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The peak of peaks or the *peak peak*

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Abstract
The term peak oil was first introduced by Colin Campbell in December 2000, with an article titled "Peak Oil - a Turning Point for Mankind", leading to the founding of ASPO "Association for the Study of Peak Oil and gas". Peak oil is often related to the M.King Hubbert Peak from his famous 1956 paper forecasting the USL48 oil peak in 1970, with an ultimate volume of 200 Gb. But in his last paper in 1981 he was convinced that the USL48 oil ultimate was only 170 Gb, based on the extrapolation of discovered oil by exploratory foot. The recent estimate is 230 Gb. The problem is that Hubbert was using the official misleading proved current discovery data and was too pessimistic about the US offshore potential. Gold peak seems to have passed, silver peak and copper peak could occur within this decade. My grandchildren will see the peaks of most important commodities, or "peaks peak" (or "peak peaks")

-Hubbert crude oil forecasts

-Hubbert's US crude oil peak

Peak oil is often related to the *Hubbert Peak* from his famous 1956 paper forecasting the USL48 oil peak in 1970 with an ultimate of 200 Gb (but also in 1965 for an ultimate of 150 Gb). In 1956 the US had only the 48 states because Alaska only joined in 1959!

In 1956, Hubbert was not the first geologist to forecast such a peak around this date. The forecast by J.Pogue & K.Hill (Chase Manhattan Bank), which is similar and earlier than Hubbert, should also been vindicated: http://www.inteldaily.com/pdf.php?a=5447
Hubbert quotes Pogue& Hill in his 1956 paper.
The Chase Manhattan report titled «Future growth and financial requirements of the world petroleum industry» was published on February 21, 1956 for presentation at the Annual Meeting of the Petroleum Branch of the American Institute of Mining, Metallurgical and Petroleum Engineers and was reported in the New York Times. As shown in the figure below, the report concluded that the US peak of production would likely occur between 1965 & 1970 based on the assumption that only 85 billion barrels of oil would be discovered in the lower 48 states after 1956.
Figure 1: US oil production forecast by Pogue & Hill 1956 for ultimate 165 Gb

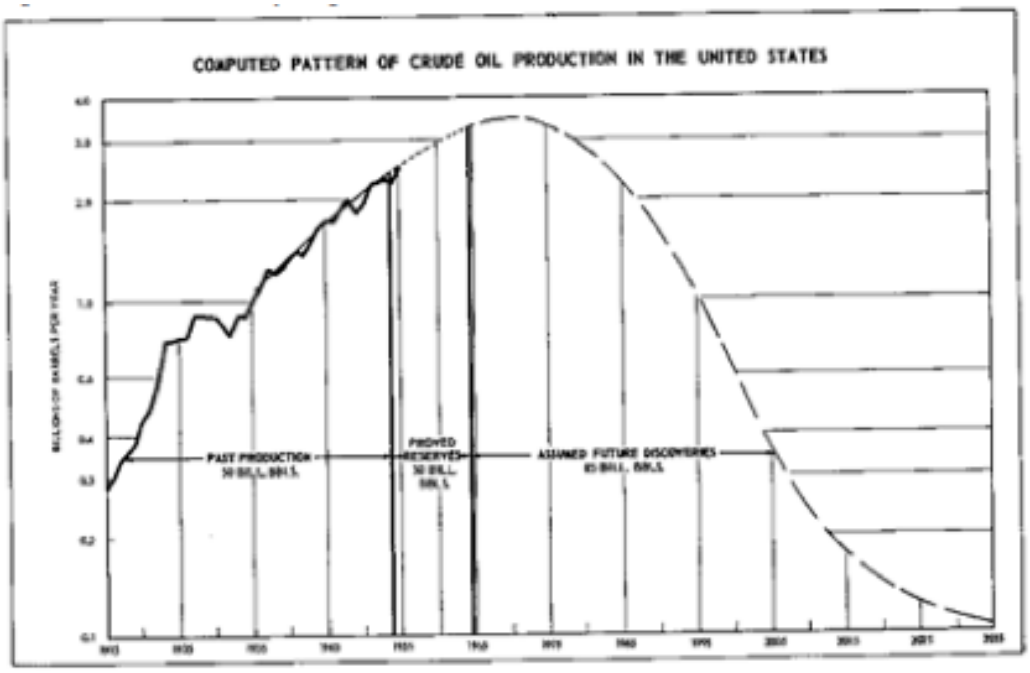


FIGURE 10 – Computed Pattern of Crude Oil Production in the United States on the basis of Future Discoveries of 85 Billion Barrels, the Approximate Equivalent of Past Discoveries.

Pogue & Hill's graph (time scale hard to read: seems to be every 10 years from 1915 to 2025) with a future discovery of 85 Mb plus proved reserves of 30 Gb, with a cumulative production of 50 Gb (or an ultimate of 165 Gb) is too pessimistic with an end of production in 2025!
Also their graph was far from being symmetrical, in contrary to Hubbert's forecast!
But 2P backdated discovery up to 1956 was in fact 150 Gb, so Pogue's ultimate should have been in fact 235 Gb, close to reality.
The US problem for reserves is the poor practice of reporting only proved reserves, because of the SEC rules (change in 2010)!
In his 1956 paper, Hubbert forecasted a peak in 1965 for an USL48 ultimate of 150 Gb (his estimate) and a peak in 1970 for an ultimate of 200 Gb (taking the largest estimate (DGMN) from a Delphi enquiry by W.Pratt upon 25 experts).
Figure 2: US oil production forecast by Hubbert 1956 for ultimates 150 & 200 Gb

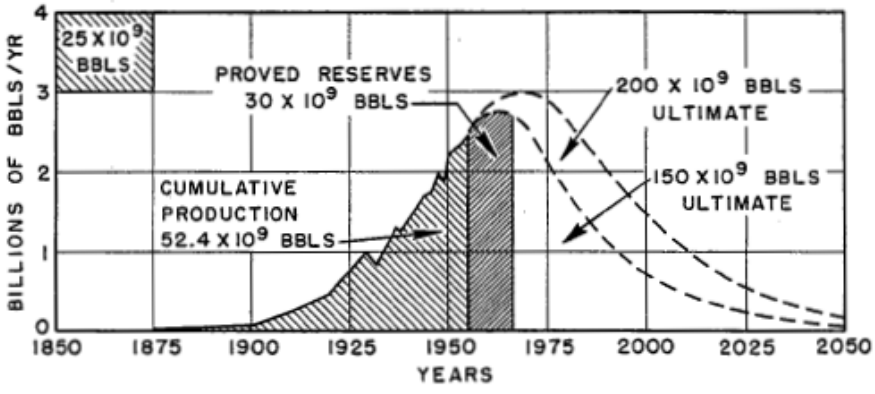
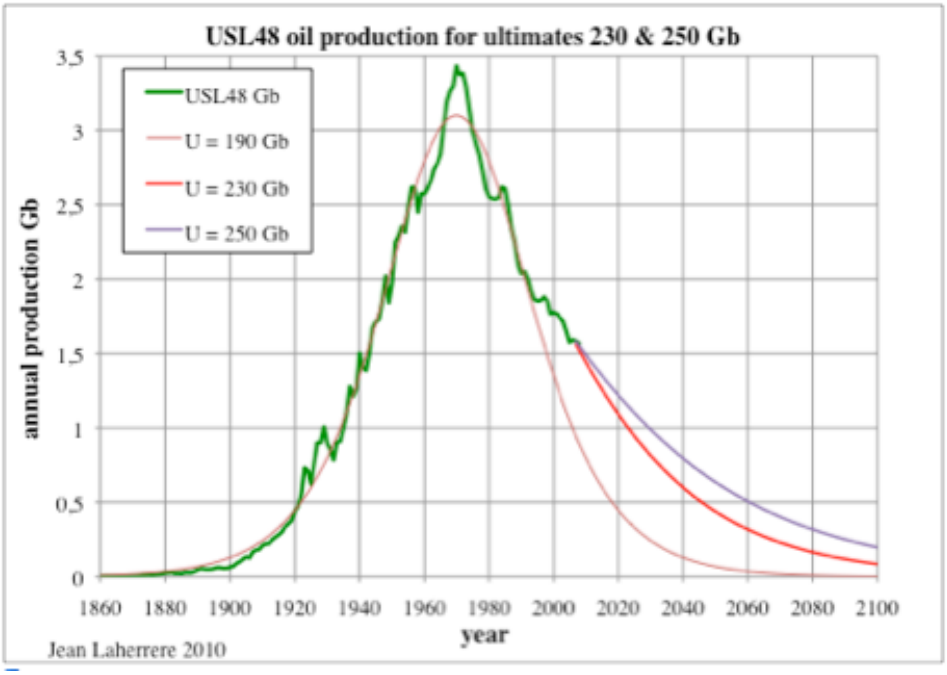


Figure 21 – Ultimate United States crude-oil production based on assumed initial reserves of 150 and 200 billion barrels.

His curve was drawn by hand and the area below the curve was estimated by counting the square (the unit is shown in the right up corner for 25 Gb).
Hubbert in 1956 was only saying that the production curve starts from zero, goes to a peak and ends at zero, the only equation was that the area below the complete production curve represents the ultimate reserves (reserves = recoverable resources) and there may be an infinite number of curves

corresponding to this ultimate. The main problem is to estimate the ultimate and the so-called Hubbert linearization of production data, introduced by Deffeyes later on, is not the best way. The creaming curve of cumulative backdated mean discoveries is the best way to estimate ultimates. In reality, USL48 crude oil peaked in 1970 at 3.4 Gb and the ultimate is about 230 Gb (maybe 250 Gb with subsalt). With such ultimate, the production curve is unsymmetrical!

Figure 3: USL48 oil production forecast for ultimates 230 & 250 Gb



The estimates for US oil ultimates up to 1962 (Hubbert 1962 “Energy resources”) ranged from 110 to 590 Gb.

Hill in 1957, with Hammer & Winger, raised the value to 250 Gb when in 1956 with Pogue he had 165 Gb!

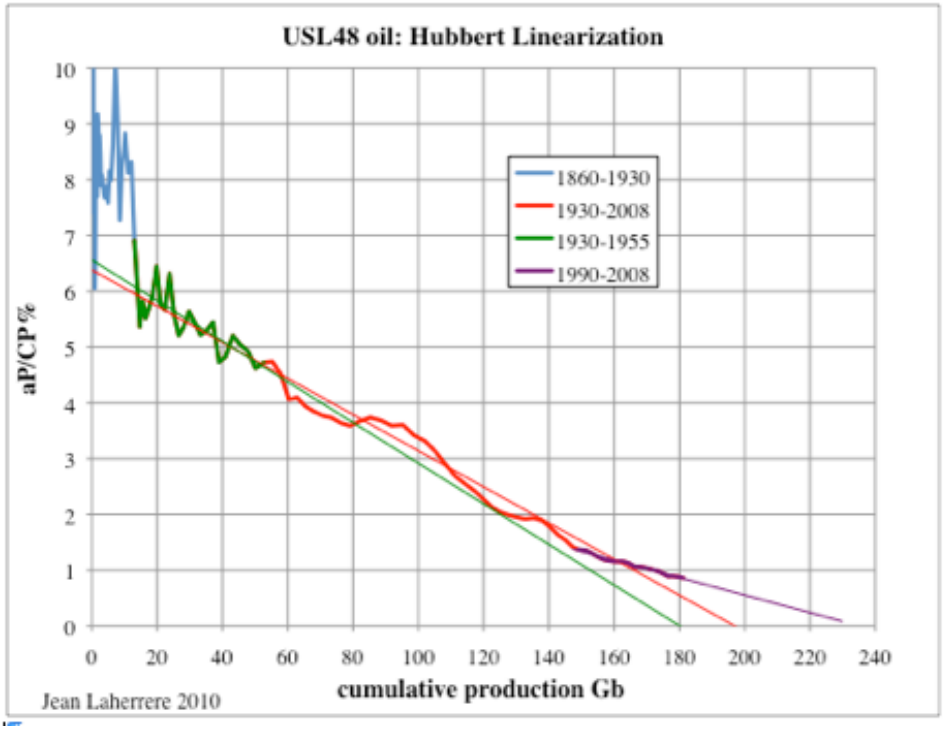
Figure 4: US oil ultimate estimates from 1948 to 1962

Estimated Ultimate U. S. Crude-Oil Reserves

	Date	Author	Estimate (Barrels)
a	1948	Weeks	110×10^9
b	1956	Dept. of Interior	300×10^9
c	1956	Pogue and Hill	165×10^9
d	1956	Hubbert	150×10^9
e	1956	Pratt	145×10^9•
f	1957	Hill, Hammar and Winger	250×10^9
g	1958	Netschert	372×10^9•
h	1958	Weeks	204×10^9•
i	1958	Davis	165×10^9
j	1959	Weeks	391×10^9•
k	1959	Knebel	173×10^9•
l	1961	Zapp (U.S.G.S.)	590×10^9
m	1961	Averitt (U.S.G.S.)	400×10^9•
n	1962	Moore	364×10^9

If Hubbert had used the production data to estimate the ultimate by plotting what is now called the Hubbert linearization (by Deffeyes), which is the percentage of annual production over cumulative production versus cumulative production. The plot from 1930 to 1950 is roughly linear and trends towards 180 Gb. But the recent linear trend from 1990 to 2008 (deepwater) trends towards 230 Gb

Figure 5: present USL48 oil production Hubbert linearization 1860-2008



In 1959 (Techniques of prediction) Hubbert started to use different techniques to estimate US oil ultimate, combining cumulative discoveries (but assessed as proved reserves) and production.

