GLOBAL WARNING -ECONOMIC HISTORICAL RESEARCH

By Michel LEPETIT, Global Warning CEO – November 15th 2014

ENERGY IN THE FUTURE
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by PALMER COSSLETT PUTNAM
Consultant to the United States Atomic Energy Commission

FOREWORD
By the
UNITED STATES ATOMIC ENERGY COMMISSION

In 1949, the Atomic Energy Commission requested Mr Palmer Putnam, consulting engineer, to make a study of the maximum plausible world demands for energy over the next 50 to 100 years. The study was envisaged as background for the Commission's consideration of the economic and public policy problems related to the development and use of machines for deriving electrical power from nuclear fuels.

On completion of Mr Putnam's report, a number of interested people asked for copies of the broadly conceived analysis for use in various research projects. At the request of these people, the Commission was glad to assent to publication of the text without expense to the government.

The conclusions of the study are those of Mr Putnam. The Commission assumes no responsibility for the information, data, interpretations or conclusions presented. The Commission and staff will be pleased if, as has been predicted by many who have examined the manuscript, the report further stimulate and assists development of studies in the broad fields of demography and energy resources.

March 19, 1953

(page 454)
Notes on chapter 6

HOW MUCH LONGER CAN WE LIVE OFF CAPITAL ENERGY ? THE ECONOMICALLY RECOVERABLE RESERVES OF COAL, OIL SHALE AND TAR SANDS, WITH TRENDS IN UNIT COSTS, A NOTE ON THE COMBUSTION OF FOSSIL FUELS, THE CLIMATE AND SEA LEVEL.

NOTE 6-1.

The Combustion of Fossil Fuels, the Climate and Sea-Level

Until very recently, at least, the weather has been getting warmer, especially in winter in northern latitudes. Glaciers are retreating. Sea level is rising because of glacial melt-water. (Figs. 6-16N, 6-17N, and 6-18N, and Table 6-32N).

There is a suspicion that man may have contributed to these effects by combustion and other habits. The argument runs as follows:
The activities of man tended to enrich the CO2 content of the atmosphere in two ways. First, he has prevented the removal of some CO2 by substituting grassland and cropland for woods, and streets and other barren areas for land that had supported vegetation. The effects of such substitution are suggested by Table 6-33N. Second, he has pumped increasing quantities of CO2 into the atmosphere, principally by his burn-up of fossil fuels. Table 6-34N shows an estimated schedule of the latter activities. It is likely that man's reduction in the total volume of green stuff has "backed-up" into the atmosphere several times as much CO2 as man has pumped in directly by his other activities. Perhaps the grand total increment from the two sources in the past 50 years has been 300 ppm.

It is true that the oceans, and also plants ashore, have an immense capacity to take up additional CO2 and that they maintain the balance in the CO2 cycle (Fig. 6-19N). But, it is argued, these responses tend to attenuate rather than to eliminate additions of CO2. And, in any event, there may be a time lag. The record suggests that perhaps the CO2-content has increased slightly during the past 50 years. The values put forward are: about 290 parts per million around 1900 and about 320 ppm around 1935. The suggested increase of some 30 ppm is barely twice the standard deviation, which it is thought, lies in the range 10-17 ppm for some of the determinations. (Table 6-35N.)

This small increase may be real. However, few meteorologists agree that 10 per cent increase in the CO2 content could cause the observed climatic fluctuation.
Perhaps the recent increase in temperature has already reversed itself. Perhaps there has been no true increase in the CO2 content of the atmosphere. Perhaps what increase there may have been has had no appreciable effect on climate. Should the matter be allowed to rest there without further inquiry ?

The maximum plausible demand for energy may cause us to burn up, not only the 40 Q (*) in the economically recoverable reserves of fossil fuels, but also, perhaps, some of the marginal reserves.

That is to say: in the next 50 to 100 years we may burn up 10 times as much fuel as we have in the past 50 years. In all of our activities we may "back-up" and pump out into the atmosphere 3,000 ppm of CO2 – 10 times the present content of 300 ppm.

Perhaps such a derangement of the CO2 cycle would lead to an increase CO2-content of the atmosphere great enough to affect the climate and cause a further rise of sea level. We do not know this. * We ought to know it.

CONCLUSION

If there exists a possibility that the maximum plausible expansion of demands for energy, coupled with our other activities, may inadvertently affect the weather, we should investigate until doubt is removed.

