

Partha S. Dasgupta[1,2]* and Paul R. Ehrlich[3]*

19 APRIL 2013 VOL 340 **SCIENCE**

FEATURE **Nature**

A safe operating space for humanity

Identifying and quantifying planetary boundaries that must not be transgressed could help prevent human activities from causing unacceptable environmental change, argue Johan Rockström and colleagues.

THE PLANETARY BOUNDARIES HYPOTHESIS
A REVIEW OF THE EVIDENCE
BY LINUS BLOMQVIST TED NORDHAUS AND MICHAEL SHELLENBERGER

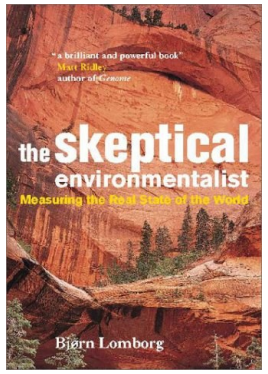
PNAS

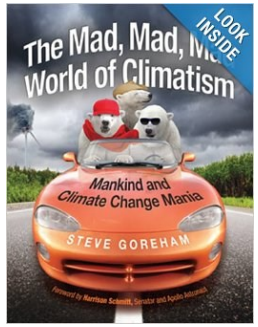
Tipping elements in the Earth's climate system

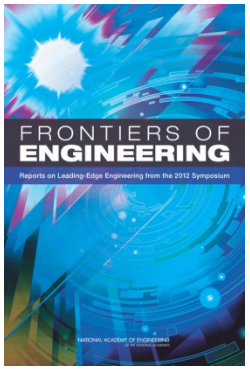
Timothy M. Lenton*†, Hermann Held‡, Elmar Kriegler‡§, Jim W. Hall¶, Wolfgang Lucht‡, Stefan Rahmstorf‡, and Hans Joachim Schellnhuber†‡||**

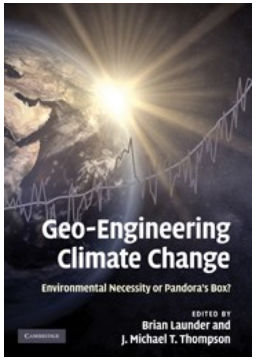
CORNUCOPIAN PERSISTENCE

- T innovation & increases in ave. indicators of human well-being embedded in critiques of GEC, foremost climate change
- More focus on "naysayers" position of GCC than on C position per se
- Elements of the Cornucopian T lurk within "geoengineering" solutions to environmental degradation
  - Champions and critics





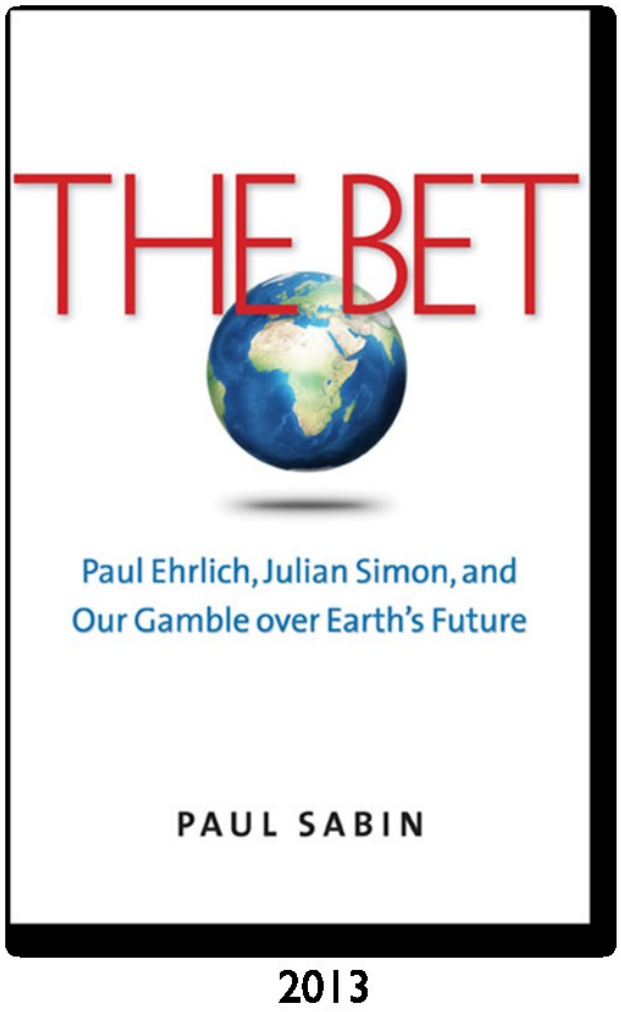




"THE SCIENCE" MASKED BY PUBLIC AND POLITICS

- IPAT or role of demand/human impress on HE relationships
- The human condition
- The state of environment
  - increasingly polarized ***political*** positions

- Analytics (research) of the HE condition often assumed to be politically aligned



CONCLUDING NOTES

- *Role of "P" in human-environment relationships is determined as much if not more so by world views of the interpreter than by the evidence*
- *Theory, concept, and data supporting Cassandra and Cornucopian positions*
- *P now embedded in larger global environmental change framing in which challenges to boundaries and limits on GEC are central*
  - *carrying capacity of the Earth is implied*
- *Current Cassandra-Cornucopian debate has explicit political economic dimensions*
- *The debate is not resolved and will likely never be owing to its ultimate source—world views*