In 1962 (Energy resources) Hubbert tried to extrapolate the number of large fields (>100 Mb), being 240 large fields at end 1961 and representing in volume 57% of the total discoveries (59 Gb out of 103 Gb). The number of large fields was only around 150 in 1951.
Figure 6: Hubbert's estimate of large US oilfields

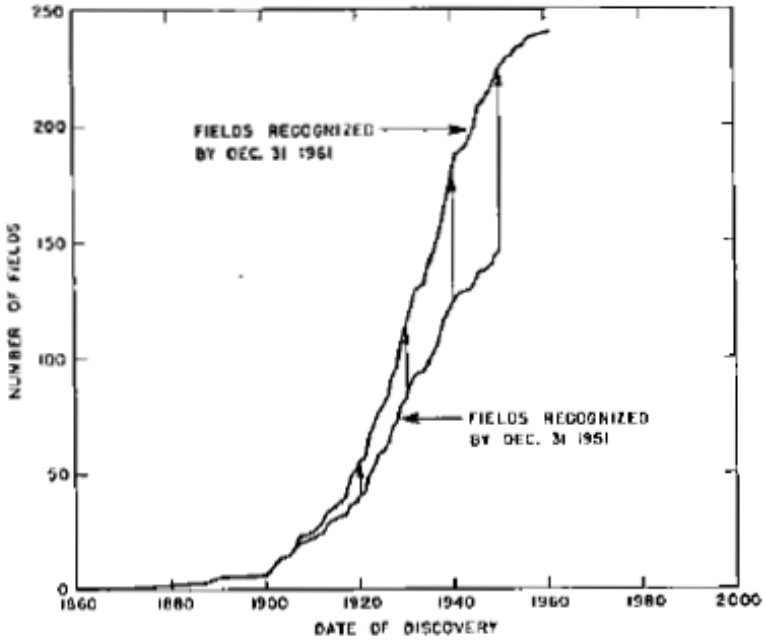


Figure 33. Large U.S. Oil Fields Recognized by December 31, 1951 and December 31, 1961

Hubbert extrapolated the number of an ultimate of 460 large fields.
Hubbert acknowledged the difference between date of discovery and date of recognition.

Figure 7: Hubbert's estimate of large US oilfields by date of discovery & date of recognition & forecast to 460 fields

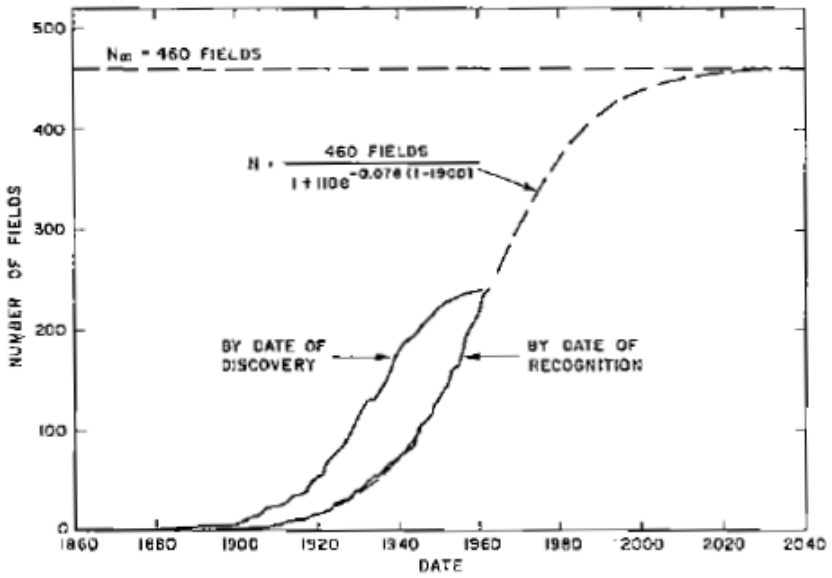


Figure 34. Large U. S. Oil Fields Plotted by Date of Discovery and by Date of Recognition

He assumed that reserve growth would increase the number of large fields discovered in 1961, from 240 recognized fields to about 400 not yet recognized fields
Figure 8: Hubbert's estimate of large US discovered but not yet recognized oilfields

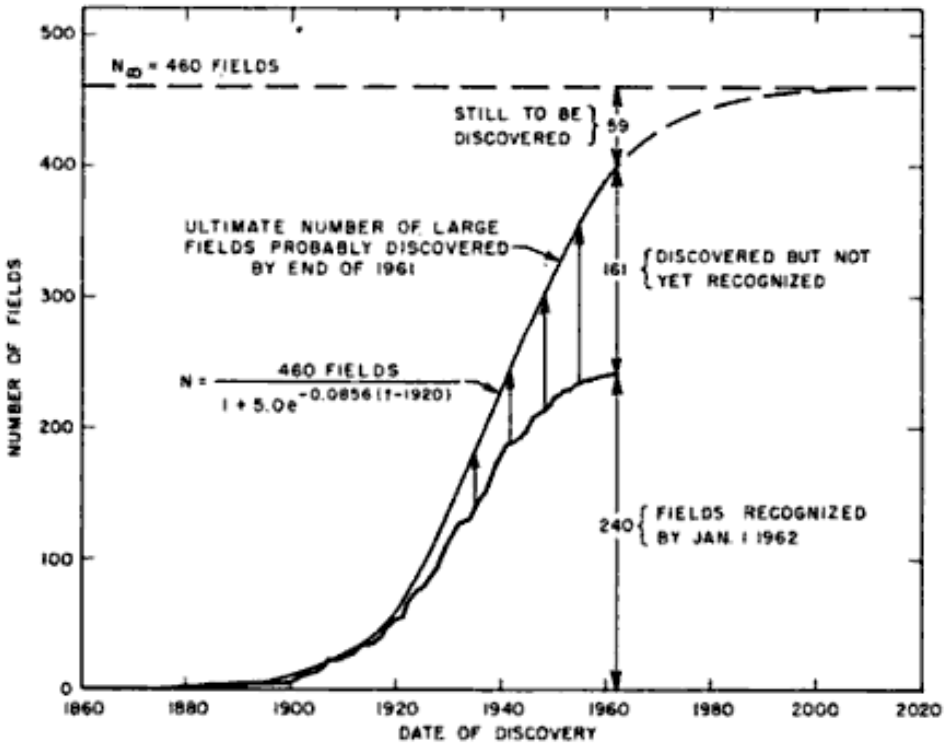


Figure 37. Cumulative Discoveries of Recognized and Probable U. S. Large Fields

Hubbert estimated the average size of large fields to be 250 Mb
Figure 9: average size of US large fields by discovery date 1871-1960

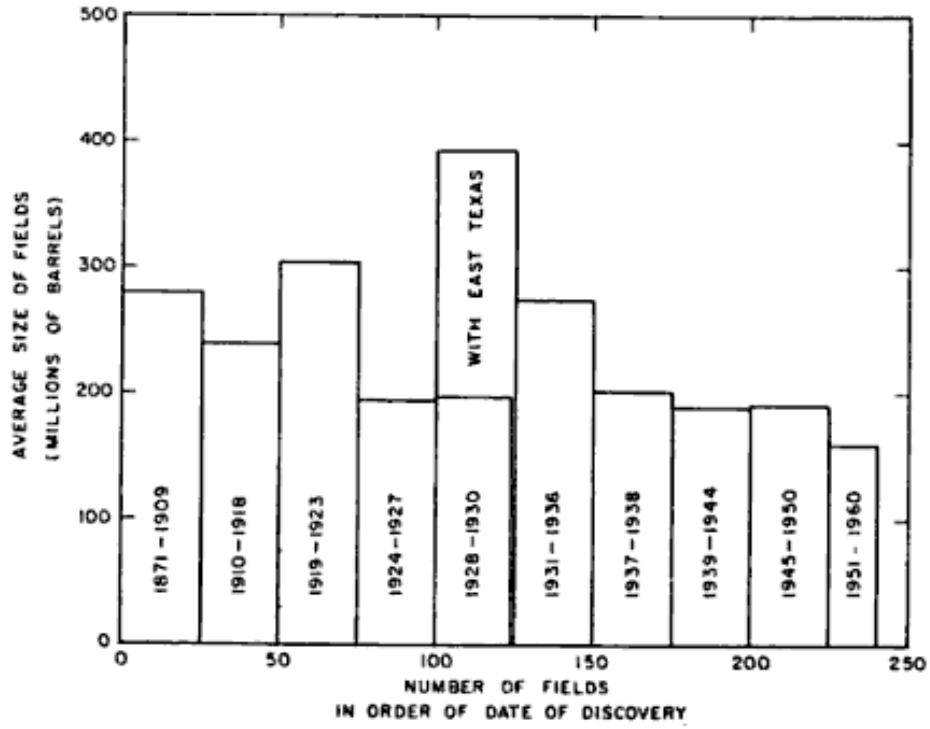
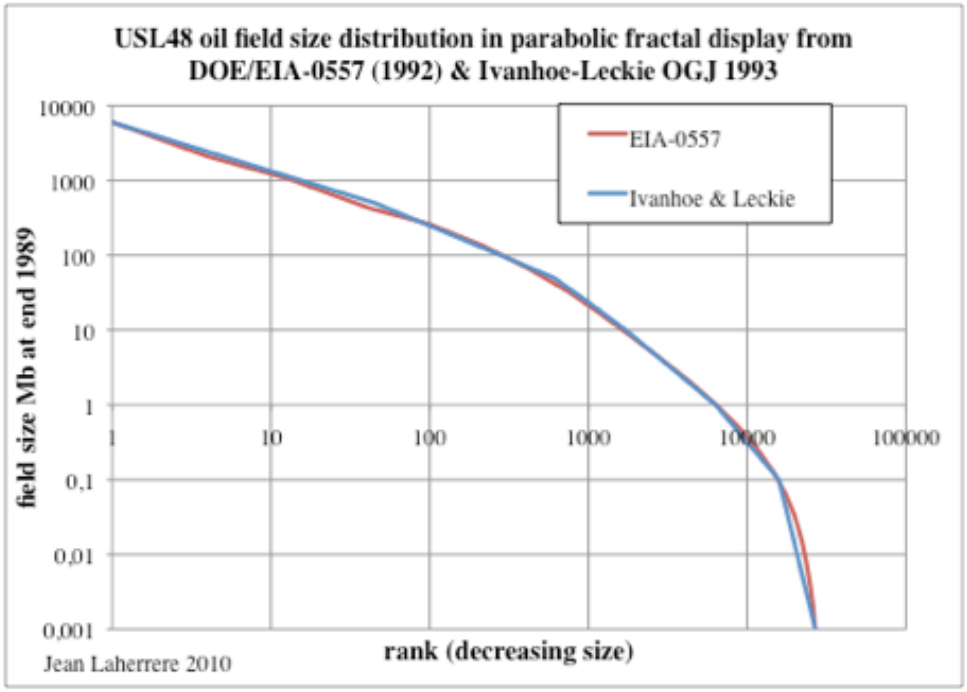


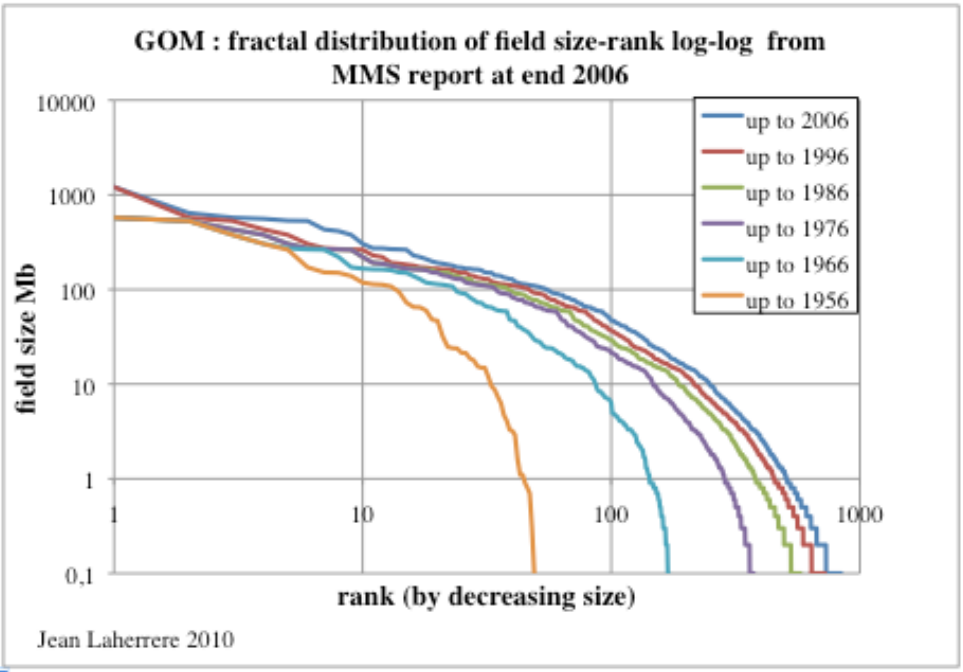
Figure 38. Average Size of Large Fields in the U. S. in Order of Dates of Discovery

So the large fields ultimate should be 460 times 250 Mb, or 113 Gb.
But L.F. Ivanhoe and G.G. Leckie, "Global Oil, Gas Fields, Sizes Tallied, Analyzed," Oil & Gas Journal, February 15, 1993, pp. 87-91 reports USDOE field sizes distribution at end 1989 with only 280 oilfields over 100 Mb. It means much less what Hubbert forecasted (450 in 1990). Hubbert's approach on number of large fields was thus unreliable.
The USDOE report 0557-1992 «Geologic distributions of US oil and gas« presents the same data but under a different size classification and allows to plot the field size distribution for US L48 (excluding Appalachian oilfields) at end 1989 in a fractal display. This 557 report states that cumulative discovery at end 1989 is 183 Gb for the all US and 167 Gb for USL48.
It is obvious that the fractal distribution is parabolic and not linear (= power law) as some claim!
Figure 10: USL48 oilfield distribution in parabolic fractal display from USDOE/EIA-0557