* Latest experimental and theoretical calculations shows that doubling the CO2 content of the atmosphere causes surface temperatures to rise 4° F if no other changes occur.

Other earth-warming factors may also be triggered by increased CO2 in the air. It could cause less rainfall by its effect on clouds, and less cloud cover for the earth, both tending to make the climate warmer and drier. (Plass (Gilbert N.), 1953) (Wash. Post, May 5, 1953, p.5, quoting paper read at opening session of American Geophysical Union at the National Academy of Sciences.)

(*) 1.0 Q = 1.0 X 10^{19} Btu, equivalent to 38 billion tons of bituminous coal. (note page 77)

Fig. 6-16N. The rise in sea level along the Atlantic coast of the United States for various periods from 1893 to 1949 (Marmer, 1949a)
Fig. 6-17N. The rise in sea level along the Gulf coast of the United States for various periods from 1909 to 1947 (Marmer, 1949a)
Fig. 6-18N. The rise in sea level along the Pacific coast of the United States for various periods from 1908 to 1947 ; and its oscillation at Ketchikan 1919-1947 (Marmer, 1949b).

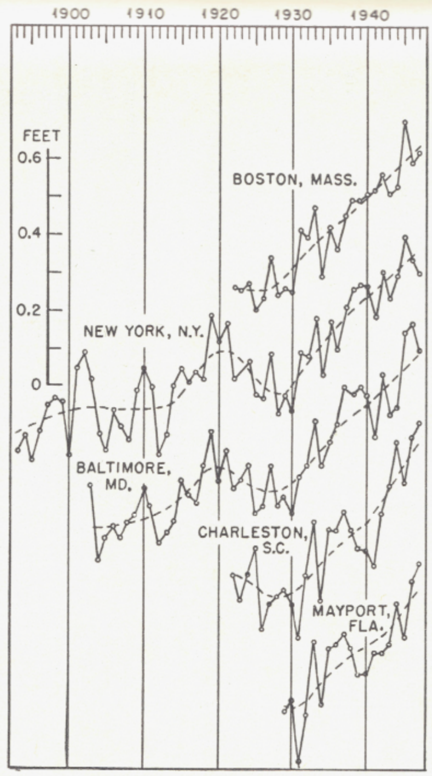

Fig. 6-16N. The rise in sea level along the Atlantic coast of the United States for various periods from 1893 to 1949 (Marmer, 1949a).

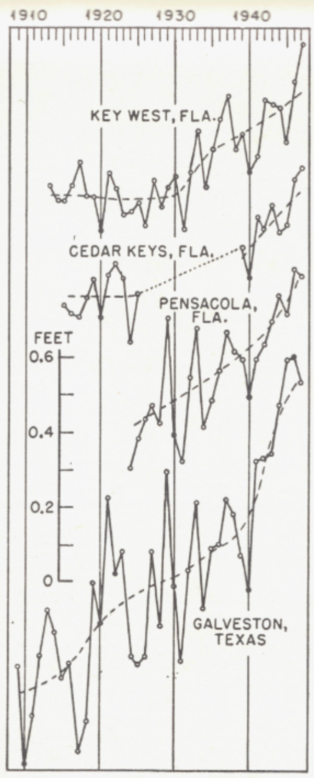

Fig. 6-17N. The rise in sea level along the Gulf coast of the United States for various periods from 1909 to 1947 (Marmer, 1949a).

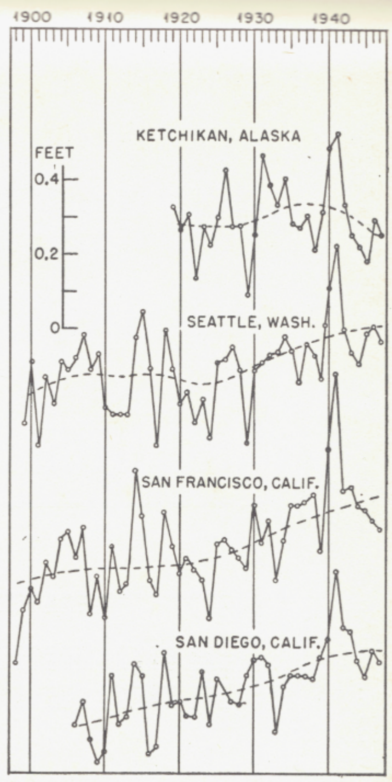

Fig. 6-18N. The rise in sea level along the Pacific coast of the United States for various periods from 1908 to 1947; and its oscillation at Ketchikan 1919-1947 (Marmer, 1949b).

