

# **‘Public-Private Ethos’ and a Brief Economic History of the Conceptual Development of Near-Earth Asteroid Utilization**

**Alexander MacDonald  
Civil and Commercial Space Division  
NASA Jet Propulsion Laboratory / California Institute of Technology**

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# 'Public-Private Ethos'

- "Ethos ([/ˈiːθɒs/](#) or [/ˈiːθoʊs/](#)) is a [Greek](#) word meaning "character" that is used to describe the guiding beliefs or ideals that characterize a community, nation, or ideology."
- **Public-Private Ethos** in the context of space activities is the guiding belief that space activities are inherently the result of a mix of public-sector and private-sector motives and actors.

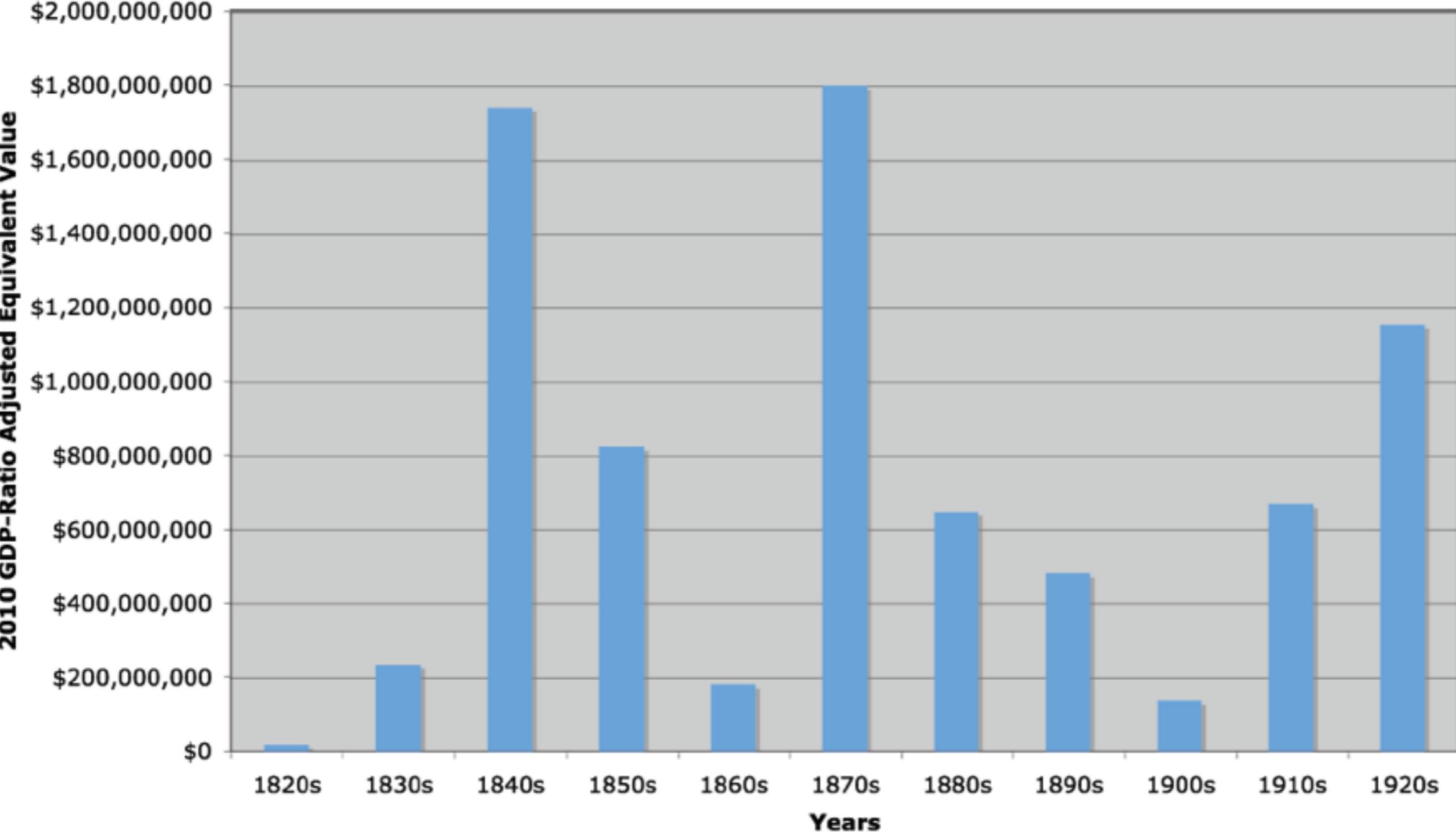
## Expenditure on U.S. Observatories, 1820-1940: Summary

