PROGRESS

Kent Peacock
Philosophy, U of L
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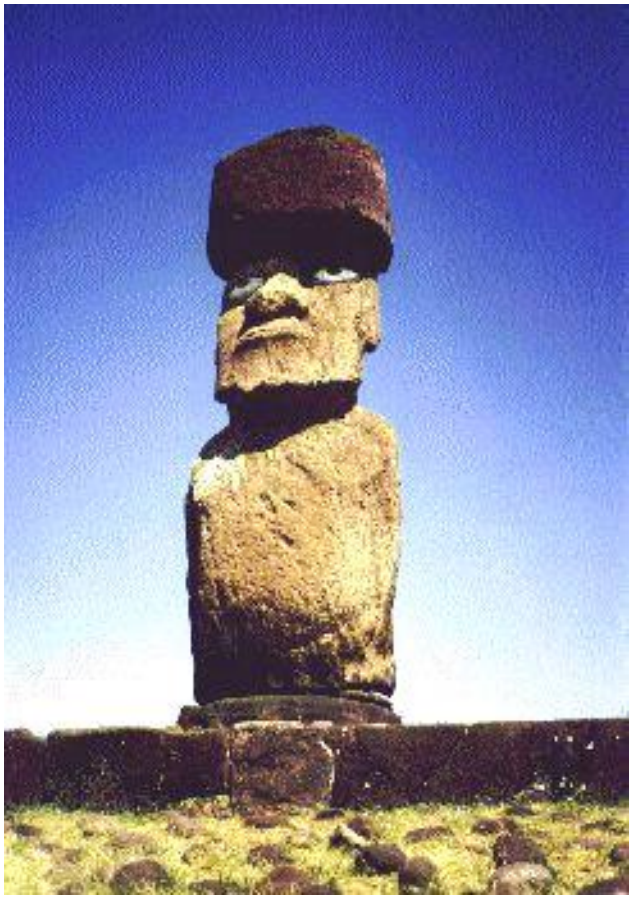


- Part I: The Bad News
- Part II: The Good News --- Maybe!!

July 20, 1969

- Talking hominids walk on the Moon.
- It was a moment of enormous confidence.
- Was this “a giant leap for mankind,” or a blip in human history?
- Have we come up against the wall of technological progress?

Heinlein's Predictions

- This was the most important moment in the history of humanity.
- We will go on endlessly into space, and the human race will not die.
- Wherever there is mass, there is (by Einstein's equation $E=mc^2$) energy we can use.
- We'll be on our way to Proxima Centauri before you know it.
- Cronkite: we can't stop progress!

How It Looks Today

- Apollo abandoned in 1972.
- Space Shuttle did not live up to expectations; soon to be replaced with 1960s-style boosters and capsules.
- We are still using chemical-powered reaction rockets.
- No real advance from the 1960s, except in information technology.