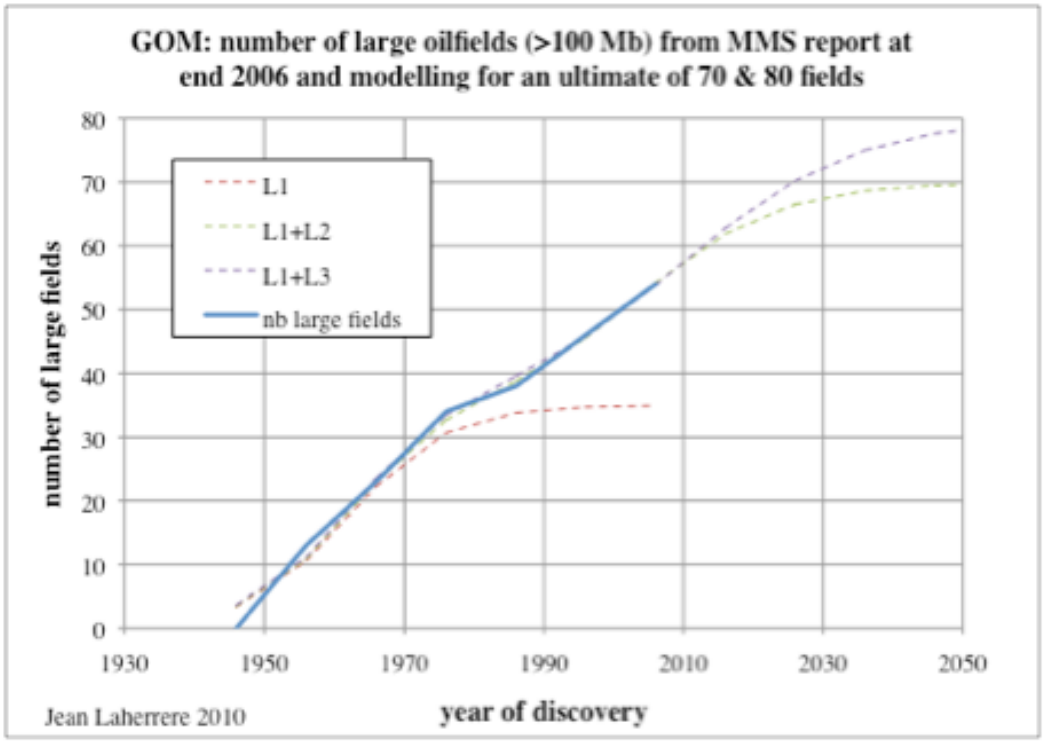
The GOM MMS report at end 2006 displays over 1200 fields and the fractal presentation for oilfields is also parabolic

Figure 11: Gulf of Mexico oilfield distribution in parabolic fractal display from MMS 2006



The number of large fields (>100 Mb) in the GOM is plotted every 10 years from 1947 to 2006 and modelled with two logistic curves (second cycle being the deepwater and subsalt) for an ultimate number of large fields of 70 & 80.

Figure 12: Golf of Mexico number of large oilfields & forecast to 70-80 fields



This ultimate from curve fitting shows that the number of **undiscovered** large fields in the GOM is about a range of 20 to 30 fields.
Hubbert's ultimate of 460 large fields looks optimistic! Furthermore, Hubbert was considering only conventional oilfields (excluding deep oceans without defining it except lack of technology to develop) and subsalt oilfields look more unconventional than conventional.

In 1967 in "Degree of Advancement of Petroleum Exploration in United States " AAPG vol 51 issue 11 Nov. 1967 Hubbert used the discoveries as function of exploratory footage to counter the study of Zapp (USGS) forecasting an ultimate of 590 Gb. He will update the same plot in 1977.
Figure 13: 1967 Hubbert's discovery per exploratory foot versus cumulative exploratory drilling

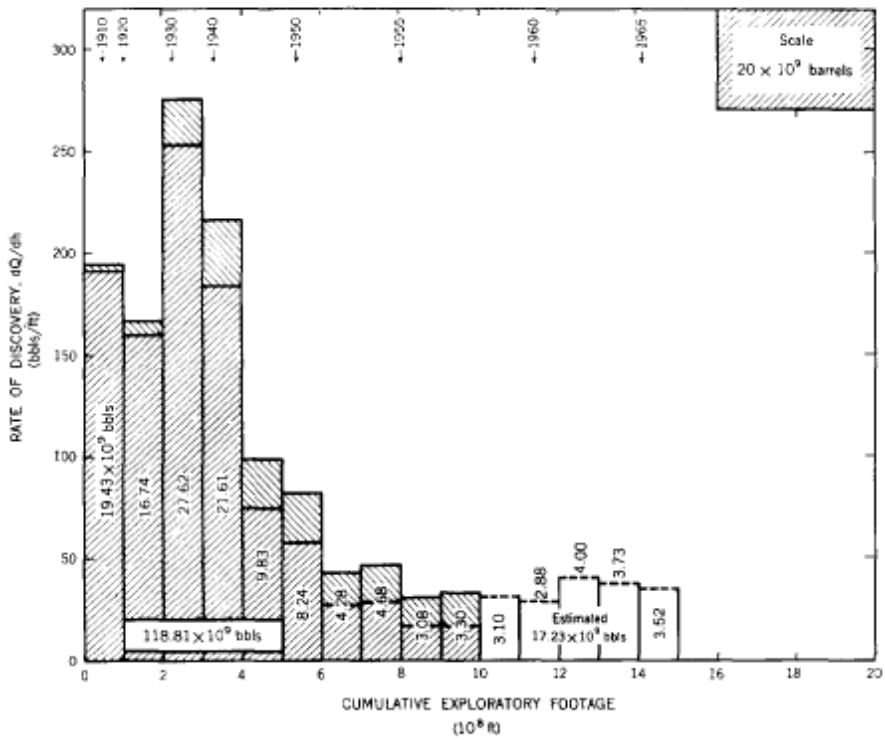


FIG. 15.—U. S. crude-oil discoveries per foot of exploratory hole, averaged for each 10^8 ft, *versus* cumulative exploratory drilling. For first 10 columns lower shaded area represents the Natl. Petroleum Council (1965) estimate as of January 1, 1964; upper shaded area represents oil added by correction-factor α. Last five columns are based on annual Am. Petroleum Inst. estimates of oil added by new discoveries, increased by factor 5.8.

In 1975 in an IIASA report "Methods and models for assessing energy resources" Hubbert fitted the annual USL48 proved discoveries with a derivative logistic curve
Figure 14: 1975 Hubbert's annual discovery modelled with a derivative logistic curve

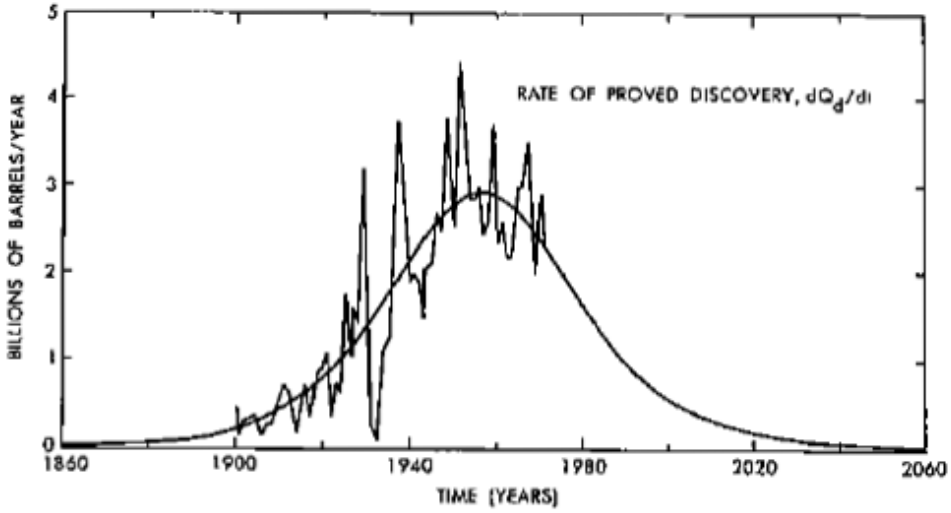


Figure 7. Comparison of annual proved discoveries of crude oil in the conterminous United States, 1900-1971, with corresponding theoretical curve derived from logistic equation (Hubbert, 1974, Figure 38).

The oil discovery peak is plotted around 1950 when it is well known that US discovery peak was about 1930 with East Texas, as shown by Hubbert in his 1962 graph for large fields

Hubbert reported that the National Petroleum Council study used backdated proved reserves at discovery peak, which confirms the discovery peak around 1930 and contradicts the peak from current proved reserves around 1950.

Another suite of data is provided by successive studies made by the Petroleum Administration for War and by the National Petroleum Council, in which the oil discovered has been allocated to the years of discovery of the producing fields. These, when corrected to an estimated ultimate growth, indicate that by the end of 1966 about 136 billion bbl of producible crude oil had been discovered. The rate of discovery per year, averaged for successive 5-year periods, reached a peak of 3.57 × 109 bbl/yr during the period 1935-1940, and has declined subsequently to a present rate of less than 2 × 109 bbl/yr.

In 1977 Hubbert stated "Twenty Years of United States Petroleum Estimates" AAPG v63 n°3:

In the meantime, successive estimates by the writer, based on analyses of publicly available petroleum-industry data, led consistently to about 165 to 175 billion bbl as the ultimate amount of crude oil, and 1,000 to 1,100 Tcf for natural gas, with the crude oil production peak due to occur during 1967-70, and that of natural gas in the mid-1970s. These estimates were predictions of the future, and that future has now elapsed. The peak of crude oil production was reached in 1970 and that of natural gas in 1973. By the end of 1972, the evidence was consistent with ***170 billion bbl for the ultimate amount of crude oil*** *and 1,000 to 1,100 Tcf for natural gas.* ***However, since 1972 proved reserves and discovery and production rates of both oil and gas have been declining more rapidly than originally estimated. Should this continue, the ultimate quantities of oil and gas may be less than those estimated in 1972.***

Hubbert failed to anticipate the discovery boom of the Gulf of Mexico!

Hubbert's graph in 1977 (role of geology) of US discovery in b/ft is too pessimistic (updating the 1967 plot of figure 13) unable to foresee deepwater (or thinking that it is unconventional), when Zapp is unrealistic with a constant discovery of 118 b/ft

Figure 15: 1977 Hubbert's oil discovery per foot of exploratory drilling

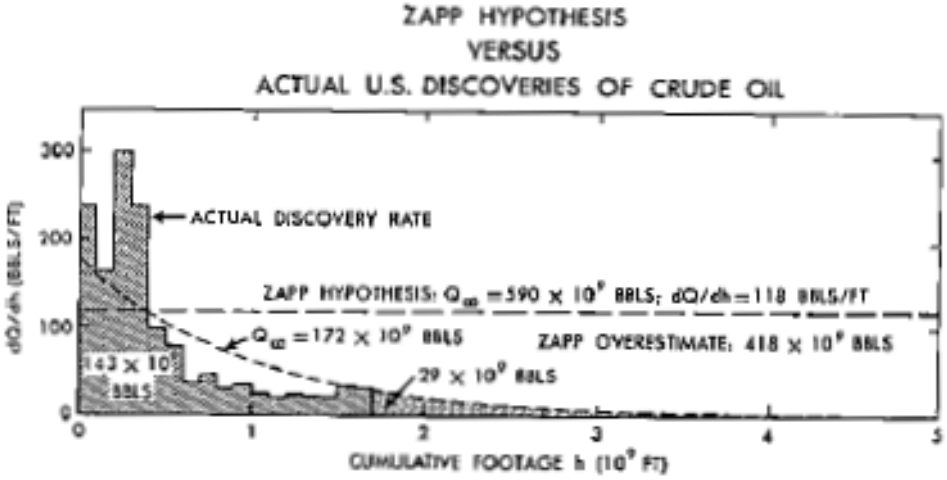
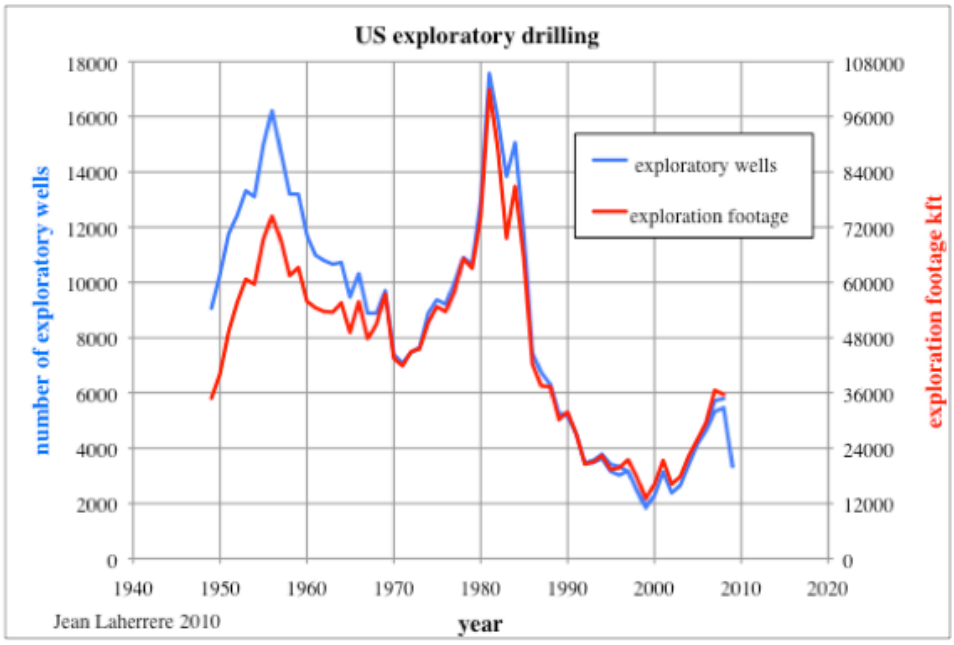