<b>Total Number of Observatories and Endowments in Data Set</b>	42
<b>Total PWC Adjusted Value of Expenditures in 2010 U.S. Dollars</b>	\$2,141,831,040
<b>Total GDP-Ratio Adjusted Value of Expenditures in 2010 U.S. Dollars</b>	\$7,912,600,000
<b>Percentage of Total GDP-Ratio Equivalent Expenditures Supplied by Government Funds</b>	3.4%
<b>Percentage of Total GDP-Ratio Equivalent Expenditures Supplied by Private-Sector Funds</b>	96.6%

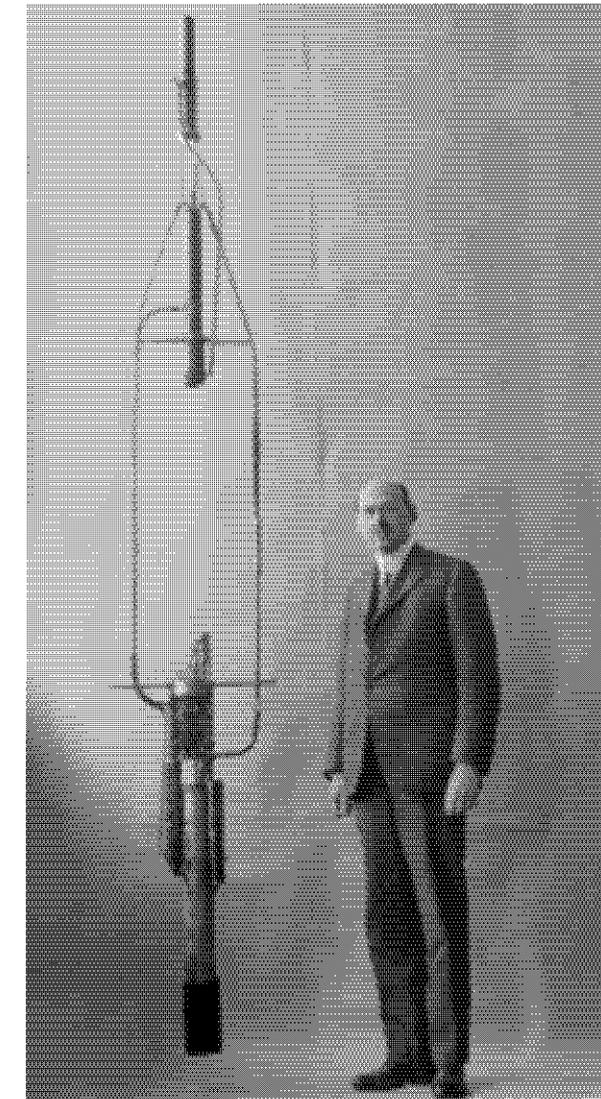
### **\*Methods for Converting to Current-Year Dollar Equivalents:**

