Duncan, R.C.
The Peak of World Oil Production and the Road to the Olduvai Gorge
November 13, 2000
http://www.oilcrash.com/articles/olduvai.htm

1. Introduction
-the Olduvai theory posits that our Industrial Civilisation has a life expectancy of about 100 years
-while easy to understand, the theory is difficult to accept
-it views energy production and use in terms of overshoot and collapse
-it is probably that a complex combination of causes will lead to the decline of Industrial Civilisation (e.g., overpopulation, resource depletion, soil degradation, war, etc.)
-Duncan's experience is in electrical power networks and the management systems that control them
-these systems "are demanding, dangerous, and delicate"
-as Industrial Civilisation collapses, permanent blackouts will accompany it
-Industrial Civilisation can be graphically represented "as a pulse-shaped curve of world average energy-use per capita"
-the Olduvai theory focuses upon the increasing problem of our high-voltage electric power networks
-it's estimated that roughly 42% of our primary energy use is for generating electricity

2. Energy and Civilisation
-as the energy exploited increases per capita, culture 'evolves' [i.e., becomes more complex']
-oil is a highly portable and energy-dense fuel and the primary energy source for Industrial Civilisation
-Figure 1 shows Duncan's most recent oil production forecast (2000-2040) with historic statistics (1960-1999)

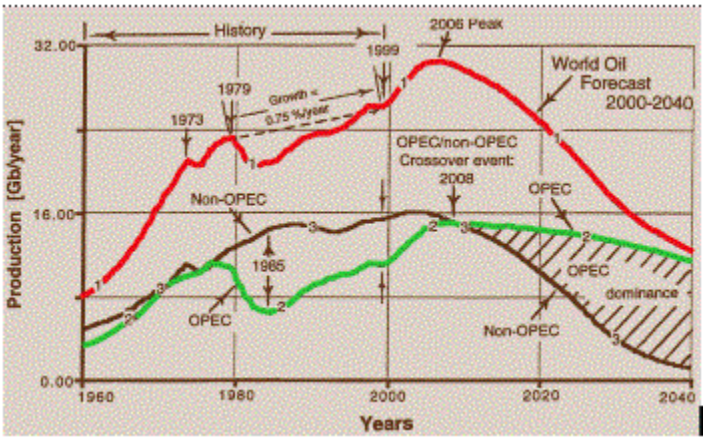

Figure 1. World, OPEC, and Non-OPEC Oil Production

-growth was 6.65% per year (1960-1973), 1.49% per year (1973-1979), 0.75% per year (1979-1999); Duncan forecasts a decline of 2.45% per year from 2006 peak to 2040

-he also predicts an inflection point in 2008 when non-OPEC production falls below that of OPEC, resulting in OPEC controlling more and more of the export market
-it's important to consider oil production in terms of total world population, so on a per capita basis
-while production per capita had grown exponentially prior to 1973 (1920-1973), it fell to almost zero up to its peak (1979) but then fell about 1.2% per year until 1999 (Figure 2)

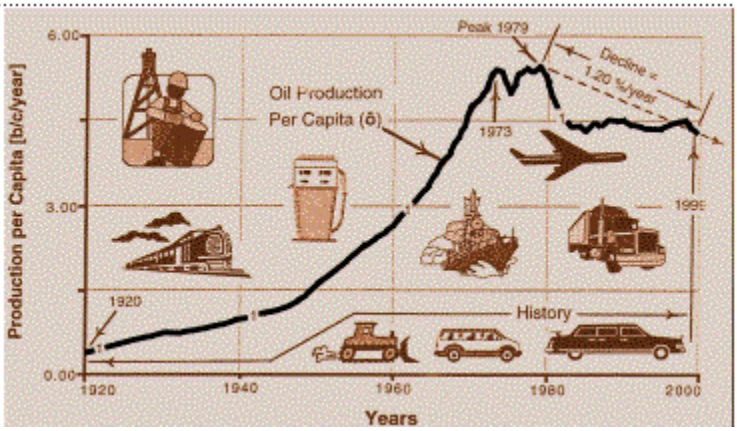

Figure 2. World Average Oil Production per Capita: 1920-1999

-production increased but at a slower rate than population
-the per capita oil production decline is what Duncan terms the 'Olduvai slope' (Figure 3)

