

Far Out Aeronautics and Motions

NASA Institution for Advanced Concepts
Broomfield, Colorado

October 11, 2005

by

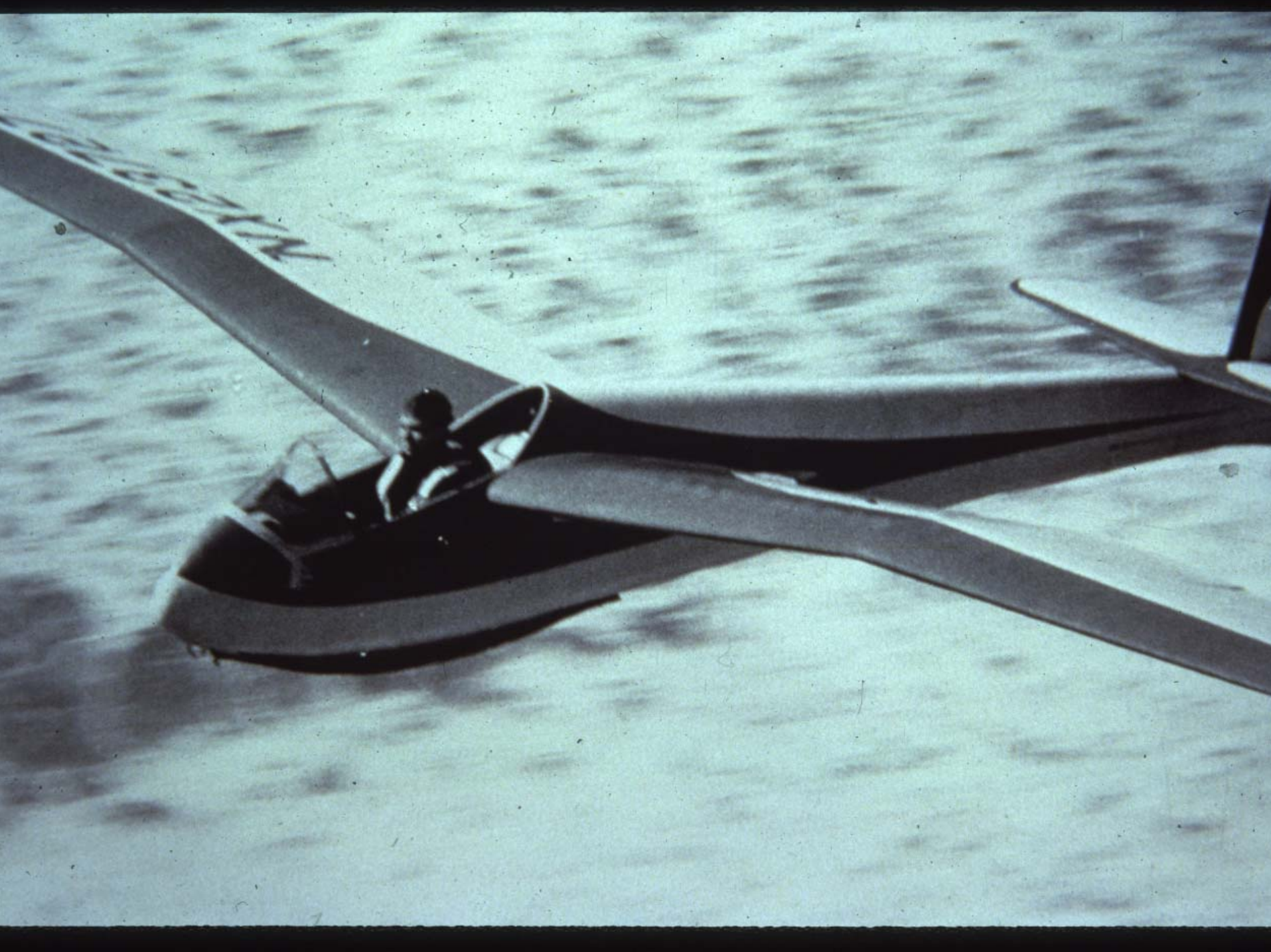
Paul MacCready

AeroVironment Inc.