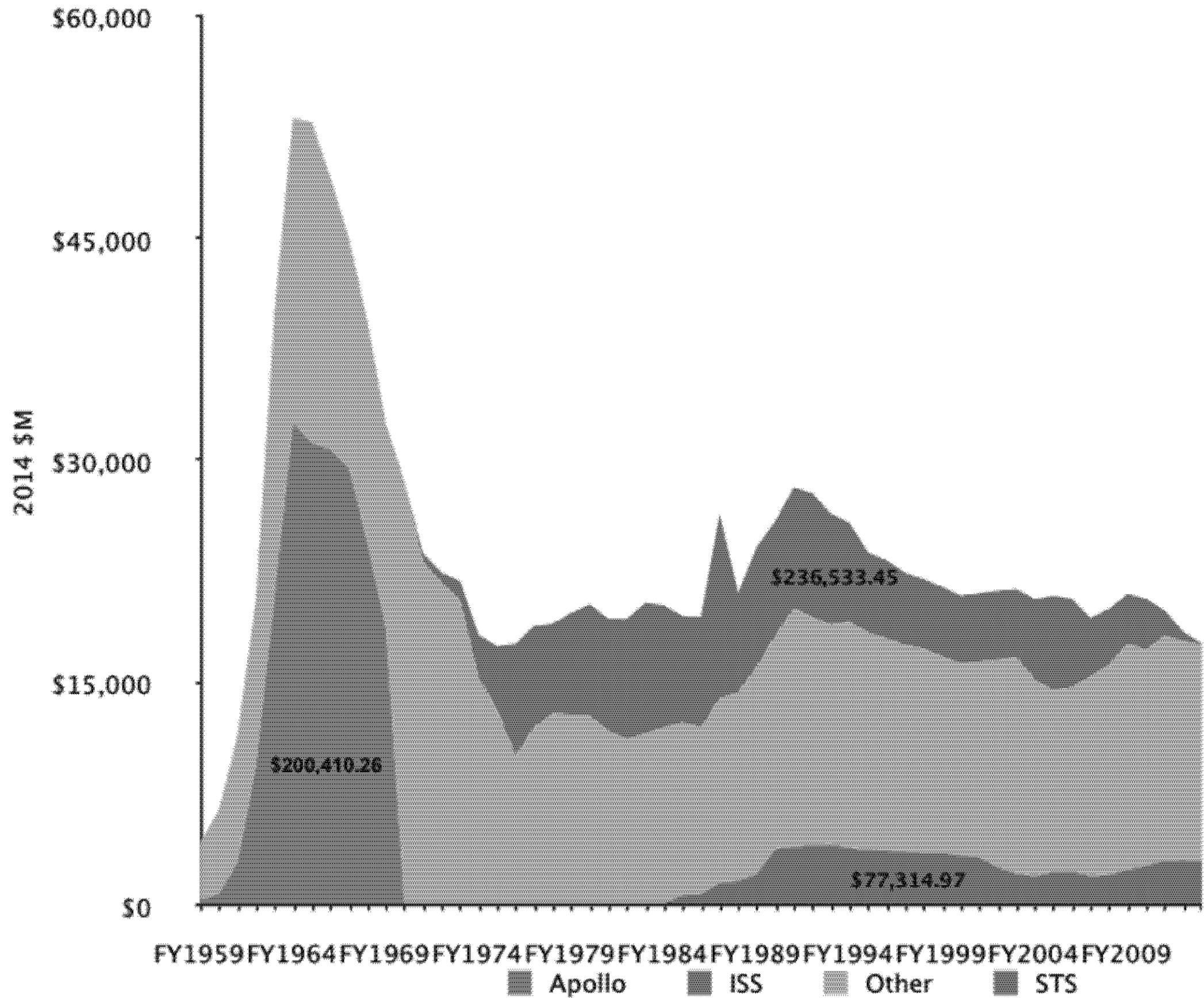
- 1) Production Worker Compensation (PWC) - adjust for cost of principle input of space exploration, which is skilled labor.**
- 2) Gross Domestic Product (GDP) - adjust for size of the economy as a whole.**

# Decadal Expenditures on U.S. Observatories, 1820s to 1920s: GDP-ratio adjusted equivalent value in 2010 dollars



<b>Year</b>	<b>Source</b>	<b>Nominal Value in U.S dollars (\$)</b>	<b>Constant-Price Value in U.S. Dollars (\$) adjusted by PWC index, base year 2010*</b>	<b>GDP-Ratio Equivalent Value in U.S. dollars (\$) adjusted by ratio to GDP, base year 2010**</b>
1917	Smithsonian (Hodgkins Fund)	5,000	464,000	1,220,000
1918	U.S. Army Signal Corp	25,000	1,850,000	4,790,000
1921	Clark University	2,500	137,000	493,000
1922	Clark University	1,000	59,500	198,000
1924	Smithsonian (Cottrell Fund)	5,000	261,000	835,000
1924	AAAS	190	9,910	31,700
1928	Smithsonian (Operations)	1,750	89,200	261,000
1929	Smithsonian (Research Corporation)	2,500	128,000	351,000
1929	Smithsonian (Operations)	2,500	128,000	351,000
1930	Carnegie Institute of Washington	5,000	251,000	796,000
1931	Daniel Guggenheim	50,000	2,580,000	9,490,000
1932	Smithsonian (Hodgkins Fund)	250	14,800	61,900
1933	Guggenheim Foundation	2,500	150,000	644,000
1934	Guggenheim Foundation	18,000	903,000	3,960,000
1935	Guggenheim Foundation	18,000	878,000	3,570,000
1936	Guggenheim Foundation	20,000	961,000	3,470,000
1937	Guggenheim Foundation	20,000	839,000	3,160,000
1938	Guggenheim Foundation	20,000	826,000	3,370,000
1939	Guggenheim Foundation	20,000	826,000	3,150,000
1940	Guggenheim Foundation	20,000	789,000	2,870,000
1941	Guggenheim Foundation	3,000	107,000	344,000
1942	Army Air Force	13,000	400,000	1,170,000
1942	Navy Bureau of Aeronautics	87,267	2,680,000	7,830,000
1943	Navy Bureau of Aeronautics	104,600	2,820,000	7,650,000
	<b>Private Sources</b>	<b>217,190</b>	<b>10,401,410</b>	<b>38,626,600</b>
	<b>Military</b>	<b>229,867</b>	<b>7,750,000</b>	<b>21,440,000</b>
	<b>Total</b>	<b>447,057</b>	<b>18,151,410</b>	<b>60,066,600</b>