TABLE 6-32N. CHANGES IN SEA LEVEL IN CENTIMETERS PER CENTURY

TABLE 6-32N. CHANGES IN SEA LEVEL IN CENTIMETERS PER CENTURY[a]

Station	Region	Time, years	Change: Station	Change: Region
Aberdeen		1862-1913	-1	
Dunbar	England	1914-1937	-6	-2
Liverpool		1857-1937	0	
Le Havre		1860-1886	0	
Cherbourg	France	1860-1884	+11	
	(Atlantic)	1891-1937	0	+2
Brest		1807-1936	+8	
Biarritz		1889-1937	-9	
Port Vendres		1888-1937	+11	
Sète		1888-1937	-8	
Port-de-Bouc		1894-1937	+26	
Martigues	France	1894-1937	+3	+9
Marseilles, P.V.	(Medit.)	1890-1926	+22	
Marseilles, M.		1885-1937	+16	
La Ciotat		1893-1926	-8	
Nice		1888-1909	+11	
Cadiz	Spain	1880-1923	+15	+6
Alicante		1874-1934	-3	
Horta	Azores	1906-1937	+9	+9
Ajaccio	Corsica	1912-1937	+10	+13
Cagliari	Sardinia	1897-1934	+16	
Atlantic City	U.S.A.	1912-1939	+34	
Baltimore	(Atlantic)	1903-1939	+25	+26
New York		1843-1902	+23	
		1893-1939	+18	
Balboa	Canal Zone (Pacific)	1909-1934	+13	+13
S. Diego-L. J.		1906-1939	+17	
Los Angeles	U.S.A.	1924-1939	+14	+12
S. Francisco	(Pacific)	1898-1939	+12	
Seattle		1899-1939	+6	
Honolulu	Hawaii	1905-1939	+22	+22
Sydney	Australia	1897-1927	-1	-1
Aden	Arabia	1880-1920	+3	+3
Bombay, A.B.		1878-1936	+7	
Bombay, P.D.	India	1888-1920	+2	+7
Karāchi		1868-1920	+7	
Madras		1880-1920	+11	
Porto Maurizio		1897-1922	+21	
Genova	Italy	1884-1936	+13	
Civitavecchia	(Thyrrh.)	1896-1921	+8	+20
Napoli, Arsen.		1899-1921	+32	
Napoli, Mandr.		1897-1921	+27	
Palermo	Sicily	1897-1922	+6	+6
Catania		1897-1919	+7	
Porto Corsini		1897-1921	+37	
Venezia, Lido	Italy	1917-1934	+31	
Venezia, Arsen.	(Adria)	1889-1913	+23	+27
Venezia, Stef.		1896-1919	+26	
Trieste		1905-1936	+19	
La Goulette	Tunisia	1889-1937	+3	
Bône		1889-1925	+9	
Alger	Algeria	1905-1937	+16	+12
Oran		1890-1931	+23	
Belgrano		1915-1936	+22	
Mar Del Plata	Argentina	1911-1937	+2	+9
Buenos Aires		1905-1937	+2	
Cristobal	Canal Zone (Atlantic)	1909-1939	-4	
Galveston	U.S.A.	1909-1939	+48	+21
Key West	(Gulf)	1913-1939	+18	
Rangoon	Burma	1880-1920	0	
Moulmein		1880-1920	0	+6
Port Blair	Andaman Is.	1880-1920	+16	
Kirun	Formosa	1904-1924	+11	+18
Takao		1904-1933	+25	
Hukabori		1900-1924	+13	
Hamada		1900-1924	+8	
Iwasaki		1900-1924	+26	
Otaru	Japan	1906-1933	+20	+13
Hanasaki		1900-1924	+37	
Aikawa		1900-1924	+11	
Hososima		1905-1933	-25	
Average of all stations			+12	
Average of all regions				+11

[a] Gutenberg, 1941.

TABLE 6-33N. TOTAL ANNUAL WORLD FIXATION OF CARBON BY LAND PLANTS

TABLE 6-33N. TOTAL ANNUAL WORLD FIXATION OF CARBON BY LAND PLANTS[a]

Plant habitat	Area, millions of sq km	Rate of carbon fixation, millions of tons per annum: Estimated From	Estimated To	Probable Mean value
Woods	44	9,000	13,000	11,000
Farmland	27	3,500	4,500	4,000
Steppes	31	500	2,200	1,100
Deserts	47	100	500	200
Streets	2			0
Total	151	13,100	20,200	16,300

[a] Based on Rabinowitch, 1945.