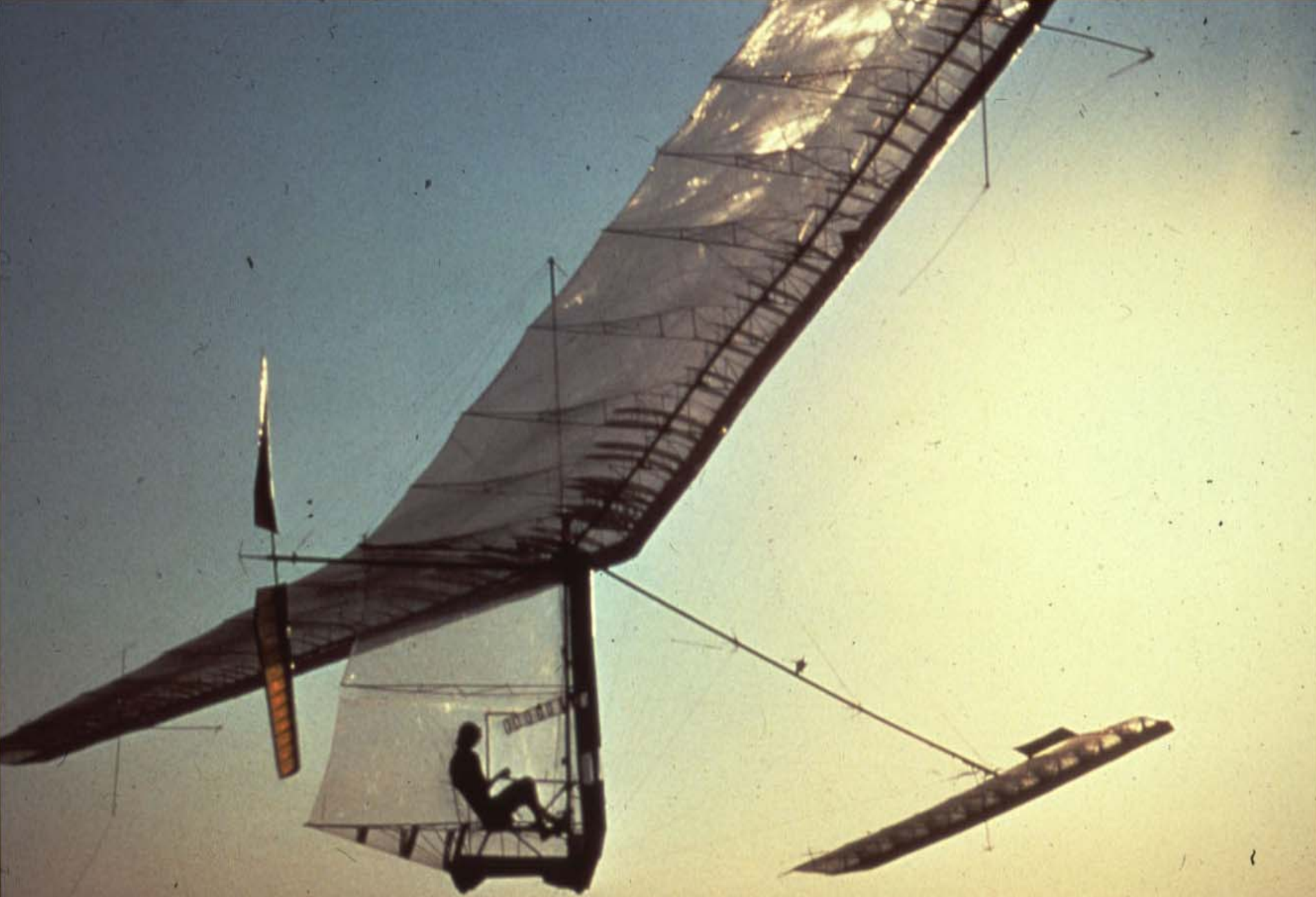
Monrovia, California

maccready@aerovironment.com

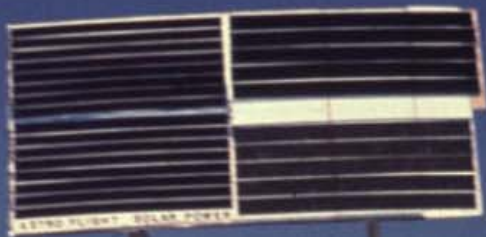




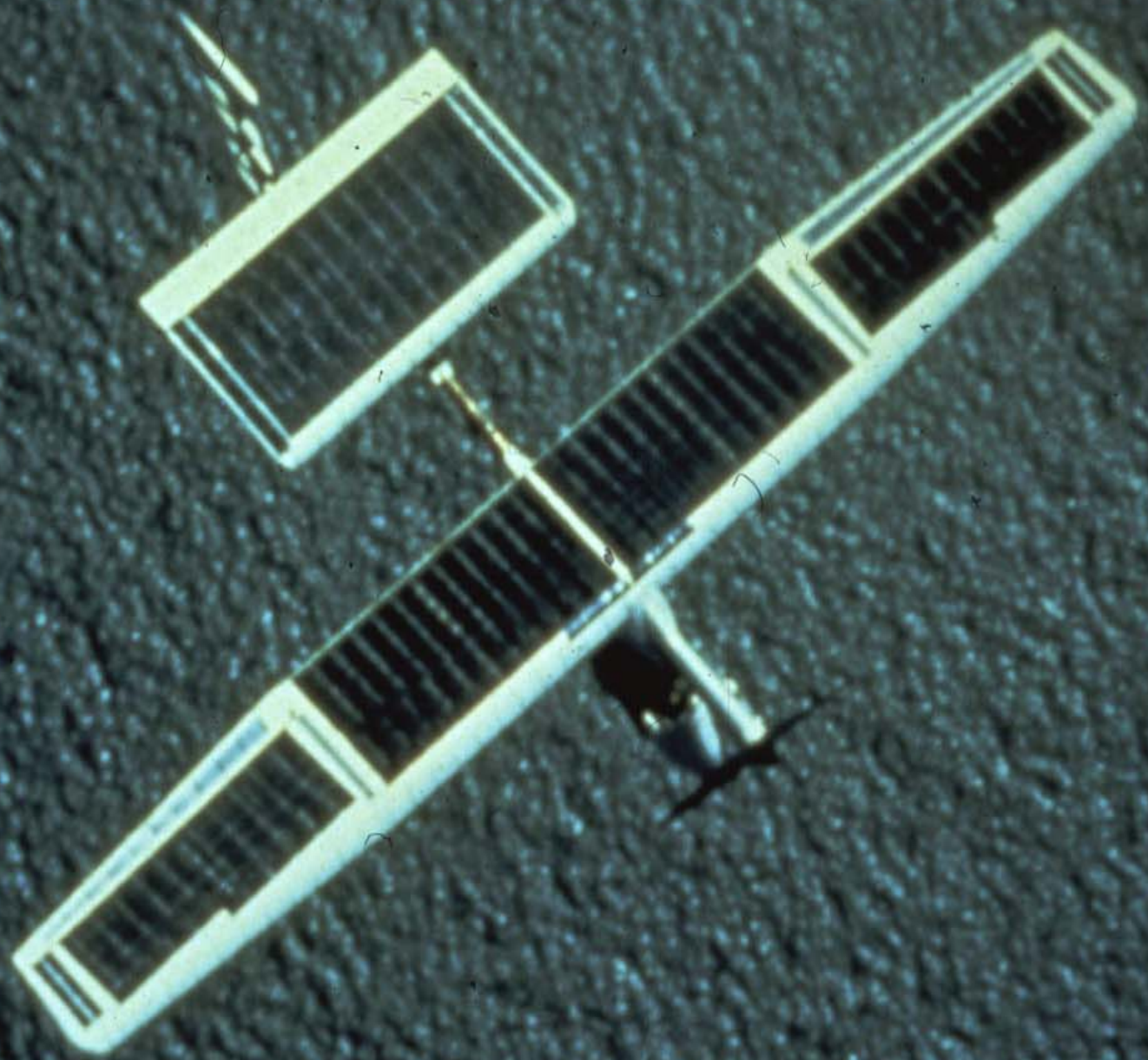






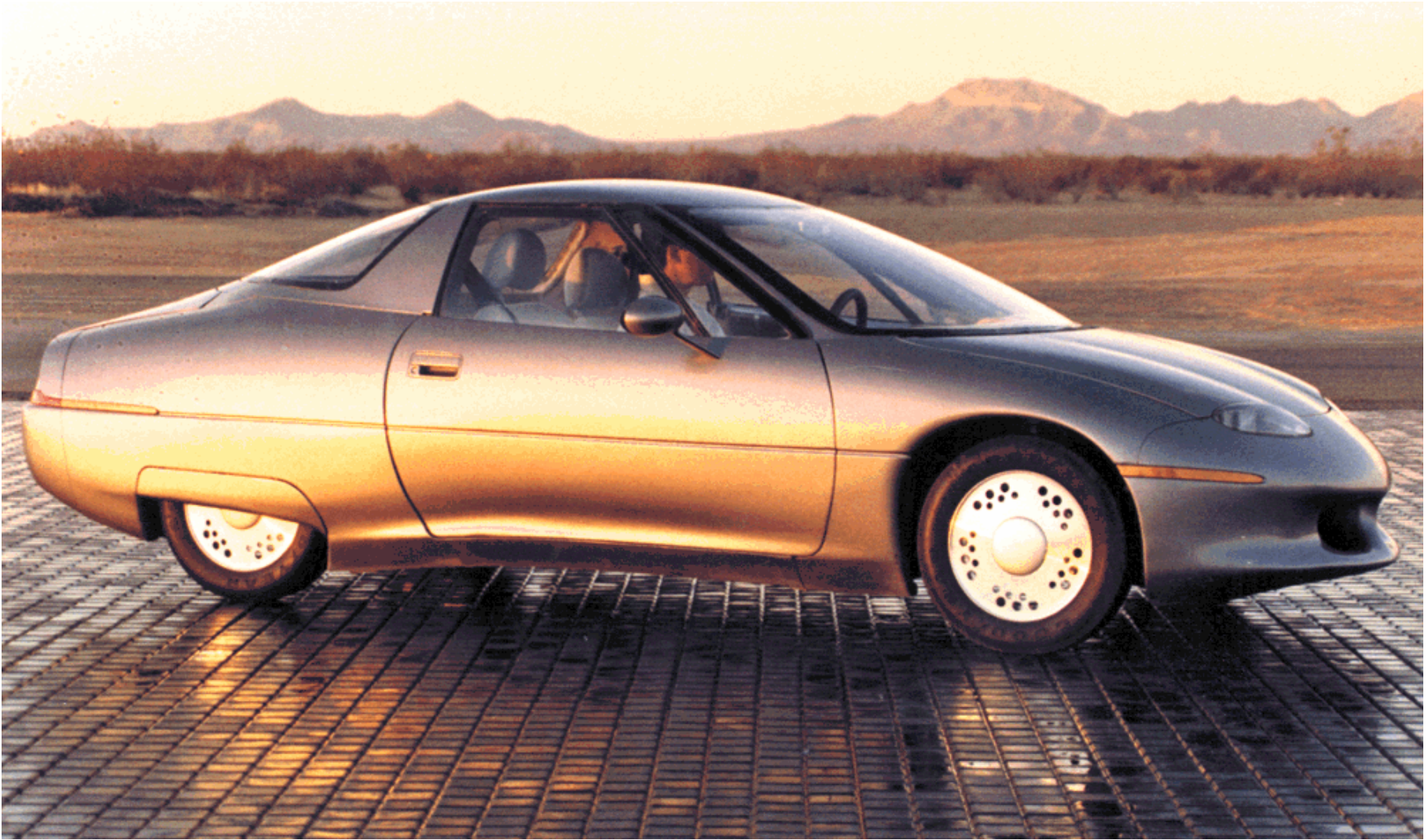


TWO









Impact







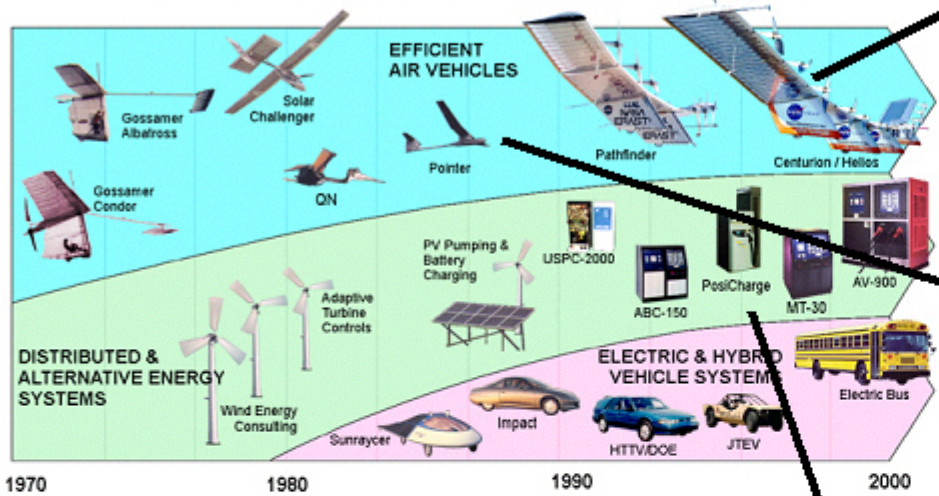
AeroVironment Inc.
HELIOS

NASA ERAST
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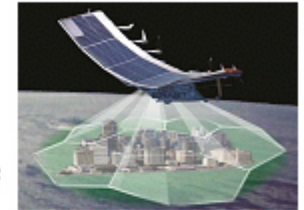
“New Technologies for a Better World”



Helios



247' span
“Eternal Stratospheric Flight”

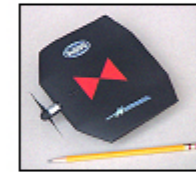


- ▶ Communications platform
- ▶ Atmospheric Monitoring
- ▶ Remote sensing, Surveillance

Mini and Micro Air Vehicles



New Pointer
9 lbs., 9' Span



Black Widow
2-3 oz. 6" Span

- ▶ Surveillance for security, including night vision
- ▶ Safe probing where human presence precluded

Electric Energy/Power

Projects, Products, Systems

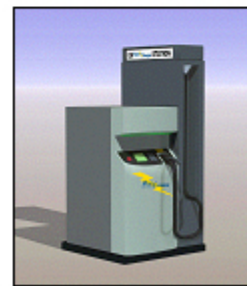


- ▶ Test & Simulation Equipment
- ▶ Electric Vehicles, Electric and Hybrid
- ▶ Distributed Power
- ▶ Fuel Cells
- ▶ Advanced Battery Systems, integrated monitoring and control devices

Fast Charging



- ▶ Electric lift trucks
- ▶ Airport ground support equipment
- ▶ On-road cars and buses