# Return of the Private-Sector in the ‘Second Space Age’

- ▶ Internet produces ‘tech-billionaires’ who start space companies
- ▶ Jeff Bezos, Amazon.com, Blue Origin (2000)
- ▶ John Carmack, Doom/Quake, Armadillo Aerospace (2000)
- ▶ Elon Musk, PayPal.com, SpaceX (2002)
- ▶ Paul Allen, Microsoft, “SpaceShipOne” (2004)
- ▶ Richard Branson, Virgin Group, Virgin Galactic (2004)
- ▶ Larry Page & Sergey Brin, Google, Google Lunar X Prize (2007)
  
- ▶ 2004-2014: Commercial Spaceflight Federation estimates that these and other ‘commercial space companies’ have had private investment of \$2.5B; comparable to \$1.8B for private observatories in 1870s;

# Elements of a Public-Private Ethos

- i) Recognizing that space activities result from a mix of private-sector and public-sector motives and actors, and that the roles of each have shifted over historical timescales.
- ii) Objective assessment of the relative strengths and weaknesses of private-sector and public-sector actors for given activities.
- iii) Identification and utilization of mechanisms for strengthening public-sector and private-sector collaboration, partnership and mutual benefit.



# A Rough History of Asteroid Utilization

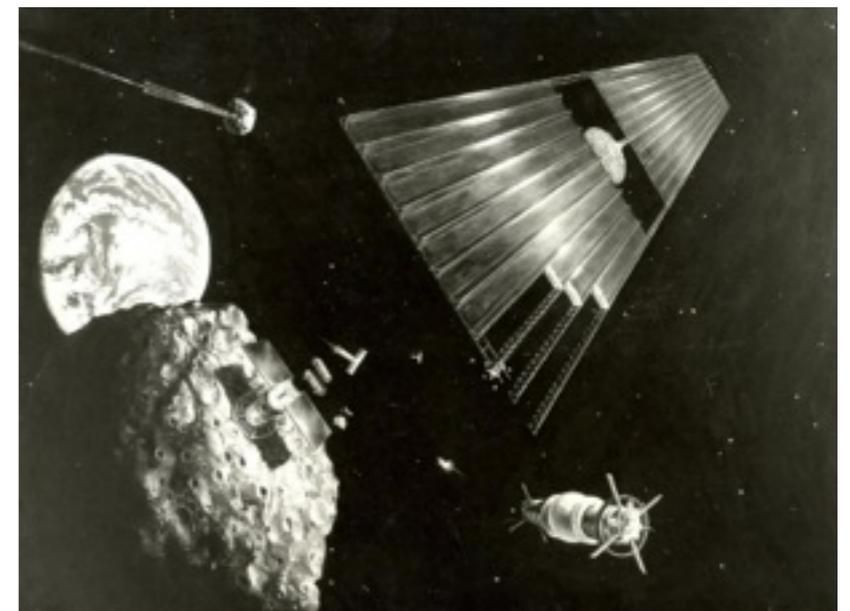
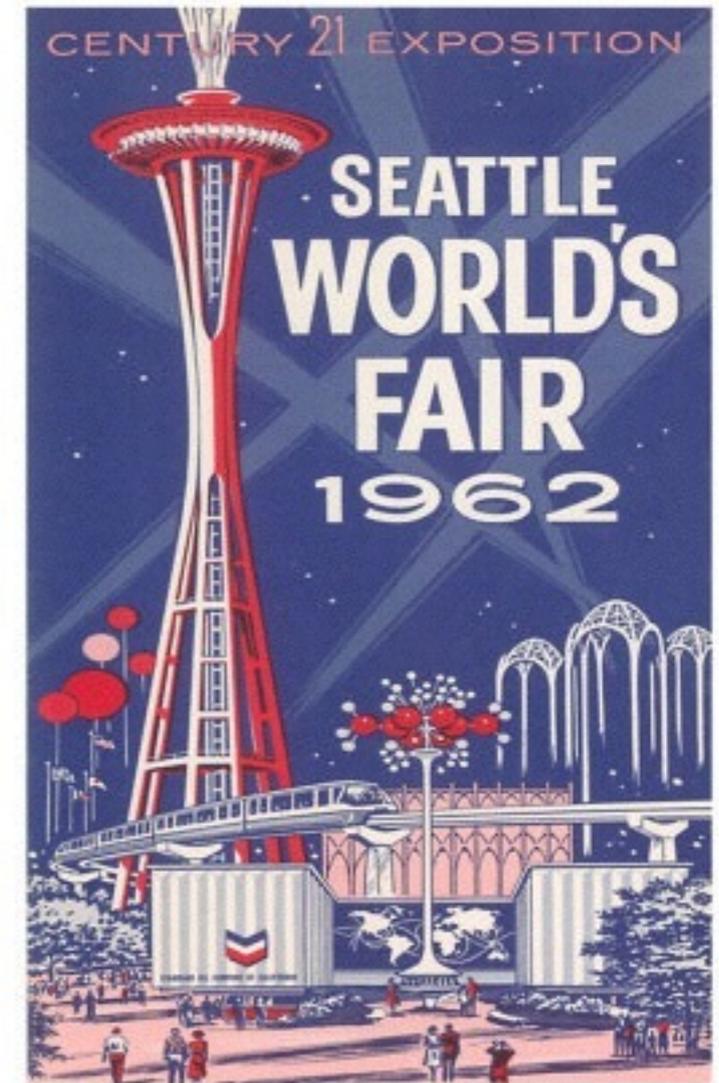
## Conceptual Development and Investment