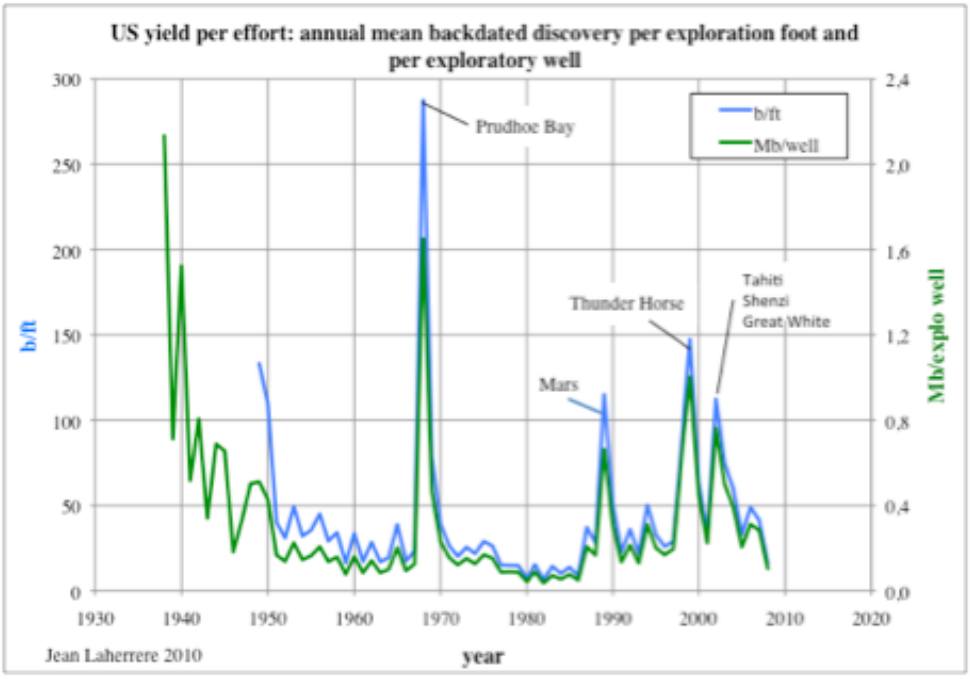
Fig. 11. U.S. crude-oil discoveries per foot of exploratory drilling versus cumulative depth of drilling (Hubbert, 1974, Fig. 50).

But present data on US exploratory drilling shows several cycles and when will be the next?

Figure 16: US exploratory drilling 1949-2009



The US yield per effort displays also several cycles difficult to foresee
Figure 17: US annual mean backdated discovery per exploratory foot and per exploratory well



The data for the USL48 is not available to plot discovery in b/ft, but Alaska discovery is mainly shown with a spike by the Prudhoe Bay discovery of 1968. To compare with Hubbert's plot in figure 15, Prudhoe Bay has to be eliminated. Hubbert did not foresee this 1986 offshore success or simply ignored it by deeming it unconventional

In 1981 « The world's evolving energy system » Hubbert USL48 ultimate estimate was 170 Gb. It is the last Hubbert graphs on USL48.
Figure 18: last Hubbert forecast in 1981 for an USL48 ultimate of 170 Gb

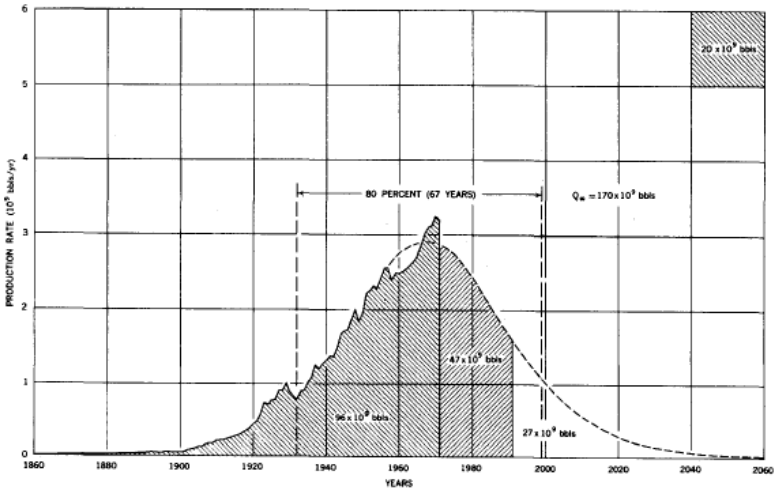
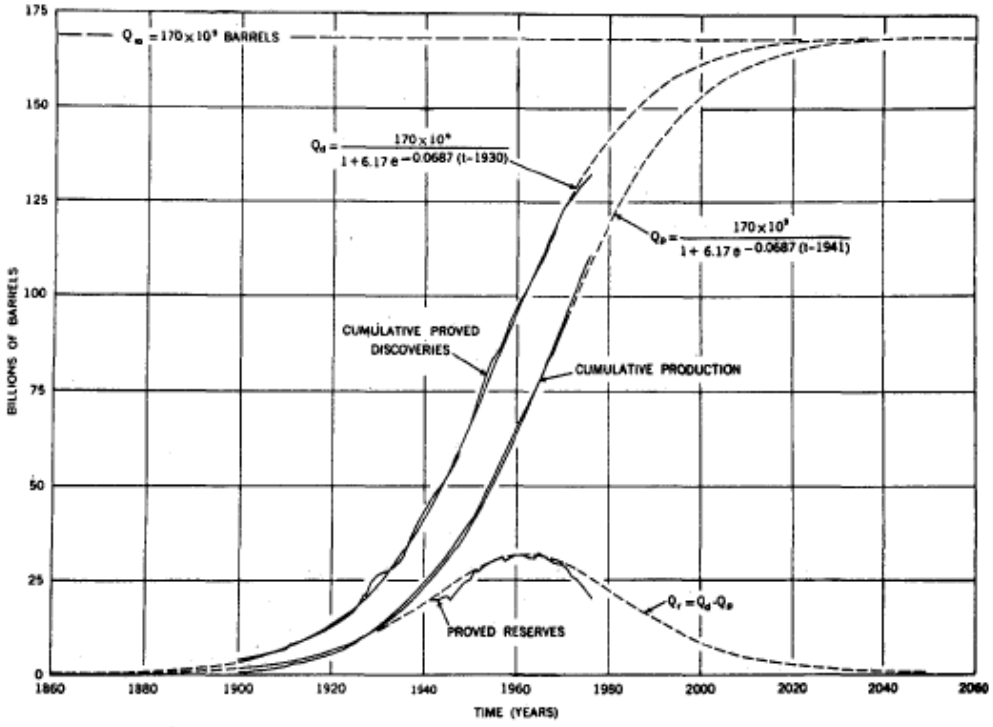


Fig. 26. Estimated complete cycle of crude-oil production from lower-48 states, based upon data to the end of 1971 (Ref. 6, Fig. 51).

After US production peaked in 1970, Hubbert's approach was well recognized, but however he kept only one estimate for the USL48 well below 200 Gb (170 Gb in Hubbert's 1981 last paper).

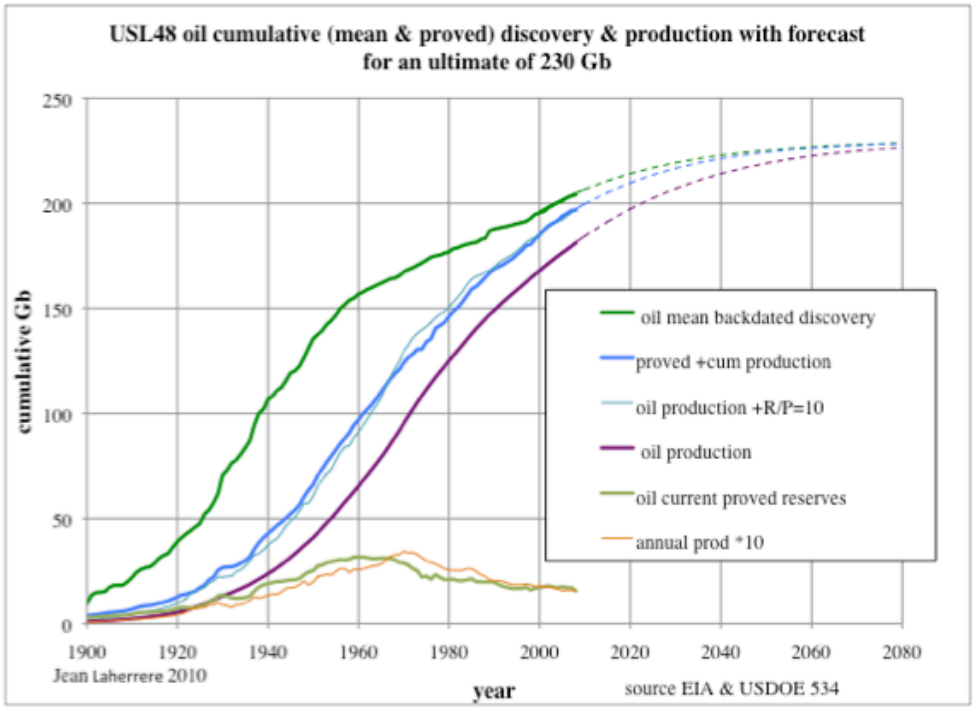
In 1988 Hubbert was interviewed by Steve Andrews:
« *In 1978, I got a telephone call from Houston. 'You wrote this report in 1956. How about writing an update report for the API meeting?' I made an oral presentation; I didn't have enough time to submit a paper. I reviewed historically and made a new estimate [for the lower-48 onshore]. My data was 163 BB; the data would allow no exception—it was the best I could do, but I thought it was too low…It will be more than 170, but not a hell of a lot more. It could be 180. I'm going to go back and re-examine the data; I'll try to see if I can find out what went wrong…* »
The last graph from Hubbert was in 1981, using an ultimate of 170 Gb with 96 Gb already produced at end 1971, 47 Gb proved value and 27 Gb (undiscovered or probable).
The US oil peak occurred in 1970 at 3.2 Gb, but the 1956 forecast curve was a peak in 1970 at only 3 Gb (for 200 Gb), when the 1981 forecast was a peak was at 2.8 Gb in 1970 for 170 Gb!
Figure 19: last Hubbert plot of USL48 cumulative oil discovery & production for an ultimate of 170 Gb



Hubbert was wrongly using proved reserves (because it was the only one available due to SEC rules) despite it being well known that they do not represent the reality, showing discovery peaking in the 1950s when it was in the 1930s!

As shown in figure 5, extrapolation of production data trends towards 230 Gb with recent deepwater discovery and the cumulative oil mean (proven + probable) backdated discovery trends also towards 230 Gb. The mean discovery is completely different from the financial SEC proved remaining reserves (which must be added to cumulative production to get initial reserves). It should be noticed that the so-called proved reserves are close to ten times the annual production, because in Texas this rule of thumb is used to estimate reserves (it is also the way that notaries estimate the value of a building by multiplying the annual rent by ten)

Figure 20: USL48 cumulative oil discovery & production for an ultimate of 230 Gb



It is strange to see Hubbert believing in 1981 that the USL48 ultimate is 170 Gb when his success of the 1970 peak was based on a 200 Gb ultimate.
In 1981 USDO1/Geological Survey circular 860 « Estimates of undiscovered recoverable conventional resources of oil and gas in the United States » estimated the following:

Gb	produced	remaining	undiscovered	ultimate
US	120.7	54.8	82.6 2	257
USL48	118.9	40.7	63.5	223

In 1981 USGS was better than Hubbert in USL48 oil ultimate forecast, in contrary to 1956 when USGS ultimate was 590 Gb

In 1982 Hubbert stated that *the discoveries per foot of exploratory drilling have continuously declined from an initial rate of about 200 barrels per foot to a present rate of only 8 barrels per foot*
Hubbert was too pessimistic about the US offshore potential (over 100 b/ft around 2000 and 1990), maybe because he was excluding the deepwater!
A good way is to study the range of estimates from several independent studies, like Bowden did in 1982 and 1985. The unrealistic estimates of Zapp, at 600 Gb, were quickly reduced to a more realistic 250 Gb
Figure 21: USL48 ultimate US oil ultimates by Bowden 1985