Sunraycer, PV cell powered



Helios (75 m)
Altitude record 29,531 m



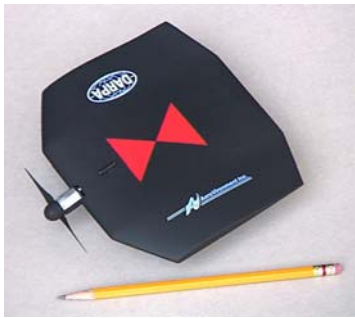
2005 Global Observer



Charger, battery assist



IMPACT battery powered



Black Widow
(15.2 cm)



Raven
(1.3 m)



Puma
(2.8 m)

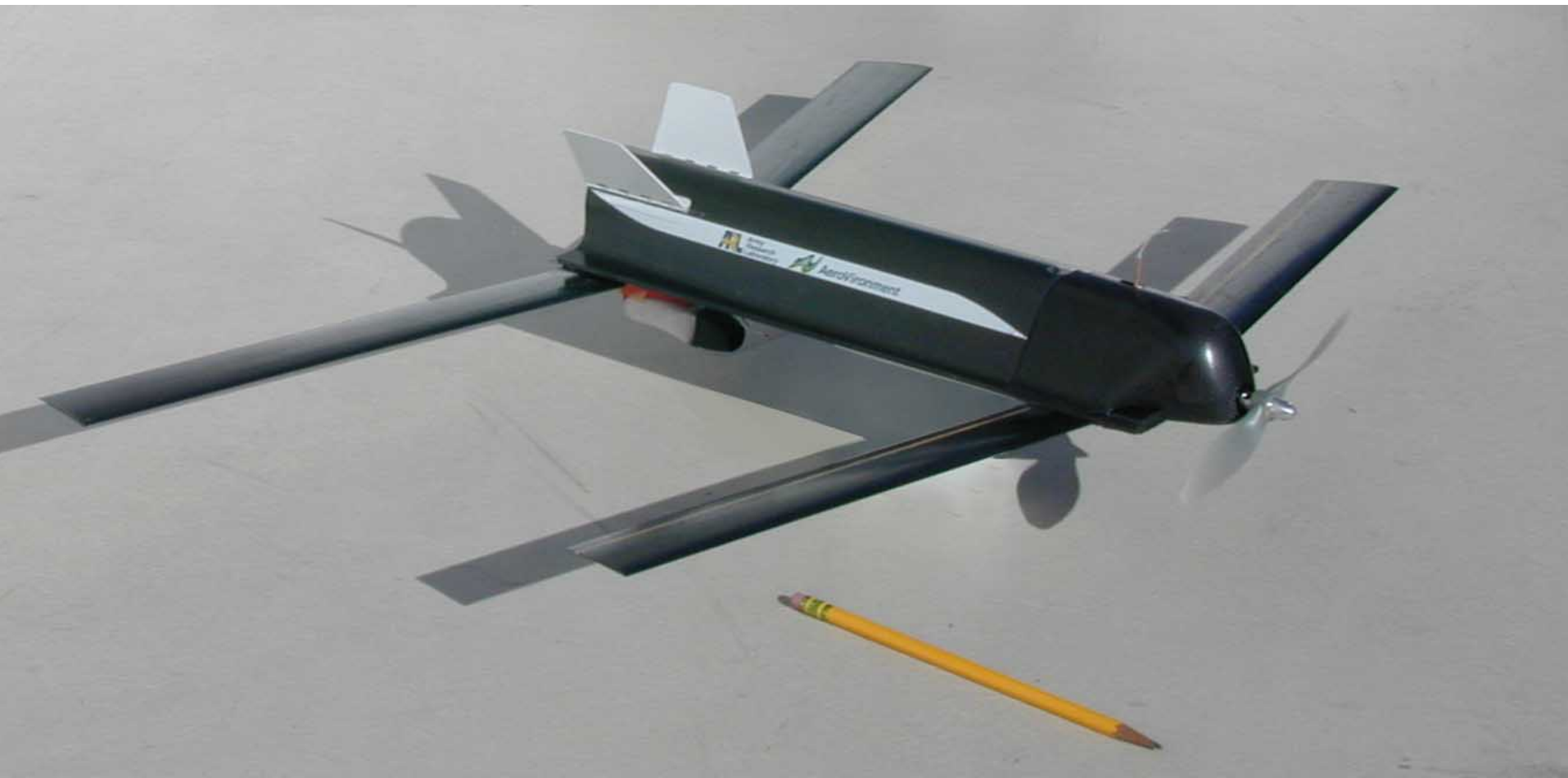


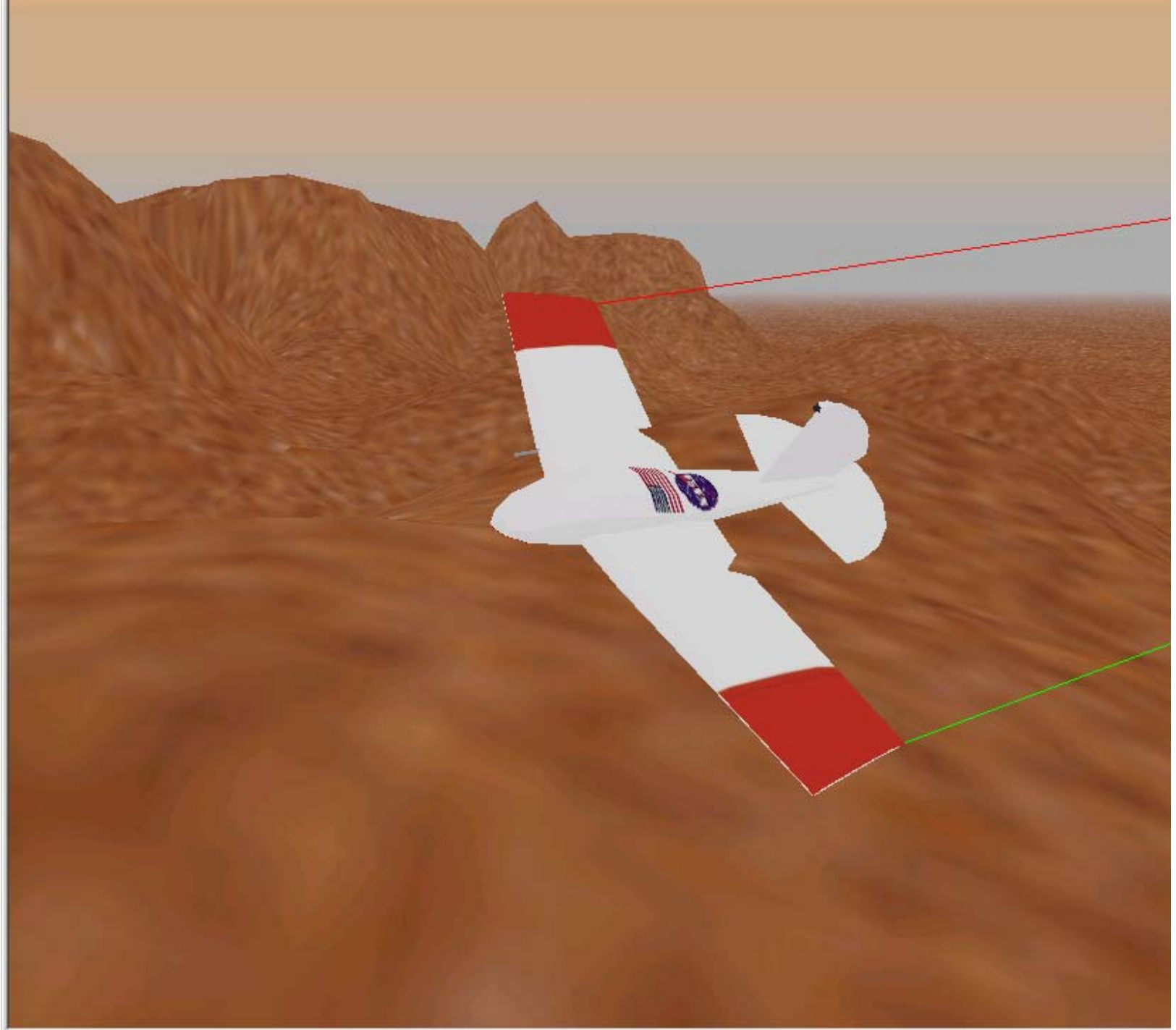
Wasp (35.6 cm)



Dragon Eye (1.2 m)

All powered by lithium batteries, equipped with one or several video cameras, duration 30 minutes to 4 hours.





Almost all airplanes carrying more than 8 people are efficient. Less efficient vehicles fail in the marketplace.

Cars are marketed more like toys, with efficiency at low priority but different, jazzy appearance and features at high priority. We all have tended to respond to this marketing approach.

Start Thinking About Ultimate Electric Car

Present Reality

Future Reality

100% efficient battery
(in = out)

93%

95%

100% efficient electric
motor

94%

96%

Zero aerodynamic drag

0.19 x cross-section area

0.13 x cross-section area

Zero rolling friction

0.007x lighter weight

0.006x lighter weight

100% regenerative braking

65%

75%

Vehicle, 5 passenger, has
 ∞ range (except for
battery powered radio,
horn, steering, lights,
etc.)

Vehicle has 300 mile
range with modern
lithium batteries (but
expensive)

Vehicle will cost less
but still expensive

Battery Powered Cars

For efficient, low-drag vehicles with just 45 mile exclusive electric range (saving 85% of battery cost, for which an ethanol or gasoline motor and tank is substituted).