- First Phase (1880s - 1950s) ~Private
- Second Phase (1960s -1980s) ~Public
- Third Phase (1990s - 2000s) ~Public/Private
- Fourth Phase (2010s - ?) ~Public-Private

# First Phase (1880s to 1950s)

- ▶ *Man Abroad: A Yarn From Another Century*, 1887, Anonymous
  - ▶ ‘Hardly a day passes but an aerial and ethereal car light on one of these asteroids and colonizes it with human beings’
- ▶ *Edison’s Conquest of Mars*, 1898, Garrett P Serviss
  - ▶ “Had (the asteroid mine) been easier to reach, perhaps they would have removed more, or, possibly, their political economists perfectly understood the necessity of properly controlling the amount of precious metal in circulation.”
- ▶ *Seetee Ship*, 1951, Jack Williamson
  - ▶ “The scattered, despised and numerically inferior asteroid miners are left as the sole remaining champions of individual liberty.”

# Second Phase (1960s - 1980s)



▶ *Second National Conference on the Peaceful Uses of Outer Space, 1962, Vice-President Johnson*

- ▶ “Someday we will be able to bring an asteroid containing billions of dollars worth of critically needed metals close to Earth to provide a vast source of mineral wealth to our factories”

▶ *NASA ‘Five Year Plan’, 1969, includes humans to asteroids*

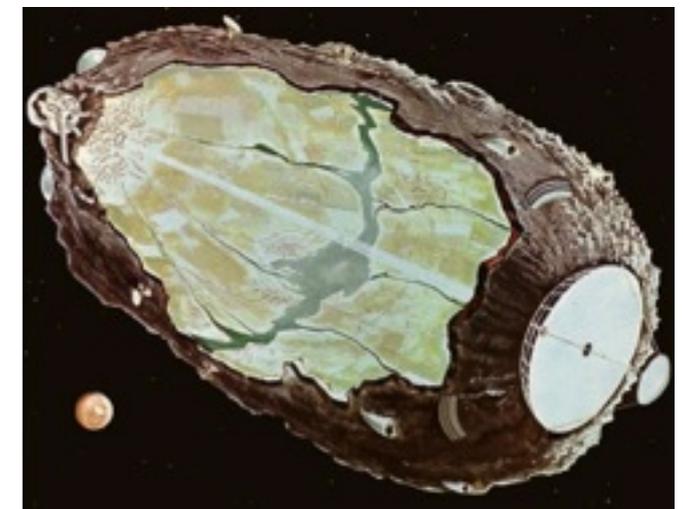
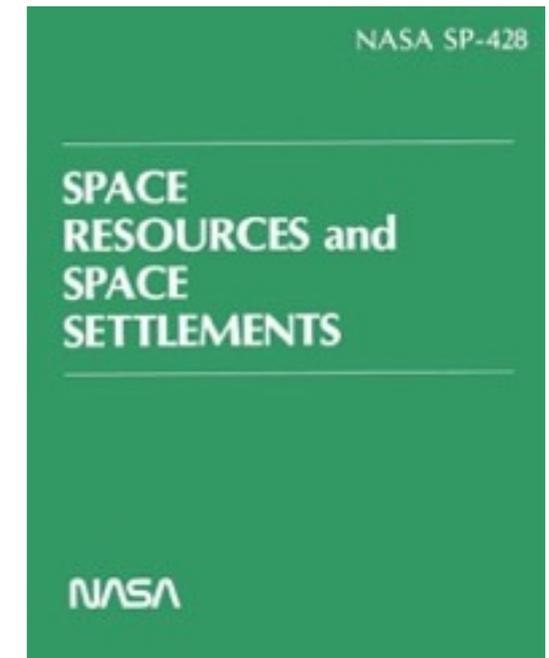
▶ *Asteroids: An Exploration Assessment, 1978, NASA*