Easter Island

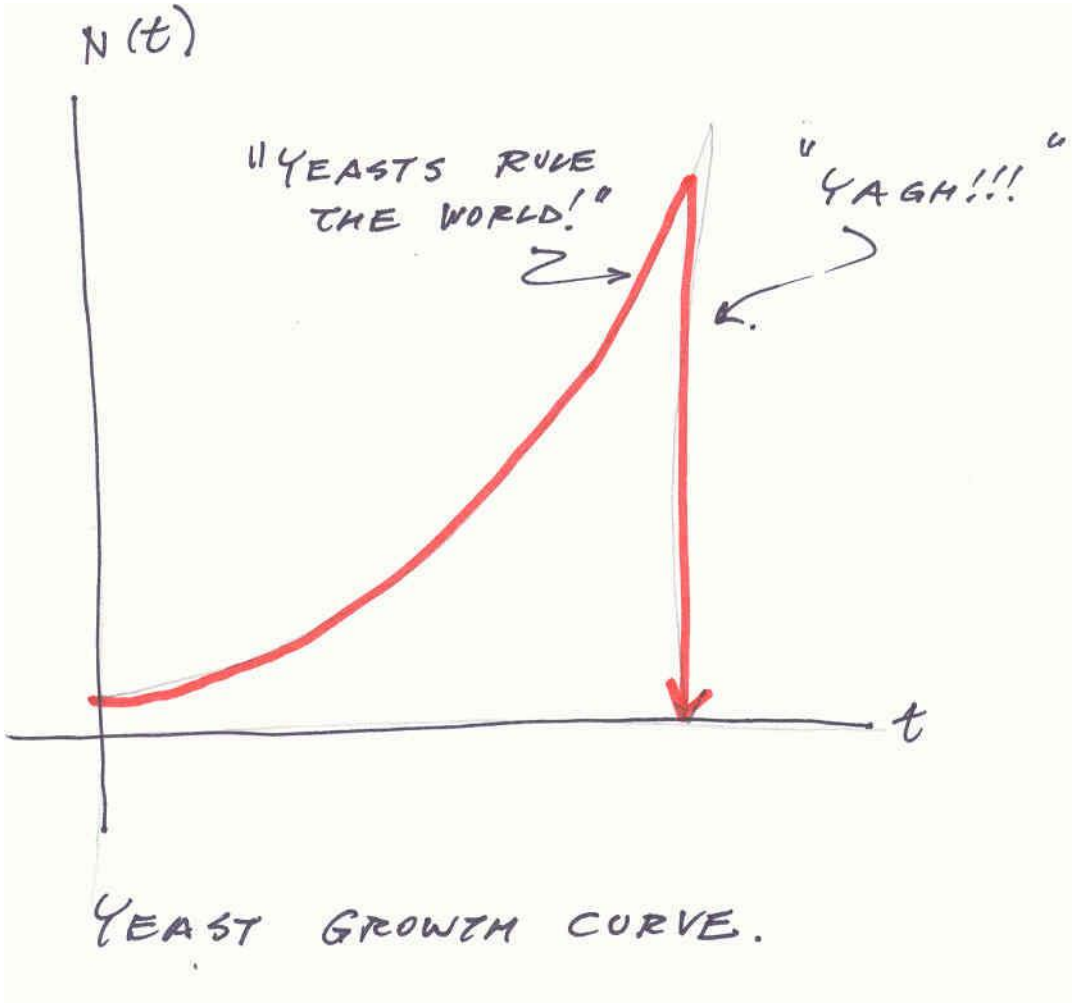
- Ecological collapse of complex society caused by over-exploitation of resources.
- Wright: “the statue cult became a self-destructive mania, an ideological pathology.”
- Typical example of the grim cycle of deforestation, soil erosion, species loss, leading to warfare and social collapse.
- Sometimes (as in N. Africa) desertification occurs as well; regional climate becomes drier (though this is controversial).

Warning!

- Such collapses have occurred many times throughout history!
- Key fact: they are often very sudden!
- Societies often collapse at the height of their complexity and apparent power.
- Often marked by obsession with “social” reality at the expense of “natural/physical” reality.
- Are we going to “Easter Island” the whole planet?

•Ecological Pattern

- Such social collapses are similar to many examples in nature where an invading organism overshoots the carrying capacity of its environment.
- Simple example is the growth of yeast in wine-making:
- Yeast have apparently ideal environment, with no predators and infinite food.
- Yet they sterilize themselves out of existence with their own waste product (alcohol).



YEAST GROWTH CURVE.

Hitting the Bottleneck

- Populations of invading organisms often hit a bottleneck, typically due to either resource exhaustion or pollution; sometimes a combination of the two.
- Can lead to extinction, or succession by the next “dominant” organism.
- Extinctions can also be caused by catastrophes (impacts, volcanoes).

“If the Grim Reaper plays any favourites at all, then it would seem to be a special fondness for striking down dominant organisms in their prime.”

--- Les Kaufman (1986)

The “Ecological Bind”

- An organism becomes successful because it finds an effective way to exploit its environment.
- But over-exploitation undermines the suitability of the environment for that organism.
- It becomes a victim of its own success!
- Wright calls this a “progress trap.”
- Can humans avoid this “bind”?
- It is crucial to realize that the overshoot-collapse scenario does not *always* happen!