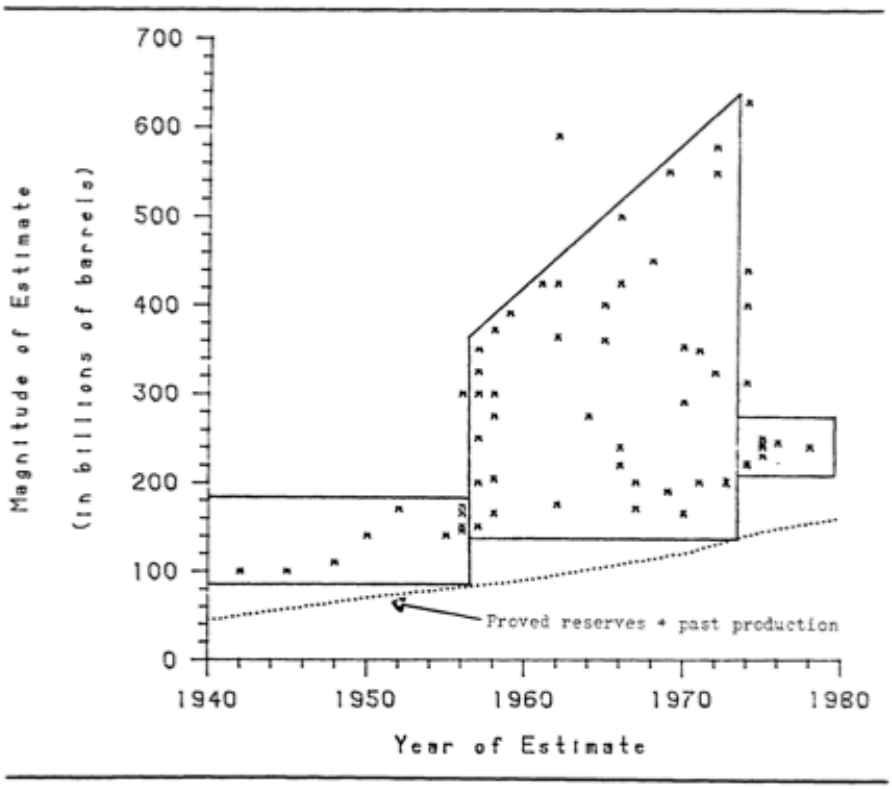
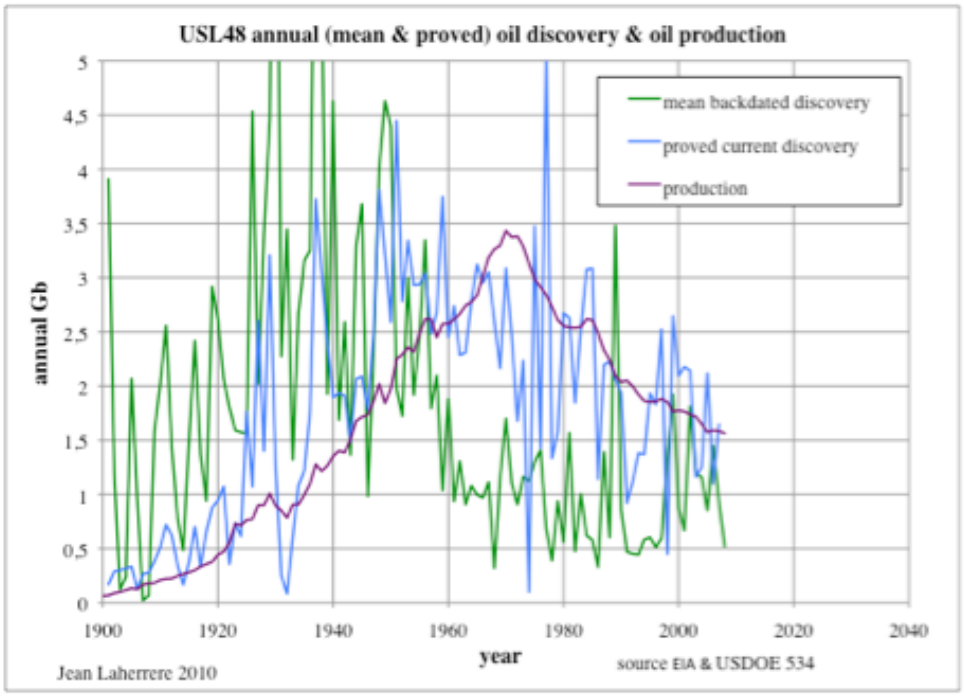


Figure 1: Historical Periods in the Estimation of U.S. Crude Oil Resources

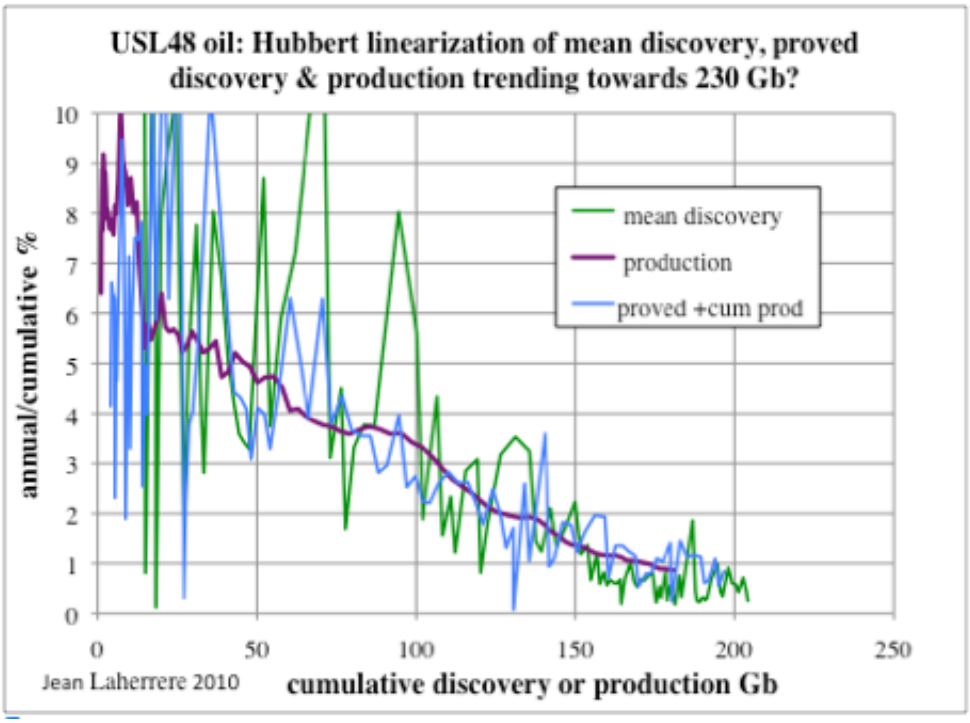
My forecast for USL48 is 230 Gb, using the backdated “mean” values (USDOE/EIA-0534 1990 "US oil and gas reserves by year of field discovery" Aug. Open file and EIA annual reports) shows that the lag between discovery and production is then about 30 years (only 10 years with Hubbert). The use of proved reserves by Hubbert (only available data because of the SEC rules) has completely disturbed his view on the US ultimate.

Annual discovery peaks around 1930 using the backdated mean (2P) data and not the financial current proved (1P) reserves.

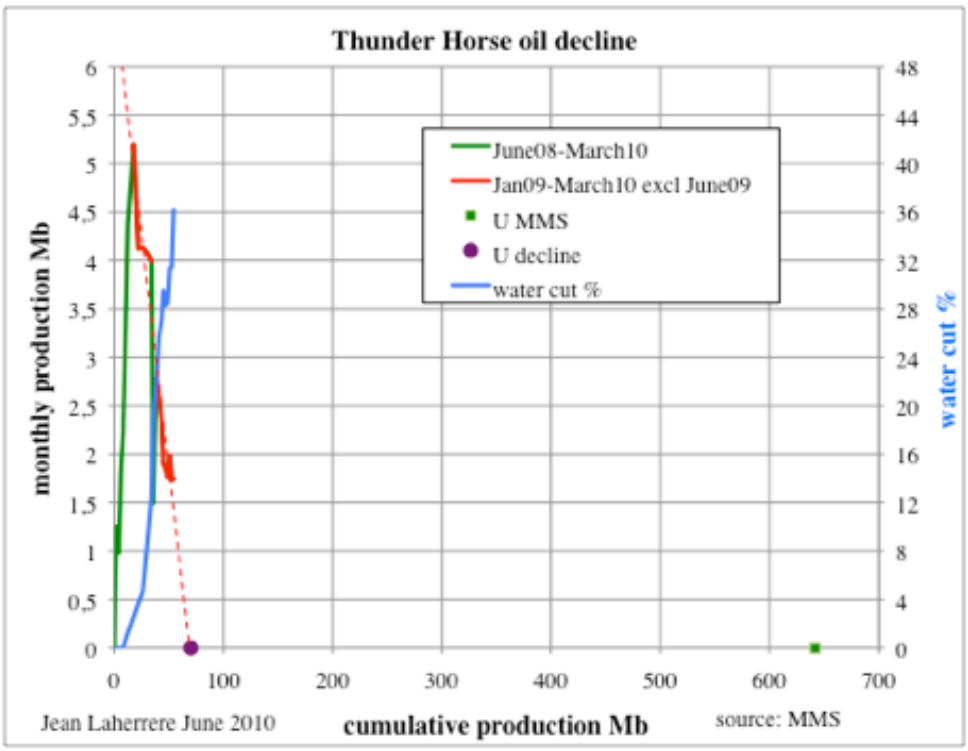
Figure 22: USL48 annual oil discovery and production 1900-2008



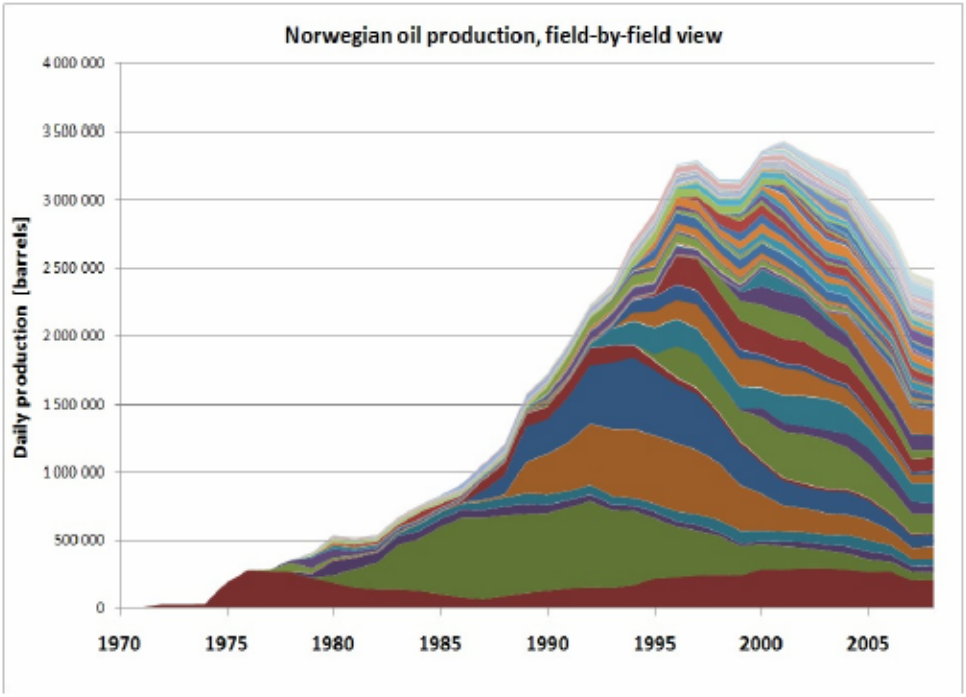
The Hubbert linearization of the 2P and 1P discovery and production is difficult to extrapolate because the last data is flattening, approaching the zero axis.
Figure 23: USL48 oil Hubbert linearization from discovery (2P and 1P) and production 1900-2008



But the mean backdated discovery data could be overestimated for deepwater. The deepwater Thunder Horse field in the Gulf of Mexico, discovered in 1999, is reported by MMS as having 650 Mb (800 Mb in my database) but the production (from 4 wells) has peaked in less than one year and the decline is 60% per year, with the water cut shooting from 4% to 31%. If this decline prevails, the reserves would be about 70 Mb (but likely more wells will be drilled) and not ten times more!
Figure 24: Thunder Horse (largest? oilfield in the Gulf of Mexico) oil decline



In 1956, Hubbert was only saying that the production curve starts from zero, goes to a peak and ends at zero, the only equation was that the area below the complete production curve represents the ultimate reserves (reserves = recoverable resources) and there may be an infinite number of curves corresponding to this ultimate.
Hubbert's 1956 paper displays several forecasts with unsymmetrical curves, but US crude oil forecast was symmetrical and most people believe that Hubbert curve is symmetrical with the peak at mid-point. There is no reason for symmetry, because individual field production is unsymmetrical: rising quickly to a plateau followed by a slow decline. But adding many unsymmetrical fields production can be grossly symmetrical as explained by R.W. Bentley "An Explanation of Oil Peaking" December 2009
Figure 25: Norway oil production from Bentley (2009)



There is another reason for symmetry as it is displayed in the USL48 oil production where there are more than 20 000 companies producing oil and gas, whereas there are very few or even only one (Aramco) in countries in the rest of the world. With over 20 000 operators the law of large number occurs because most companies behave independently and randomness rules (Gaussian law) except when all operators are pushed to act in the same way: recession in 1930, proration in 1960 and high price in 1980: this is why the USL48 oil production is roughly symmetrical from 1900 to 1990. What is unexplained is why the two shoulders of 1960 and 1980, due to completely different reasons, are at the same level of 2.6 Gb/a!
Alaska oil production is unsymmetrical because fewer fields and fewer operators. All OPEC oil production constrained by quotas and politics is obvious chaotic and unsymmetrical.
But as shown in figure 3, USL48 crude oil production started to be unsymmetrical in 1990 because of the deepwater production with few fields and few operators.