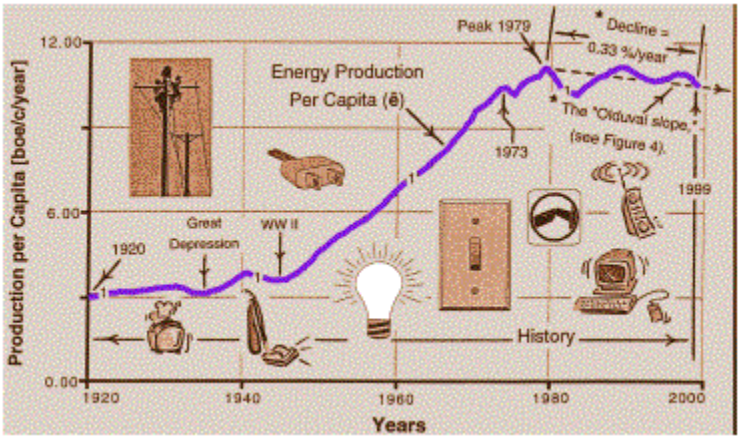

Figure 3. World Energy Production per Capita: 1920-1999

3. Evolution of an Idea

-the Olduvai Theory's main tenets have historical roots
-Ibn Khaldun (1332-1406) held that civilisation needed tribal values but those values (i.e., community and kinship ties) were destroyed by civilisation
-Joseph Granvill (1665) observed that while energy-dependent machines eased human labours it made them more reliant upon the machines and the machines consumed increasing amounts of resources
-Washington Irving (1783-1859) wrote that a quick collapse of civilisation could occur

-Alfred Lotka maintained that humans were out of equilibrium with their world and a return to the mean awaited us; and that only a true optimist would think such a return would be without labour and suffering
-Norbert Wiener (1894-1964) argued that resources seemed inexhaustible when one could easily move to an unexploited region, as had been done for centuries
-“What many of us fail to realize is that the last four hundred years are a highly special period in the history of the world. This is partly the result of increased communication, but also of an increasing mastery of nature which, on a limited planet like the earth, may prove in the long run to be an increased slavery to nature.”
-C.G. Darwin (1953) argued that once we have spent our oil and coal reserves life will change significantly especially if a substitute is not found; the change is likely to be one of declining population
-Sir Fred Hoyle (1964) suggested that as far as intelligent life evolving once we’ve exhausted all the physical resources necessary for supporting such life, the chances are basically zero

4. World Models, etc.
-“Perhaps the most widespread evil is the Western view of man and nature. Among us, it is widely believed that man is apart from nature, superior to it; indeed, evolution is a process to create man and set him on the apex of the cosmic pinnacle. He views the earth as a treasury that he can plunder at will. And, indeed, the behavior of Western people, notably since the advent of the Industrial Revolution, gives incontrovertible evidence to support this assertion.”
-in 1970, Jay Forrester developed a computer modelling program to assess human civilisation as it transitioned from growth back to equilibrium
-exponential growth cannot continue in perpetuity on a finite planet; growth will stop, we just don’t know when or how
-Forrester’s model suggested that with business-as-usual our trajectory as one of overshoot and collapse, suggesting a peak of material standard of living around 1990 and then declining thereafter until about 2100; this suggests a lifespan of Industrial Civilisation of 210 years
-adjusting certain variables, Forrester’s model found five social policies could be implemented to help us achieve sustainability, we need to:

1) Decrease natural resource-use rates by 75%;
2) Reduce pollution by 50%;
3) Bring capital investments done by 40%;
4) Decrease food production by 20%;
5) Reduce our birth rate by 30%.