The Human Story

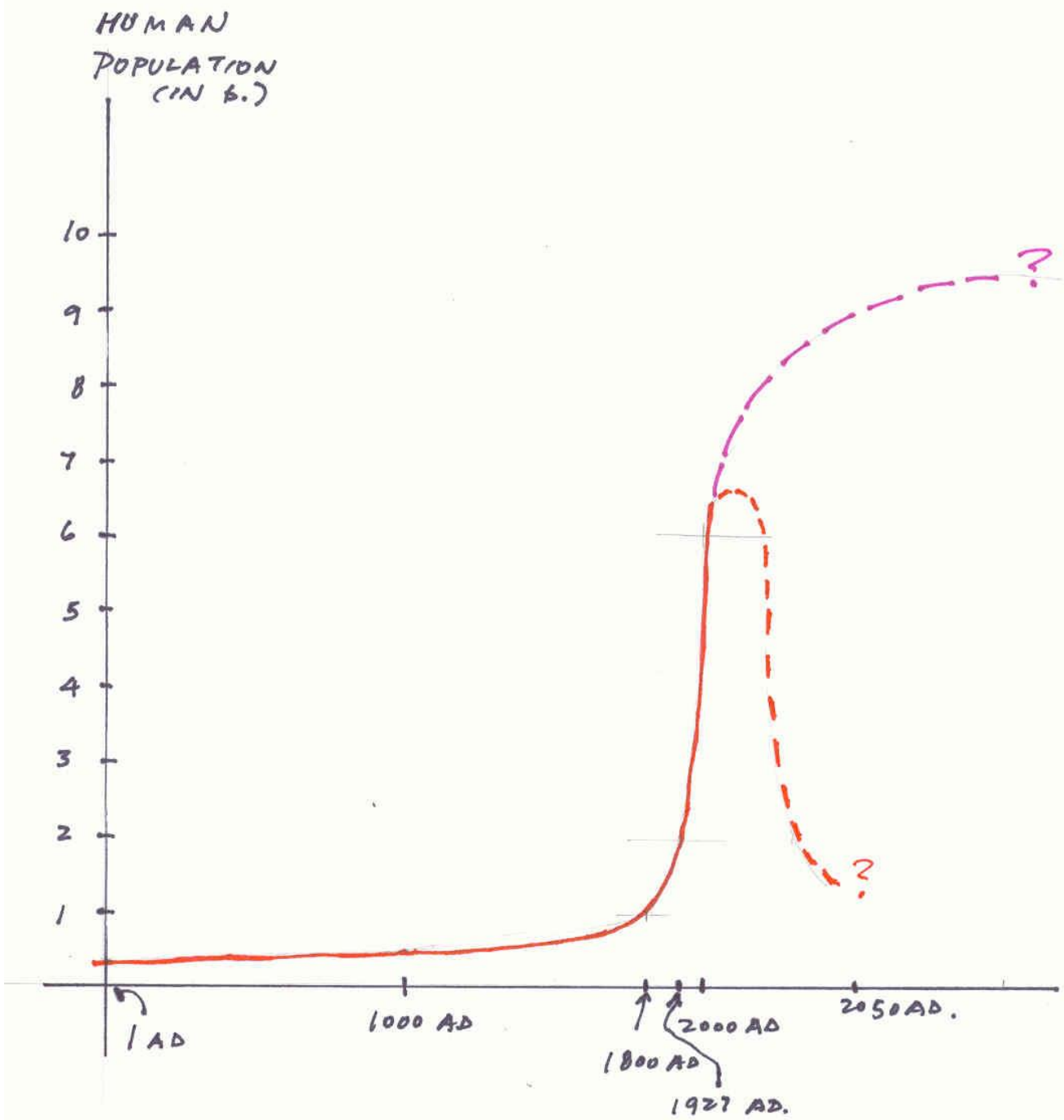
- Humans evolved from earlier hominids (*Erectus*) ca. 100,000 to 150,000 years ago in Africa (we are all Africans).
- Erect posture and tool use go back well over 2 mya.
- When did language appear? Unknown…

A Close Call

- Genetic evidence shows that humans went through a bottleneck around 75,000 years ago, probably due to Toba (biggest volcanic event in 2 million years).
- Human species may have been down to 1,000 persons or less (in Africa, probably).
- Did this near-extinction increase our intelligence (since only the smarter and more adaptable people might have survived?)
- Or were the survivors just lucky?