TABLE 6-34N. CARBON DIOXIDE PUT INTO ATMOSPHERE BY MAN'S ACTIVITIES BY HALF CENTURY, A.D. 1800 TO 1950

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	1800–1849 (tons $\times 10^{11}$)	1850–1899 (tons $\times 10^{11}$)	1900–1949 (tons $\times 10^{11}$)
Combustion of fuels	0.7	1.2	3.3
Combustion in forest fires	0.1	0.2	0.3
Breathing by humans	0.2	0.3	0.4
Breathing by domestic animals	0.7	1.0	1.5
Industrial processes			0.1
	1.7	2.7	5.6
	(ppm)	(ppm)	(ppm)
Combustion of fuels	9	16	44
Combustion in forest fires	1	2	4
Breathing by humans	3	3	5
Breathing by domestic animals	9	14	20
Industrial processes			1
	22	35	74

Fig. 6-19N. The carbon cycle in photosynthesis. Carbon dioxide is removed from the air by photosynthetic plants and returned to it principally by the microscopic plants responsible for decay (Franck and Loomis, 1949).

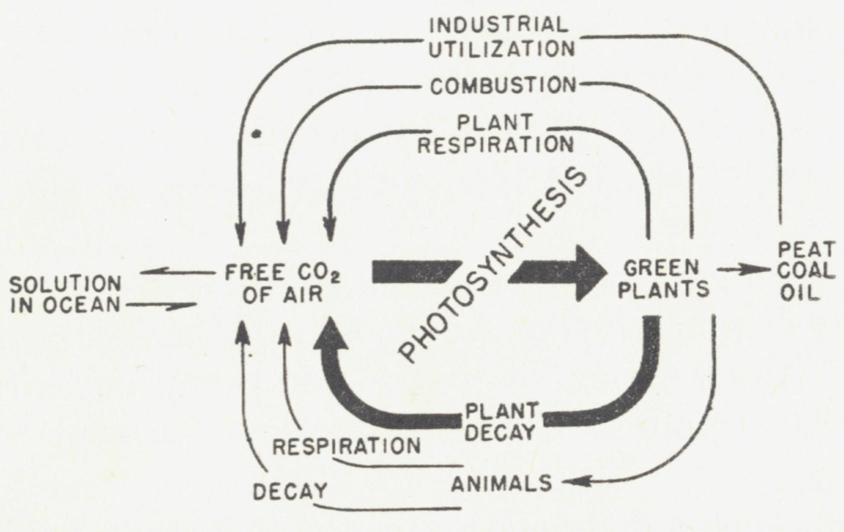

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TABLE 6-35N. OBSERVED PROPORTION OF CARBON DIOXIDE IN AIR, 1886 TO 1935 ; VOLUMES OF CO2 PER MILLION VOLUMES OF AIR

TABLE 6-35N. OBSERVED PROPORTION OF CARBON DIOXIDE IN AIR, 1886 TO 1935; VOLUMES OF CO_2 PER MILLION VOLUMES OF AIR[a]

Authority	Location	Date	No. obs.	Mean CO_2
T. Thorpe (1867)	North Atlantic	1866	51	295
F. Schulze (1871)	Rostock	1868–1871	1034	292
J. Reiset (1882)	Near Dieppe	1872–1873	80[b]	292[c]
A. Levy (1877)	Montsouris, Observatory	1876–1887	(1000)	292
G. Armstrong (1880)	Grasmere, England	1879	53[b]	296
J. Reiset (1882)	Near Dieppe	1879–1880	80[b]	291[c]
Muntz and Aubin (1886)	France (country)	1881	64	287[c]
Peterman and Graftiau (1892)	Near Gembloux	1889–1891	525	294
Letts and Blake (1900)	Near Belfast	1897	64	289[c]
Brown and Escombe (1905)	Kew Gardens	1898–1901	92	294[c]
F. Benedict (1912)	Near Boston, Mass.	1909–1912	645	303
K. Buch (1939)	North Atlantic	1932	28	318
K. Buch (1939)	Petsamo, Finland	1934–1935	95	321[c]
K. Buch (1939)	North Atlantic	1935	53	320
J. Haldane (1936)	Near Perth, Scotland	1935	152	324

[a] Callendar, 1940.
[b] Excluding night values.
[c] Thought to be the most accurate values.