-**Hubbert other forecasts**

-**world crude oil forecast**

In 1956 Hubbert forecasted a peak of the world crude oil production (excluding unconventional) around 2000 at 13 Gb for an ultimate of 1250 Gb, but in 1981 he forecasted a peak around 1995 at 37 Gb for an ultimate of 2000 Gb. In fact the world crude oil production in 2000 was 25 Gb!
Figure 26: Hubbert world crude oil forecasts

In 1956

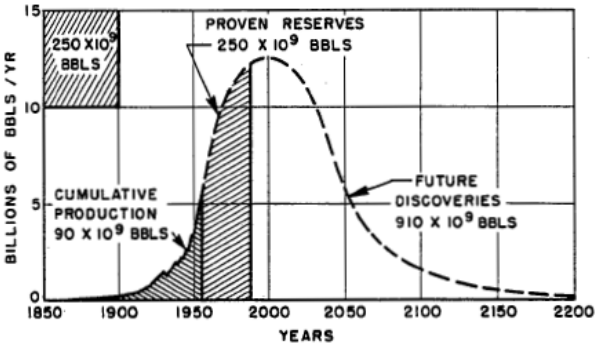


Figure 20 – Ultimate world crude-oil production based upon initial reserves of 1250 billion barrels.

in 1981

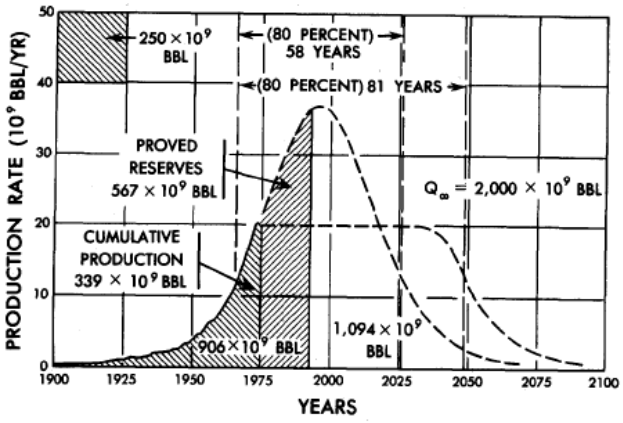
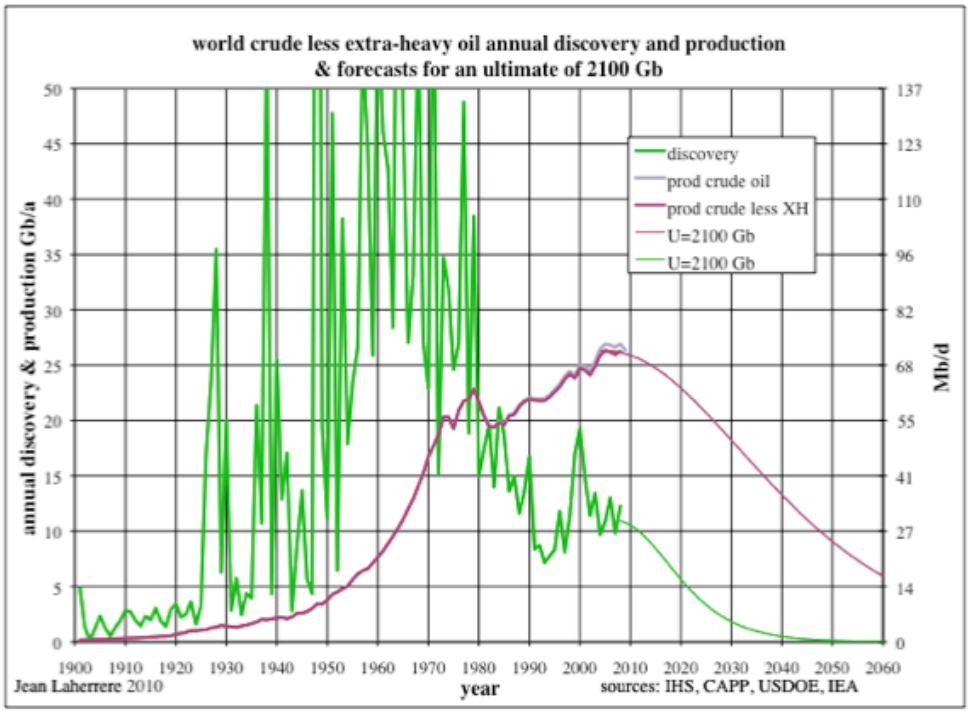
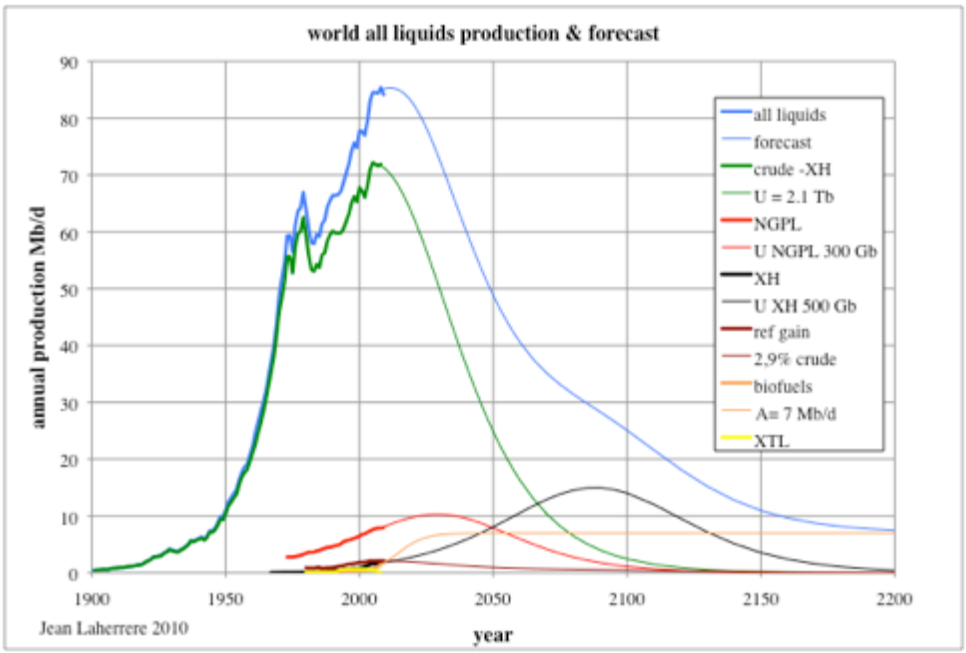


Figure 27: world crude less extra-heavy oil discovery & production for an ultimate of 2100 Gb



But the oil demand includes in addition to crude oil, natural gas liquids, refinery gains and XTL (X to liquids X being C coal, G gas, B biomass including biofuels, S shale). In order to answer when the oil demand will not been be met by oil supply, it must include all liquids.
The following model includes crude less XH oil with an ultimate of 2100 Gb, XH with an ultimate of 500 Gb, natural gas plants liquids with an ultimate of 300 Gb, refinery gain being 2.9% of the crude less XH oil production, and biofuels being renewable having an asymptote of 7 Mb/d. The XTL are assumed to be less than the accuracy of the oil supply (actually 2 Mb/d between USDOE/EIA and IEA values)
Figure 28: world all liquids production and forecast for an ultimate of 3 Tb + biofuels asymptote at 7 Mb/d, assuming no above ground constraint



-**Hubbert 1956 US natural gas forecast**

Hubbert forecasted USL48 conventional natural gas production peaking around 1970 for an ultimate of 850 Tcf

Figure 29: Hubbert's 1956 forecast for USL48 natural gas production for an ultimate of 850 Tcf

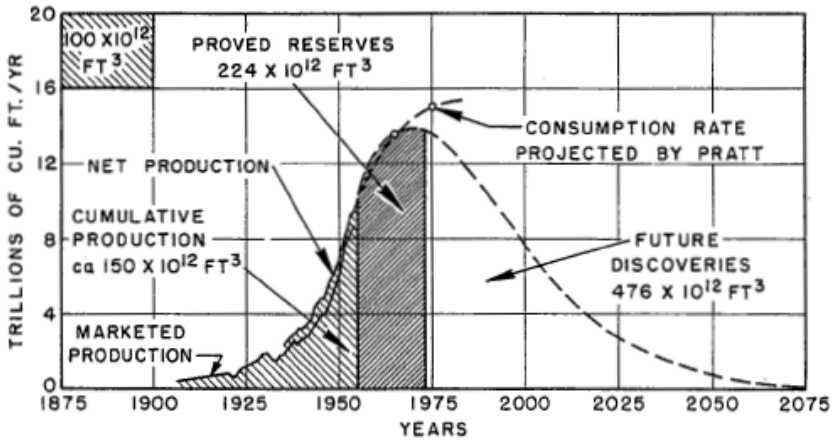


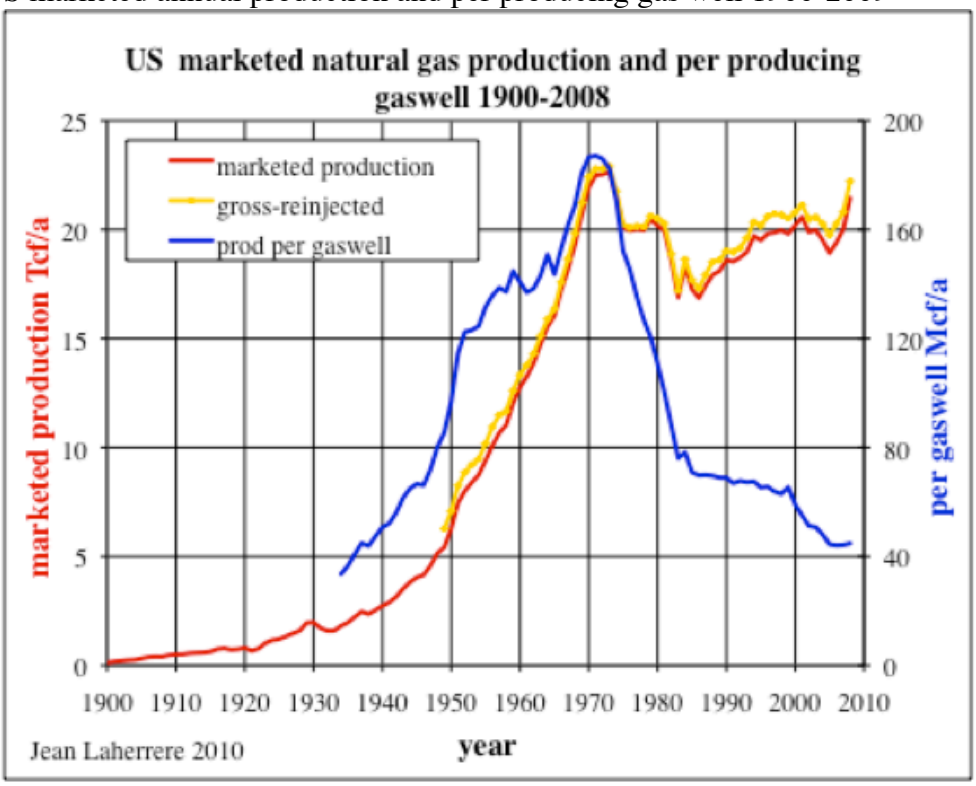
Figure 22 – Ultimate United States production of natural gas based upon initial reserves of 850 trillion cubic feet (~~after~~ Pratt, 1956)

Hubbert was right about the peak date about 1970, but he was completely wrong on the volume of the peak: it was 23 Tcf instead of 14 Tcf. His forecast for 2000 production was 8 Tcf, when in reality it was 20 Tcf!

The large gas reserves in Alaska are still unproduced by lack of gas pipeline.

The US marketed natural gas production did peak around 1970, but its decline is not at all what Hubbert had forecasted, it is the production per producing gas well which declined sharply after 1970. Heavy drilling has sustained the production.

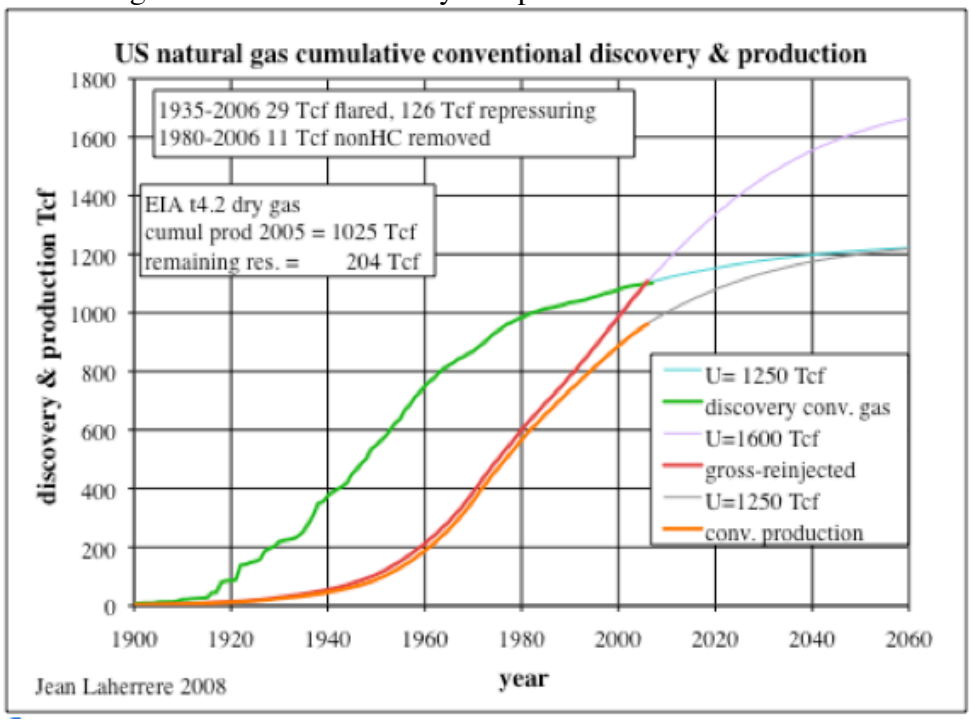
Figure 30: US marketed annual production and per producing gas well 1900-2009



The likely US conventional natural gas ultimate is 1250 Tcf. The large volume of reported gas shale represents resources in the ground and the amount of reserves depends on many factors: price, cost, pollution of shallow aquifers. Historical production data is just few years and the life of most wells

could be between a few years and 50 years as claimed by promoters. The US NG ultimate could be over 1600 Tcf!