The Ice Age

- Our ancestors had to survive not only Toba, but thousands of years of Ice Ages.
- Harsh and variable climate may have favoured intelligence, adaptability.
- There were several other near-human species (Neanderthals); did we just kill them off? (All were extinct ca. 25,000 ya.)
- First agriculture appears ca. 10,000 ya (Indus Valley), just as Ice Age melts down.


HUMAN POPULATION (IN B.)
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1800 AD
1927 AD.
2000 AD
2050 AD.

How Did This Happen?

- Human population bloom made possible by technology and language.
- Language allows transmission and multiplication of information; each generation does not have to learn everything from scratch.
- Favoured by relatively mild climate; glacial interstade. (Soon to end?)

The Fossil Fuel Bonanza

- Human growth curve resembles yeast growth curve when a spoonful of sugar is added to the mix.
- Exploitation of fossil fuels (coal, oil, gas) sped up human bloom.
- It is humbling to see how much like micro-organisms we really are!

The Next Bottleneck?

- Will fossil fuels be our next bottleneck?
- Two problems: depletion and climate change.
- Climate change is very real, all denial to the contrary.
- Risks include drought, shift of climate zones, and rapid sea level rise.
- The latter could happen *soon*!

Peak Oil

- Some figures:
- The world uses 88.5 million barrels of oil/day, over 32 billion barrels/year
- OECD countries (1 billion people) use 50 mbl/d = 23 bl/person/year!
- U.S. consumption is 21+ mbl/d
- Rate of discovery is *far* behind rate of consumption; in 2005, 5 bbl discovered, 26 bbl consumed.

More Bad News

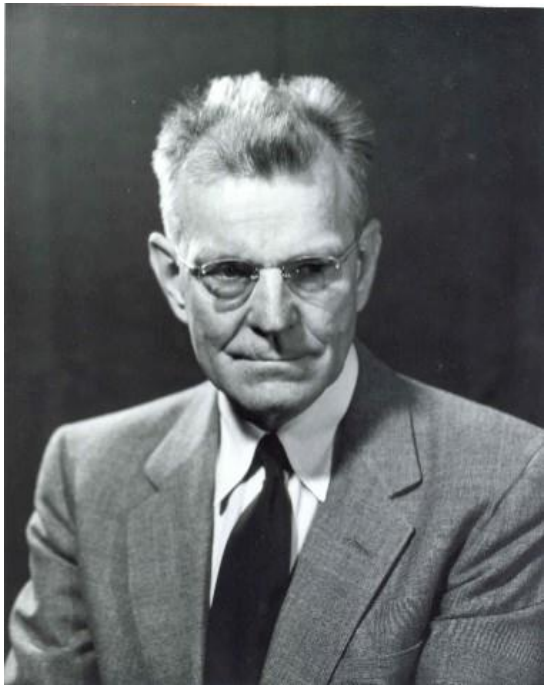
- Saudi oil production declines 8%/year
- By 2018, Mid-East production estimated to be half of current production.
- We are increasingly dependent on oil that is very expensive in energy to extract:
- As India and China industrialize, the demand only continues to increase.

More Bad News

- EROI ("energy return on energy investment") was up to 100:1 in the 1930s, may be as low as 1.5:1 in oil sands. (A losing proposition!)
- Natural gas is near peak as well, probably.
- Coal can last longer, but it is very polluting.

The Hubbert Curve

- The oil peak was predicted by geophysicist M. King Hubbert (1903-1989), who showed that extraction of a finite resource such as oil tends to follow a hump-shaped curve (rough inverse exponential).
- In 1956, he predicted that continental U.S. oil production would peak in 1970; called it to the year.