-economists especially criticised this
-a subsequent run of a more comprehensive program concluded that the same business-as-usual endgame with decline being primarily due to the depletion of non-renewable resources
-it projected industrial output per capita peaking in 2013 and declining steeply, and suggesting a 105 year Industrial Civilisation lifespan
-human history may be viewed as occurring in 3 phases

1) Pre-industrial with a long period of equilibrium where simple tools and weak machines limited economic growth;

2) Industrialisation with a short and intense period of growth based upon powerful machines;
3) De-industrialisation where industrial societies decline towards equilibrium

-a rerun of the 2nd program 20 years on found we had continued upon the business-as-usual scenario and were still headed towards overshoot and collapse (but that the Industrial Civilisation lifespan had shortened to 102 years)
-an argument can also be made that we are on a 'plague cycle' that threatens to impact us in the not-too-distant future
-many professionals have come to conclusions similar to the Olduvai theory

5. The Olduvai Theory: 1930-2030

-the Olduvai theory holds that Industrial Civilisation has a lifespan of about 100 years
-Duncan defines the beginning as the point energy production reached 30% of peak and the end when the decline falls back to that 30% level (forecast for 2030)
-the 'Olduvai curve' (see Figure 4) highlights major inflection points with the decline section consisting of a slope, slide, and cliff (each steeper than that preceding it)

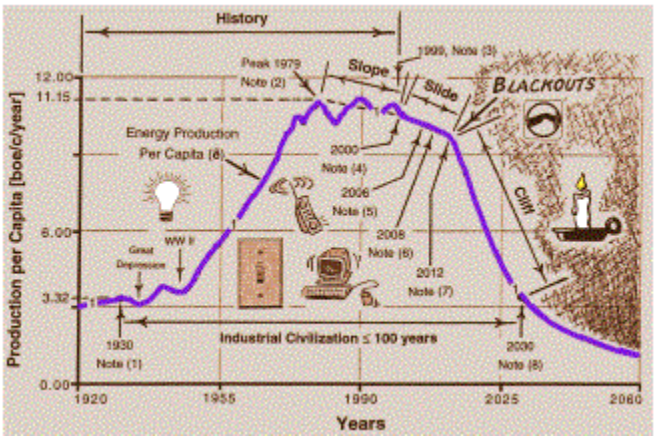

Figure 4. The Olduvai Theory: 1930-2030

-it also shows 8 key events:

1) 1930--beginning of Industrial Civilisation;
2) 1979--peak of per capita energy production;
3) 1999--end of cheap oil;
4) 2000--eruption of Middle East violence;
5) 2006--world oil production peak;
6) 2008--OPEC/non-OPEC production crossover;
7) 2012--beginning of Olduvai cliff when permanent blackouts begin;
8) 2030--end of Industrial Civilisation.

-electricity reliability has already begun to falter
-California has begun experiencing shortages
-new power plants construction has slowed as populations continue to increase and energy-fuelled technologies expand
-producers have been pushing for new gas generation but the need for them is not yet there
-electricity is the backbone of Industrial Civilisation and modern living; in 1999 it supplied 42% (and increasing) of the end-use energy (oil only 39%)

-the die-off that is ahead will likely occur everywhere but urban centres will be most dangerous due to a lack of food; many will flee to the countryside

6. Summary and Conclusions

-the evolution of civilisation has a long history culminating in computer-generated models based on a complex array of variables that postulate a lifespan of 100-200 years for Industrial Civilisation

-the Olduvai theory argues Industrial Civilisation's lifespan is shorter at about 100 years

-"Although all primary sources of energy are important, the Olduvai theory postulates the electricity is the quintessence of Industrial Civilization."

-based upon per capita energy production, Industrial Civilisation will only last about 100 years

-the 'Olduvai slide' (2001-2001) may resemble the Great Depression with a subsequent 'cliff' (2012-2030) with no human precedent

-"Governments have lost respect. World organizations are ineffective. Neo-tribalism is rampant. The population is over six billion and counting. Global warming and emerging viruses are headlines. The reliability of electric power networks is falling. And the instant the power goes out, you are back in the Dark Age."