Figure 31: US natural gas cumulative discovery and production



-**Hubbert world coal forecast**

Hubbert' 1956 forecast for an ultimate of 2600 Gt is a peak in 2150 at 6.2 Gt/a

Figure 32: Hubbert's 1956 world coal production for an ultimate of 2600 Gt

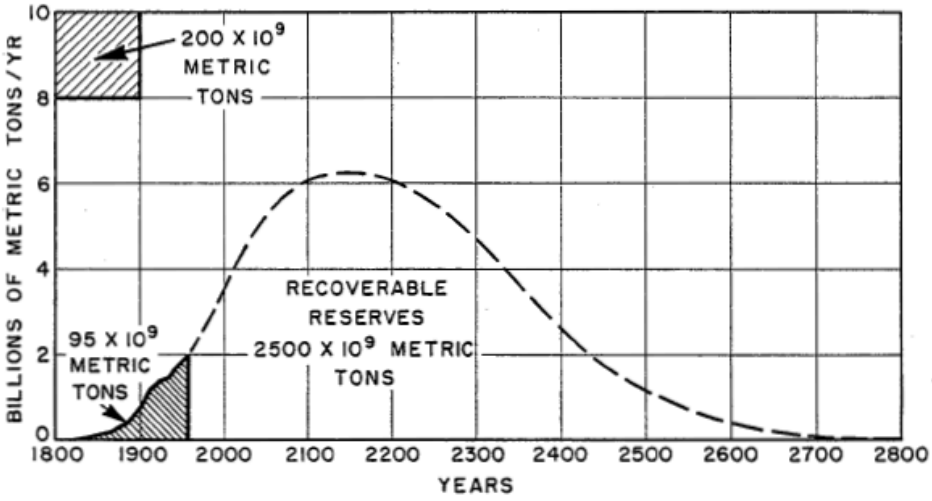
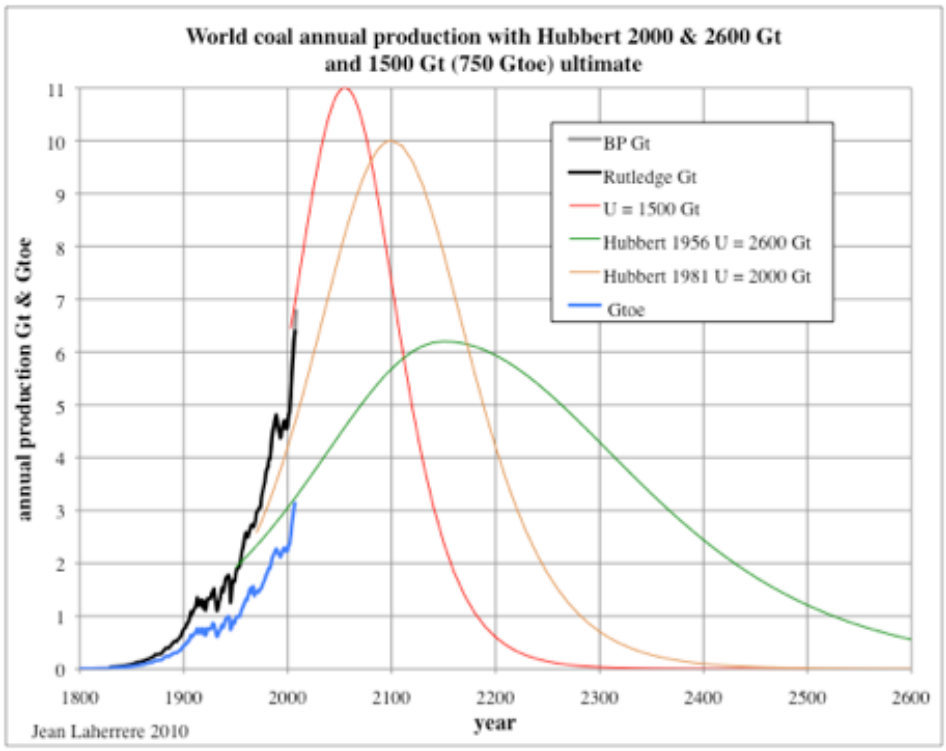


Figure 18 – Ultimate world coal production. The shape of the curve is variable but subject to the condition that the area under the curve cannot exceed thirteen squares.

Hubbert diminished world coal ultimate to 2400 Gt in 1962 and to 2000 Gt in 1981!

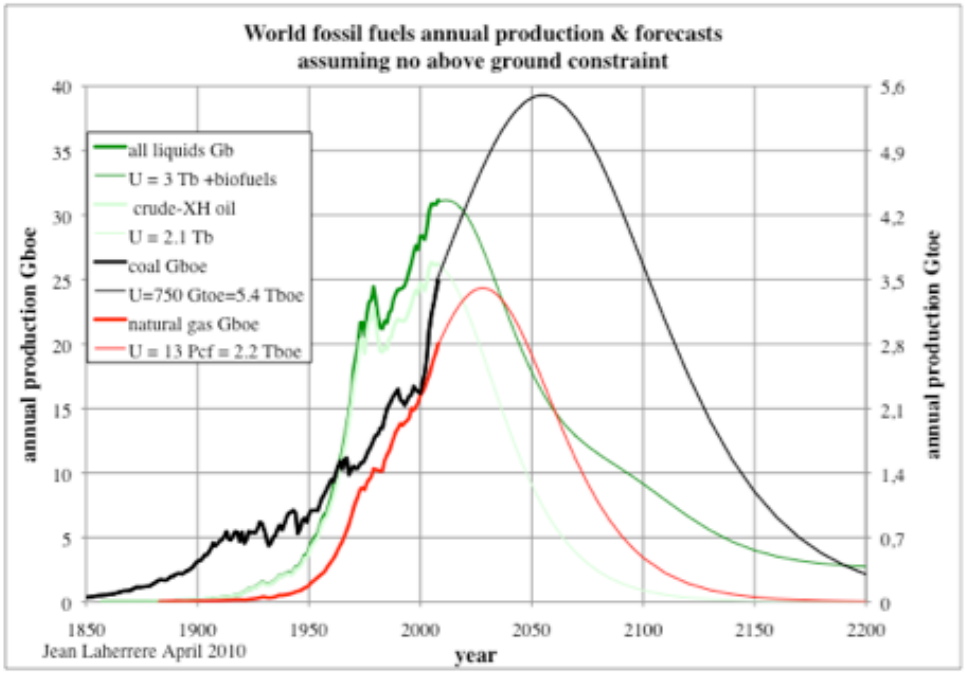
Hubbert's forecast for 2008 was 3.3 Gt in 1956, but 4.7 Gt in 1981, when real production is 6,8 Gt!

Figure 33: world coal production for ultimates Hubbert 2600 Gt 1956, 2000 Gt 1981 and mine 1500 Gt



My forecasts for liquids (U= 3 Tb +7 Mb/d biofuels), natural gas (U= 13 Pcf) and coal (U= 750 Gtoe) shows that coal will return in the first place around 2020

Figure 34: world fossil fuels annual production & forecasts (assuming no above ground constraint)

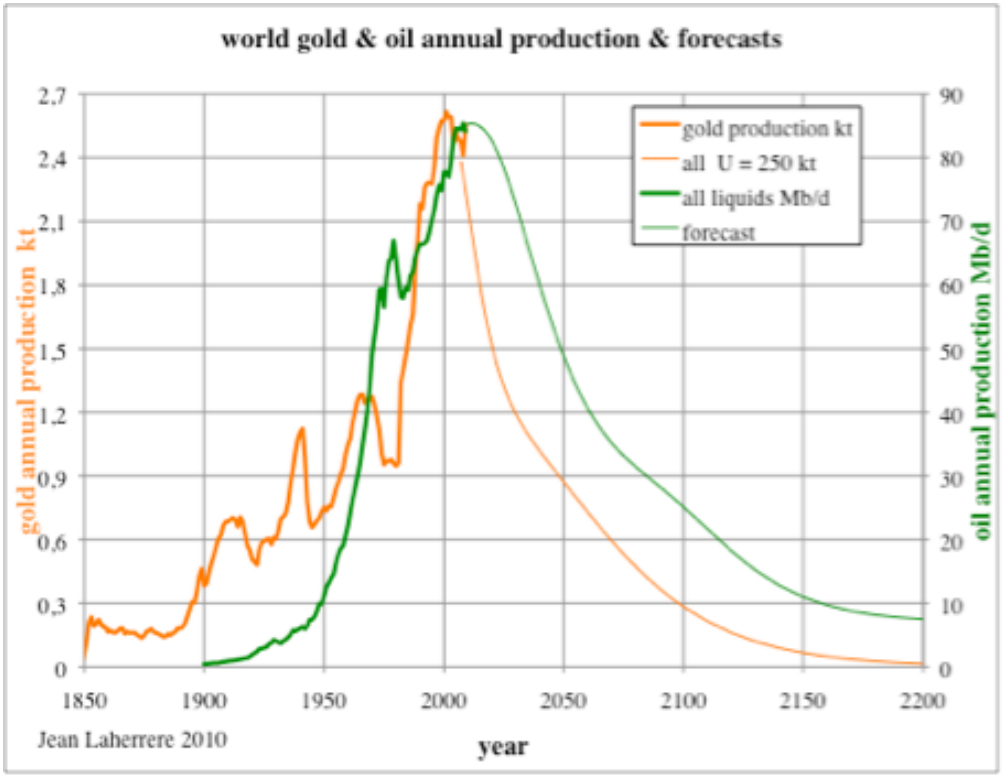


-gold, silver & copper peaks

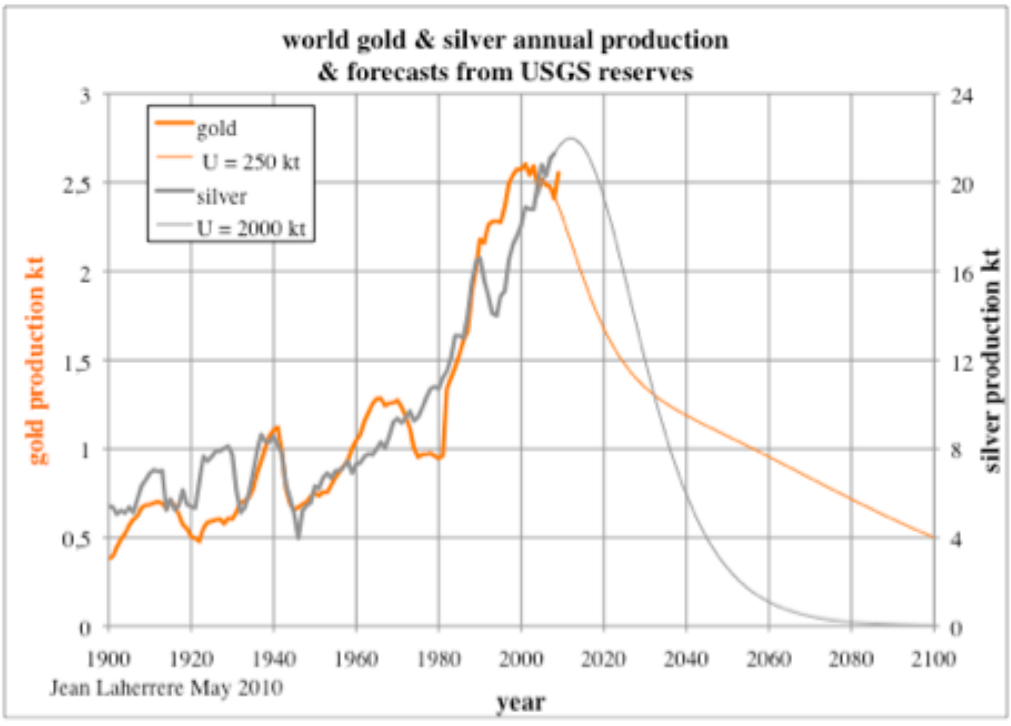
The display of gold production & forecast for an ultimate of 250 kt is compared to oil (liquids) production.

It is amazing to find that gold and oil = black gold are peaking in our present decade, and their decline look parallel, in contrary to their rise where gold started millennia before!

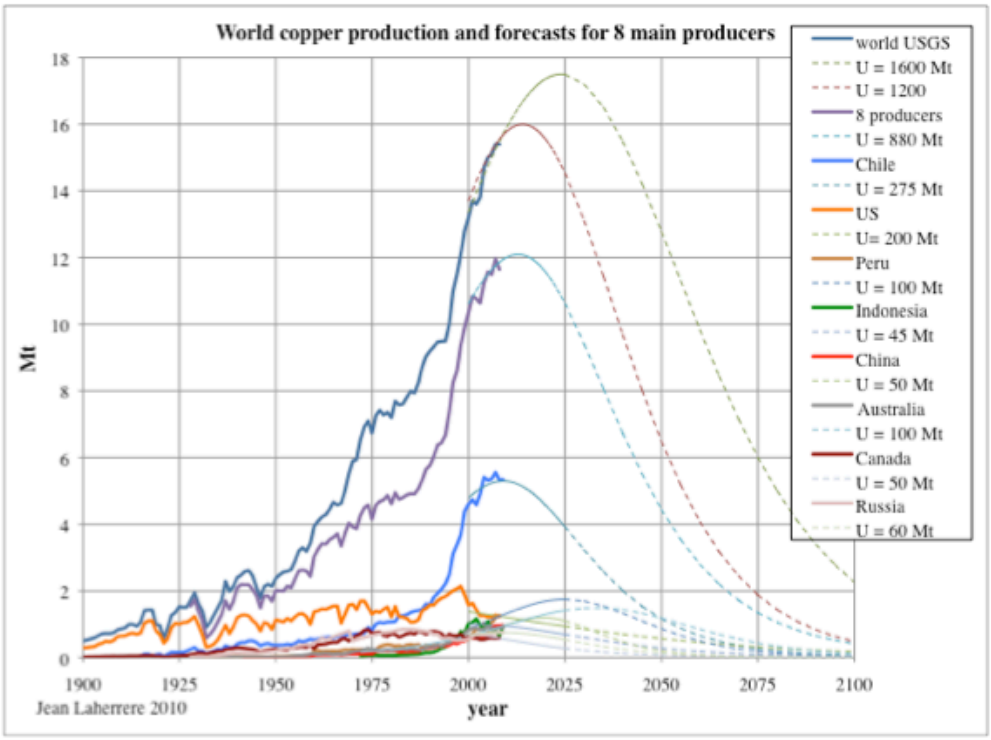
Figure 35: gold and oil (liquids) production & forecasts 1800-2200



Gold and silver production had similar rise and likely similar decline for the next two decades.
Figure 36: world gold & silver annual production



The world copper production will peak in the 20s, with Chile being the largest producer peaking in the 2010s
Figure 37: world copper annual production & forecasts for 8 main producers 1900-2100