At the Top of the Roller Coaster

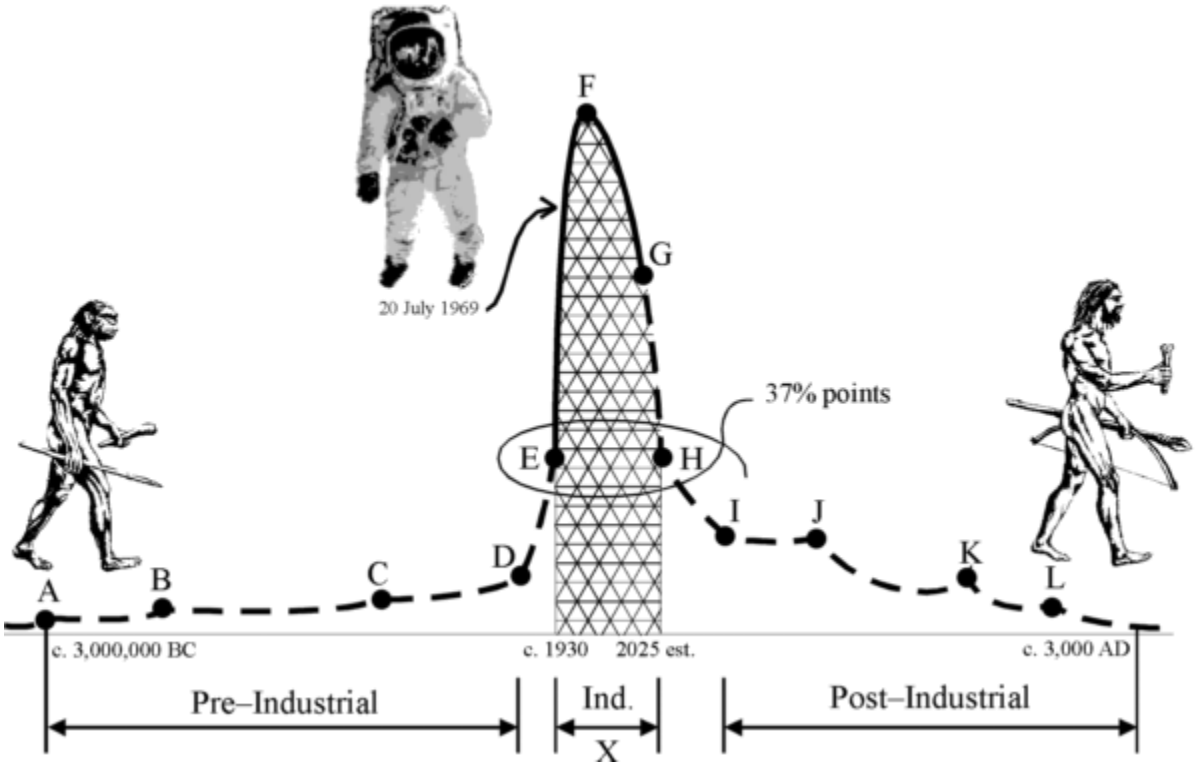
- There is alarming evidence that we are very near or over the top already in total possible petroleum production (which is ultimately limited by geology).
- Harder to estimate world Hubbert curve, since reserve estimates are unreliable (many countries exaggerate their reserves).

"*There is no Plan B*!!!"

- See September 2006 *Scientific American* for review of alternate energy sources.
- Some have great theoretical promise (such as fusion), but *at present* none can come close to replacing petroleum.
- Hubbert: we get into trouble as soon as we pass the peak, since we come to depend on a certain rate of flow of the resource.

Misplaced Priorities

- U.S., Britain are fighting desperate war for oil in Iraq to buy time.
- This is costing ~$100 b/year.
- They are not spending anything close to that on R & D for alternative energy sources and conservation.
- Cheney: “The American way of life is not negotiable.”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The Olduvai Theory

- Due to Richard C. Duncan
- The industrial era is a brief blip in the history of the human species, which will soon return to a hunter-gatherer way of life permanently.
- This will occur mainly because of the depletion of fossil fuels (though anthropogenic environmental damage is a factor as well).

Expressions of Pessimism

- James Howard Kunstler:
- “So much of what we construe to be among our entitlements to perpetual progress may prove to have been a strange, marvelous, and anomalous moment in the planet’s history.”
- We have taken a cache of hydrocarbons that took hundreds of millions of years to accumulate, and blown most of it off in about 100 years!