45 mile exclusively electric capability; 300 additional miles fueled

Battery charged either by motor, or by plug-in to 220V wall plug. Fueled motor can be restarted automatically when battery is down to 20% of full (started with a delay to permit the anti-pollution catalyst to be preheated).

Motor delivers energy at 18 kW to system of battery + car driving; turns off at 90% battery recharged.

With two-way plug-in a) help balance line voltage and frequency, time constant 1 minute or less, and b) provide extra energy for utility's load of air conditioners, say 5-11 p.m., then get battery recharged 11 p.m. – 5 a.m.

More Practical Hybrid Cars (Battery + Ethanol or Gasoline)





Bob Hoey and Two RC Models of Soaring Birds



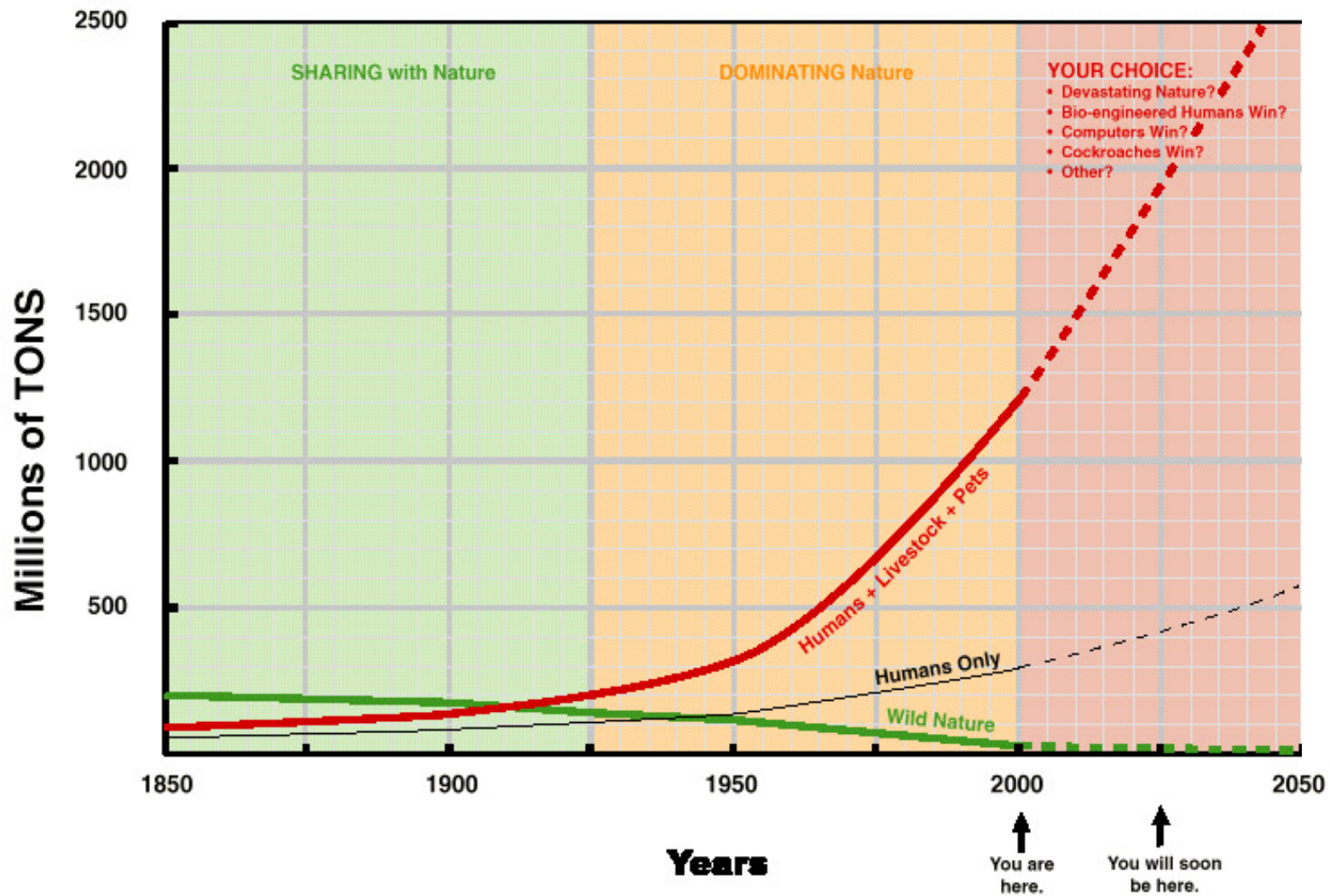




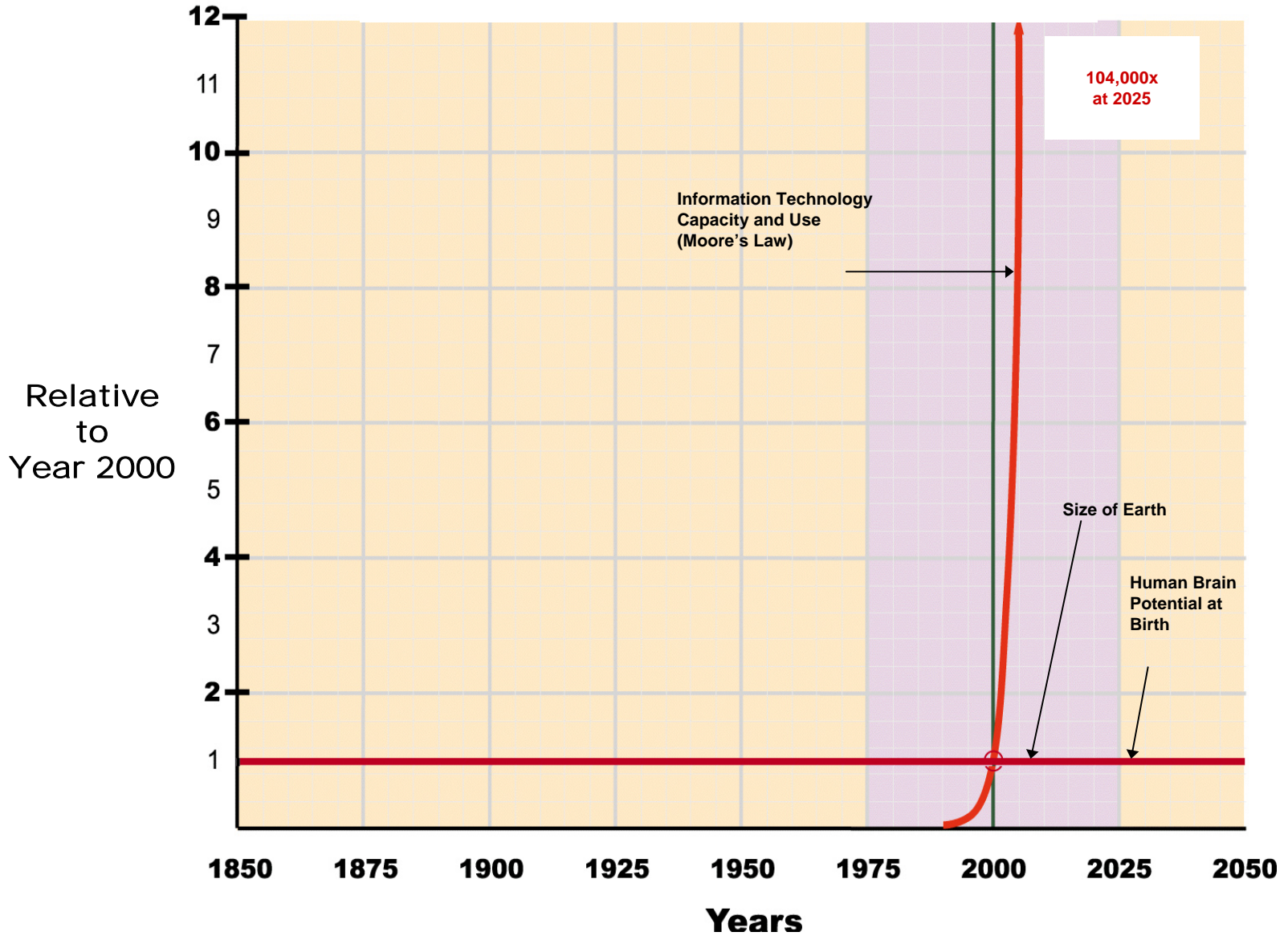
Technalegs™

Nature vs. Humans

(Weight of all air and land vertebrates.)



Information Technology, Earth, and Mind



- Rachel Carson - Silent Spring (1962)
- Charles Lindbergh - If I had to choose only airplanes or only birds, I'd choose birds. (1964)
- Hermann Scheer - A Solar Manifesto (2001 Second edition, first version 1993): Sustainable, global solar energy policies can suffice.
- Peter Raven - Missouri Botanical Garden (2000)
“We must get by on the earth’s interest, not the earth’s capital.”
- Yvon Chouinard - “It would take seven Earths to provide enough raw materials to allow the rest of the world to consume at the same rate Americans do.” Founder/Owner of Patagonia Inc. Author “Let My People Go Surfing”, October 2005.

Over billions of years, on a unique sphere, chance has painted a thin covering of life -- complex, improbable, wonderful and fragile.

Suddenly we humans (a recently arrived species no longer subject to the checks and balances inherent in nature), have grown in population, technology, and intelligence to a position of terrible power: we now wield the paintbrush.



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CENTURION