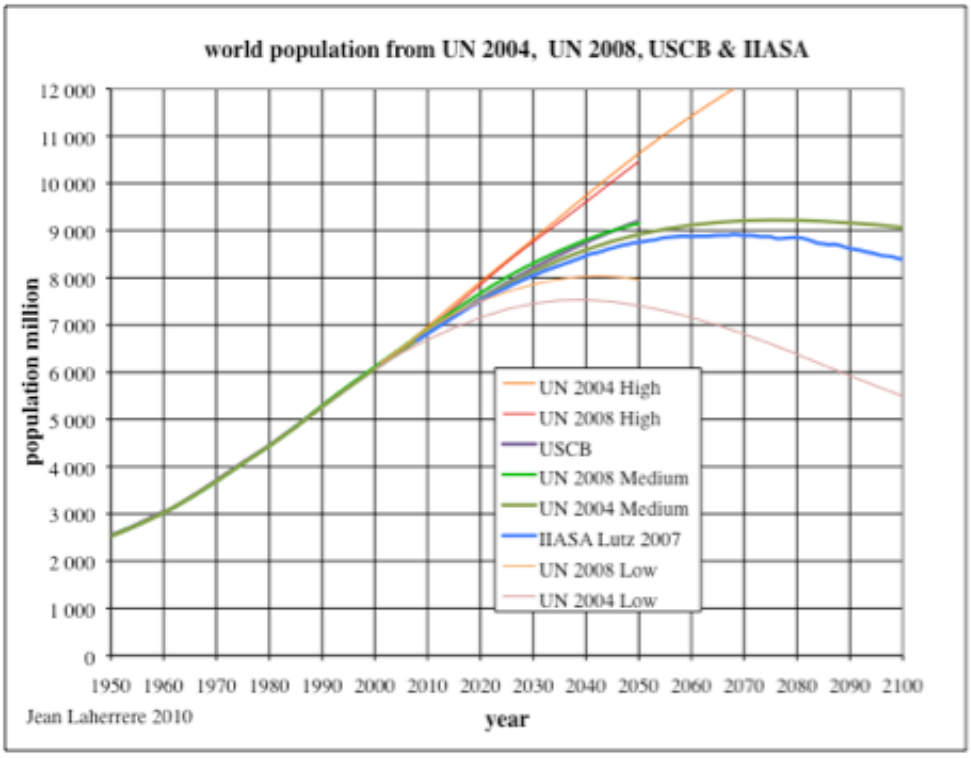


-**Population peak**

-**world population**

There are very few world population recent forecasts (UN 2008, USCB 2008, IIASA 2007), but a world population peak is forecasted around 2065.

Figure 38: world population forecasts from UN 2004, UN 2008, USCB & IIASA

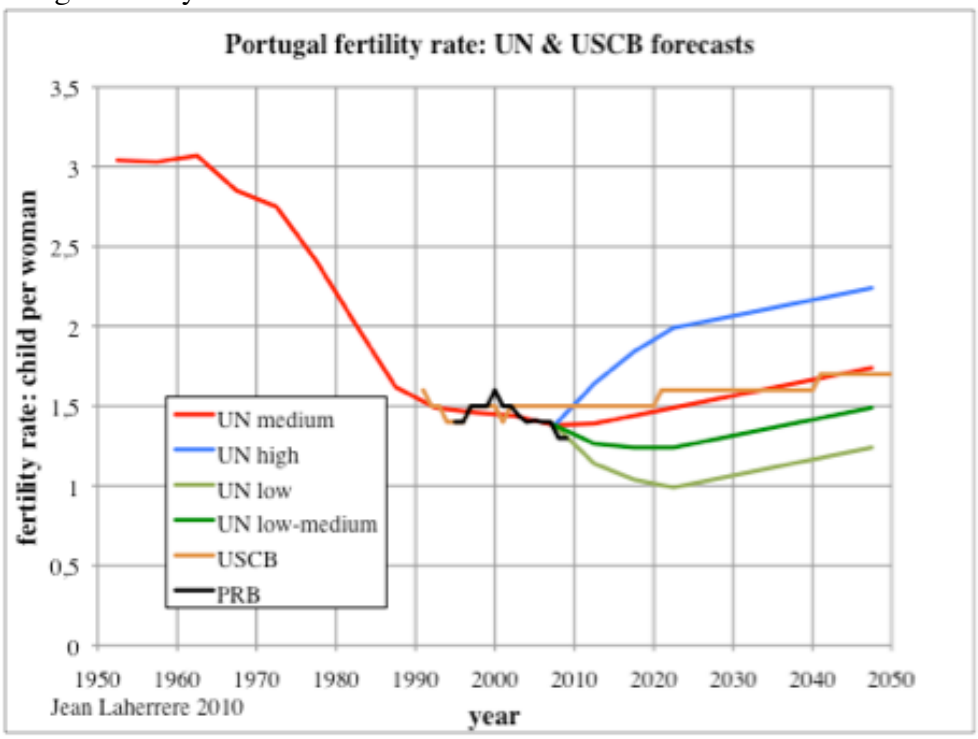


-**Portugal population**

Population UN forecasts are based on fertility rate utopian assumptions, dreaming of a long-term uniform replacement rate (2.1)!

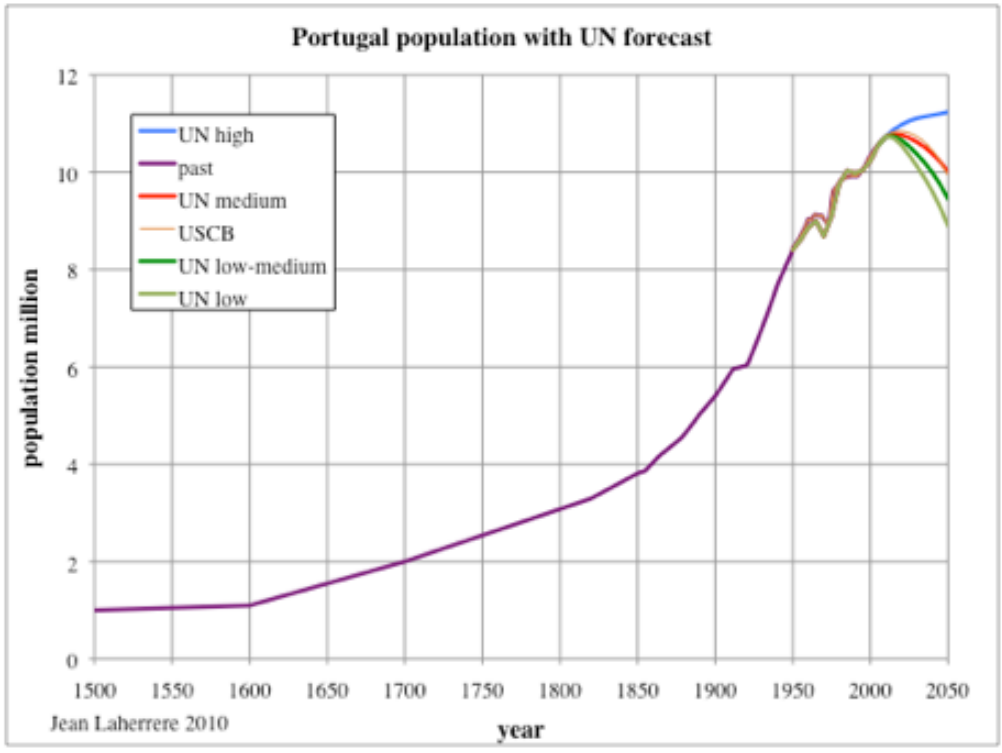
Portugal fertility rate has declined to 1.3 child per woman. UN medium variant forecasts 1.74 in 2050, when low variant is 1.24

Figure 39: Portugal fertility rate & forecasts from UN & USCB



Portugal population best forecast seems to be the low-medium scenario with a peak in 2015

Figure 40: Portugal population forecasts from UN & USCB

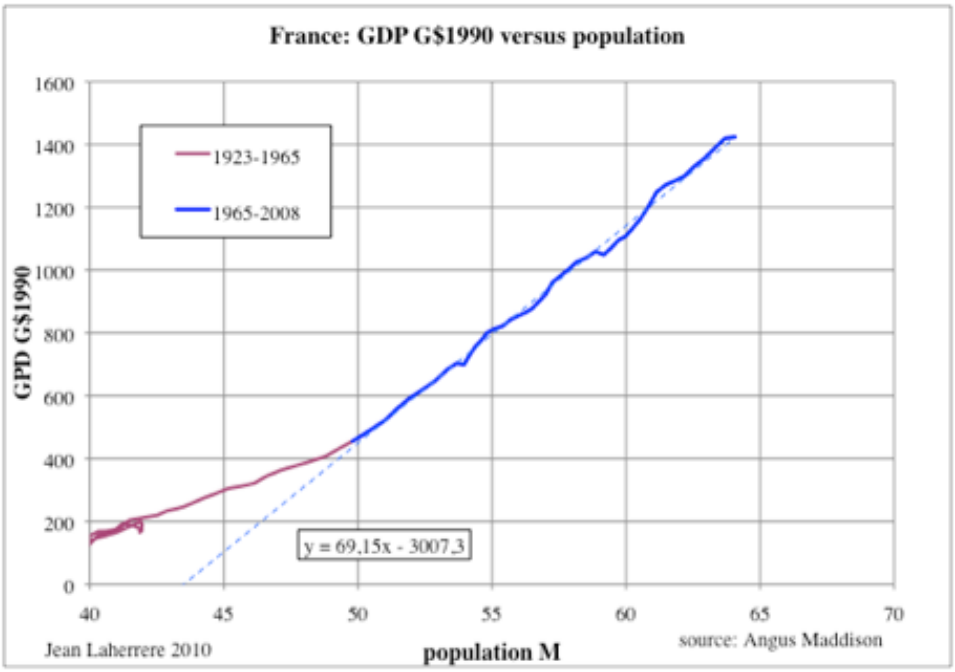


-Population and GDP

Politicians are judged on the growth of GDP. But GDP represents expenditures and not wealth of the country. GPD is completely different than the well-being (or happiness) of the people, but there is no world consensus on the definition for well-being!

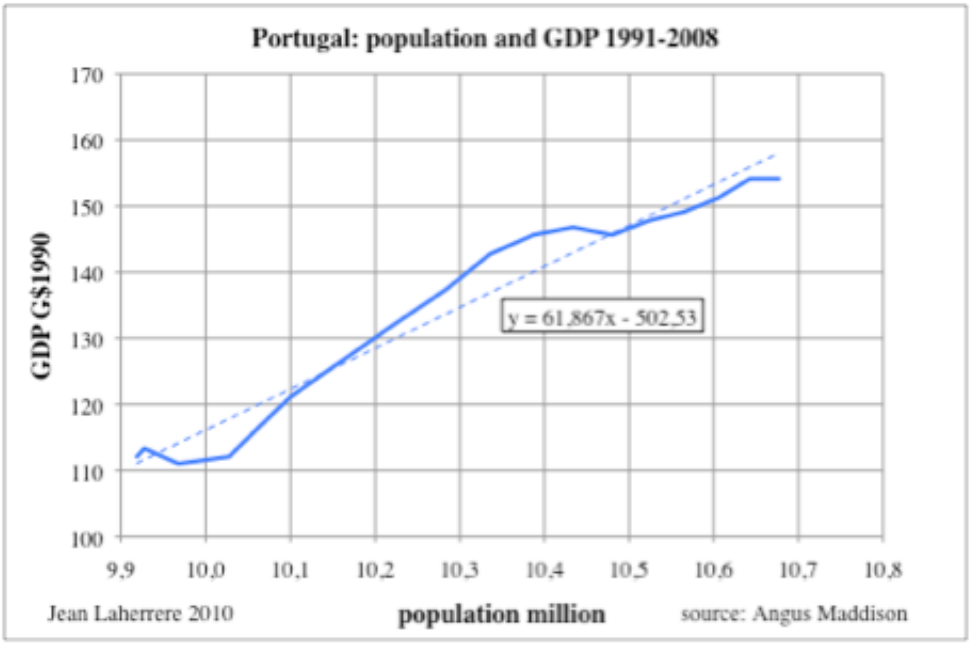
It is interesting to find that the plot of GDP versus population displays a linear trend for France, which is surprisingly the same slope as the US slope for the period 1980-2008.

Figure 41: France GPD versus population



The Portugal plot for the 1991-2008 period gives a close value with France and US.

Figure 42: Portugal GPD versus population



The comparison of the last linear trend of GDP increase per capita in k$2008 is as follows

Country	linear period	k$2008/capita
India	1992-2008	11
Brazil	1965-2008	12
world	1995-2008	27
Chile	1985-2008	53
Portugal	1993-2008	95
Australia	1990-2008	95
France	1965-2008	104
US	1980-2008	104
China	2000-2008	114

Canada	1992-2008	117
Holland	1982-2008	131
Switzerland	1995-2008	132
Germany	1990-2005	158
Denmark	1985-2008	174
Norway	1970-2008	189
UK	1970-2008	231
Belgium	1969-2008	261
Italy	1977-2008	351
Greece	1995-2008	392
Spain	1993-2008	569

The last ones in the list, that is Spain, Greece and Italy, have displayed a strong GDP increase with population but also a strong debt. Portugal is not in the same boat.

-The peak peaks or the peaks peak

During the 2000-2020 period, many peaks will occur: *gold peak, oil peak, silver peak,* and *Europe population peak*. But many call them *peak gold, peak oil,* etc

It is also another peak that I feel: ASPO Peak.

At each ASPO meeting in the past I asked Colin: *when is ASPO peak*?

The goal of ASPO was to inform the world about the **oil peak**: it is done!

ASPO was mainly a bunch of geoscientists and the following picture shows most of them:

ASPO meeting 2003 May 28, Paris, France

ASPO Barcelona was the last meeting where most were present and it was the beginning of decline.

Looking at the past ASPO meetings, I feel that the peak was Lisbon 2005 and its success is due to Rui.

The end of Colin's newsletters also indicates that the peak is passed

Without Colin, ASPO is not anymore ASPO!

But peak is not the end of the world, just a change of way of life

We need to change our way of life in our consumption society

Rui good luck in your retirement, you're welcome to join the club of many who have passed peak!