Kunstler again…

- “The Long Emergency is going to be a tremendous trauma for the human race.”
- “We will not believe that this is happening to us, that two hundred years of modernity can be brought to its knees by a worldwide power shortage.”

And Kurt Vonnegut…

- Vonnegut was recently asked “if he had any advice for young people who want to joint the increasingly vocal environmental movement.”
- “ ‘There is nothing they can do,’ he bleakly answered. ‘It’s over, my friend. The game is gone.’”

One Bit of “Good” News

- As fossil fuels run out, we will emit much less CO_2, thereby reducing global warming!
- (And then maybe the next Ice Age begins!)
- Just kidding…
- But seriously: over the past 3 million years, a stable, benign climate is the exception, not the norm!

Part II: Good News – Maybe!

- Some reasons to be hopeful:
  - Tikopia
  - Human ingenuity in general.
  - Women's ingenuity.
  - Ecological factors in our favour.

Tikopia

- Another tiny Polynesian Island, only 2 sq. mi.
- Continuous human habitation for 3000 years; ecology maintained with horticultural intensity.
- Rigorous population control.
- Might have worked because colonists realized from the outset how small their environment was.

Human Ingenuity in General

- Examples of supremely creative people (Galileo, Einstein, Mozart…) show human potential at its best.
- Humans are creatures whose survival skills were honed in a period of rapid climate change and environmental upheaval; survival demanded adaptability and a high ability to innovate.

Ingenuity

- It seems reasonable to guess that our neurology (with its high capacity for learning, creativity, and adaptation) was selected for because there was a survival advantage.
- Problem: social factors often inhibit individual creativity!

Two Kinds of Ingenuity

- Thomas Homer-Dixon (*The Ingenuity* Gap) distinguished social and technical ingenuity.
- Tikopia shows that social ingenuity can produce the conditions that allow technical ingenuity to make sustainability possible.
- My guess is that some alternatives (e.g. fusion) are blocked not because they are impossible, but because of conservatism and ritualistic thinking.

Women's Ingenuity

- Demographic evidence (see Amartya Sen, *Freedom and Development*) shows that women's empowerment, especially literacy, is the best contraceptive by far.
- Societies where women are literate and have access to basic health care have lowest infant mortality and birth rates.
- Ingenuity is selected *against* in certain social contexts, where it is perceived as a threat; this is doubly so for women's ingenuity in many societies.

Ecological Factors

- Lynn Margulis and other biologists have found much evidence that organisms from bacteria upwards can form cooperative (“mutualistic”) associations when their environments are constrained.
- Transition from opportunistic parasite (us!) to symbiote appears to be important factor in evolution, although this remains controversial.

Eugene Odum (1913-2002)

- “…if understanding of ecological systems and moral responsibility among mankind can keep pace with man’s power to effect changes, the present-day concept of ‘unlimited exploitation of resources’ will give way to ‘unlimited ingenuity in perpetuating a cyclic abundance of resources.’”

- Hence our similarity to micro-organisms might be encouraging as well as depressing!
- Are we smart enough to do what bacteria and amoebae can do?

Plant a Tree!

- Wright:
- “The reform that is needed … is simply the transition from short-term to long-term thinking.”
- “The lesson I read in the past is this: that the health of land and water—and of woods, which are the keepers of water—can be the only lasting basis for any civilization’s survival and success.”

Wright's Predictions…

- "We have the tools and the means to share resources, clean up pollution, dispense basic health care and birth control, set economic limits in line with natural ones. If we don't do these things now … this new century will not grow very old before we enter an age of chaos and collapse that will dwarf all the dark ages in our past."

Hubbert:

"*Our ignorance is not so vast as our failure to use what we know.*"

So What *Is* Progress?

- Wright: *Homo sapiens* is “an Ice Age hunter only half-evolved towards intelligence; clever but seldom wise.”
- It is hard to give an ultimate definition of “progress,” since that would imply we knew the ultimate end of human existence.
- However, for our time progress would be finding the wisdom to use the knowledge *we already have*!

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