▶ *NASA Administrator Robert Frosch, 1980, mentions desirability of asteroid retrieval to earth in congressional testimony*

# Second Phase (1960s - 1980s)

## Private Sector Activities

- ▶ NASA Ames Space Settlement Summer Studies 1975, 1977
- ▶ L-5 Society Founded, 1975
- ▶ *Alien*, 1979, Weyland-Yutani owned *Nostromo* depicted as returning 20,000,000 tons of mineral ore from an asteroid.



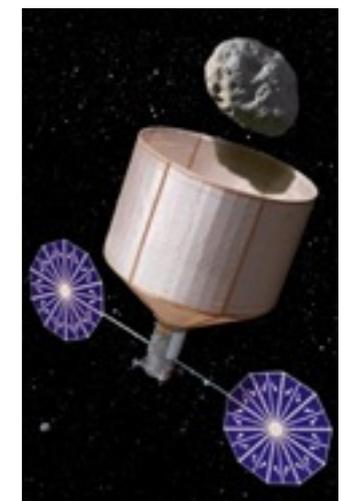
# Third Phase (1990s - 2000s) Part

- ▶ NASA launches NEAR Shoemaker, 1996
- ▶ SpaceDev Founded, 1997
  - ▶ Design and attempted sale of Near-Earth Asteroid Prospector (NEAP) mission
  - ▶ 'Benson Prize' \$50,000 to promote 'long-term utilization of near earth resources'
- ▶ *Mining the Sky: Untold Riches from the Asteroids*, 1997, John Lewis
- ▶ NEAR Shoemaker arrives at Eros, 2000
- ▶ B612 Foundation founded, 2002
- ▶ Hayabusa launch/arrive/return, 2003/2005/2010



# Fourth Phase (2010s - ?)

- ▶ President declares human mission to an asteroid as next for NASA, 2010
- ▶ OSIRIS-REx mission selected, 2011
- ▶ Keck Institute for Space Studies, Asteroid Return Mission Study, 2011/2012
- ▶ Planetary Resources announcement, 2012
- ▶ B612 Sentinel announcement, 2012
- ▶ Deep Space Industries announcement, 2013
- ▶ NASA announces Asteroid Redirect Mission and Asteroid Grand Challenge, 2013



National Aeronautics and Space Administration



# Public-Private Partnerships for Space Capability Development

*Driving Economic Growth  
and NASA's Mission*

April 2014

# Emerging Space in 2044

**NASA is on a path of exploration and pioneering in the inner solar system, opening new opportunities and challenges for future generations and driving the American economic expansion into space. Although the specific shape and rate of this economic expansion depends as much on the actions of the individuals, corporations, and foundations involved as it does on NASA, the following description presents one view of the future in 2044 as it could be as NASA catalyzes an expansion of American space activities through its program and partnerships.**

**Near-Earth Asteroids**  
NASA's near-earth asteroid explorations, begun in the late 2010s have paved the way for regular government and private-sector activities involving near-earth asteroids. With the support of NASA partnerships, companies have begun extracting water ice, metals and rock from several NEAs identified as viable candidates for mining, beginning the process of providing materials and propellant for the expanding interplanetary transportation system and economy. Activities related to mining have necessitated the development of more robust reusable systems capable of routinely operating in harsh environments. NASA's human exploration of NEAs has contributed insights valuable both to governments and private-sector actors regarding NEA characteristics, proximity operations, extraction techniques, and options for planetary defense from the threat of asteroid impact.

