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Atmospheric Science Seminar

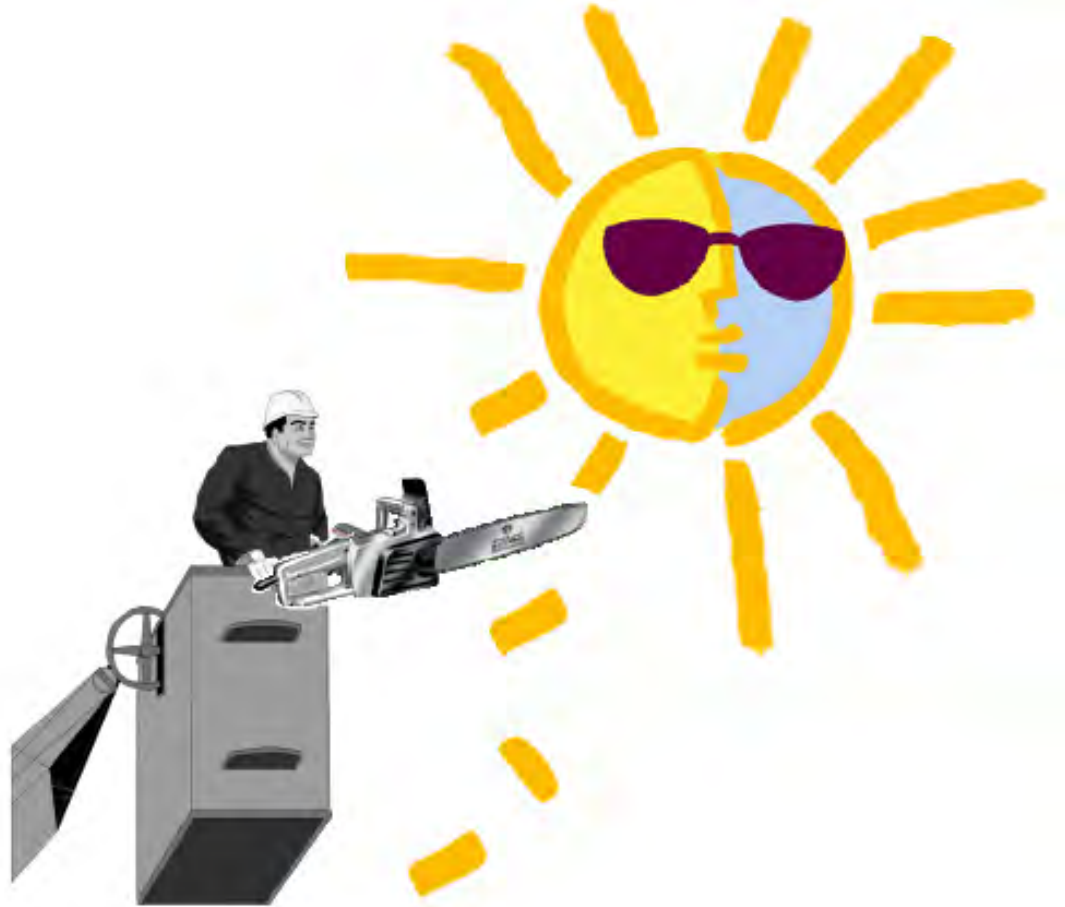
University of Washington

Jan. 25, 2011

Managing Solar Radiation



NASA-Ames Conference Center
Ames Research Center, Moffett Field, CA 94035



Edward Teller and Lowell Wood



**“The planet needs a sunscreen”
-- Edward Teller**

Can Dr. Evil Save The World?

Forget about a future filled with wind farms and hydrogen cars. The Pentagon's top weaponeer says he has a radical solution that would stop global warming now -- no matter how much oil we burn.

Lowell Wood as portrayed in *Rolling Stone* (Nov. 2006)





A male hand, god-like in scale, is on the thermostat
Thermostat is “nowhere,” perhaps in outer space
Temperature is 73° F being turned back to 54° F or five
degrees cooler than Earth’s long-term average!
The thermostat dial is centered on Roswell, NM

What' s wrong with climate engineering?

- 1. Who has the moral right?**
- 2. What? A global thermostat!**
- 3. Reduce incentives to mitigate?**
- 4. Unknown side effects?**
- 5. Once begun, can we ever stop?**
- 6. Could it be commercialized?**
- 7. Why is the military so interested?**
- 8. What if nations or companies do it unilaterally?**
- 9. Does it violate existing treaties?**
- 10. Will it alter fundamental human relationships to nature and to each other?**

-- condensed from Alan Robock, "20 reasons"

Recent a-historical statements about geoengineering, Asilomar 2010

- “We Don’ t have a history of geoengineering to fall back on...”

- Yes we do.

- “Things are moving quickly, so we don’ t have the luxury of looking at history.”

- We must take the time.

- “It is time to make a first impression on an uninformed public.”

- This is like whitewashing an old fence.

- “We are the first generation to think about these things.”

- History says otherwise.

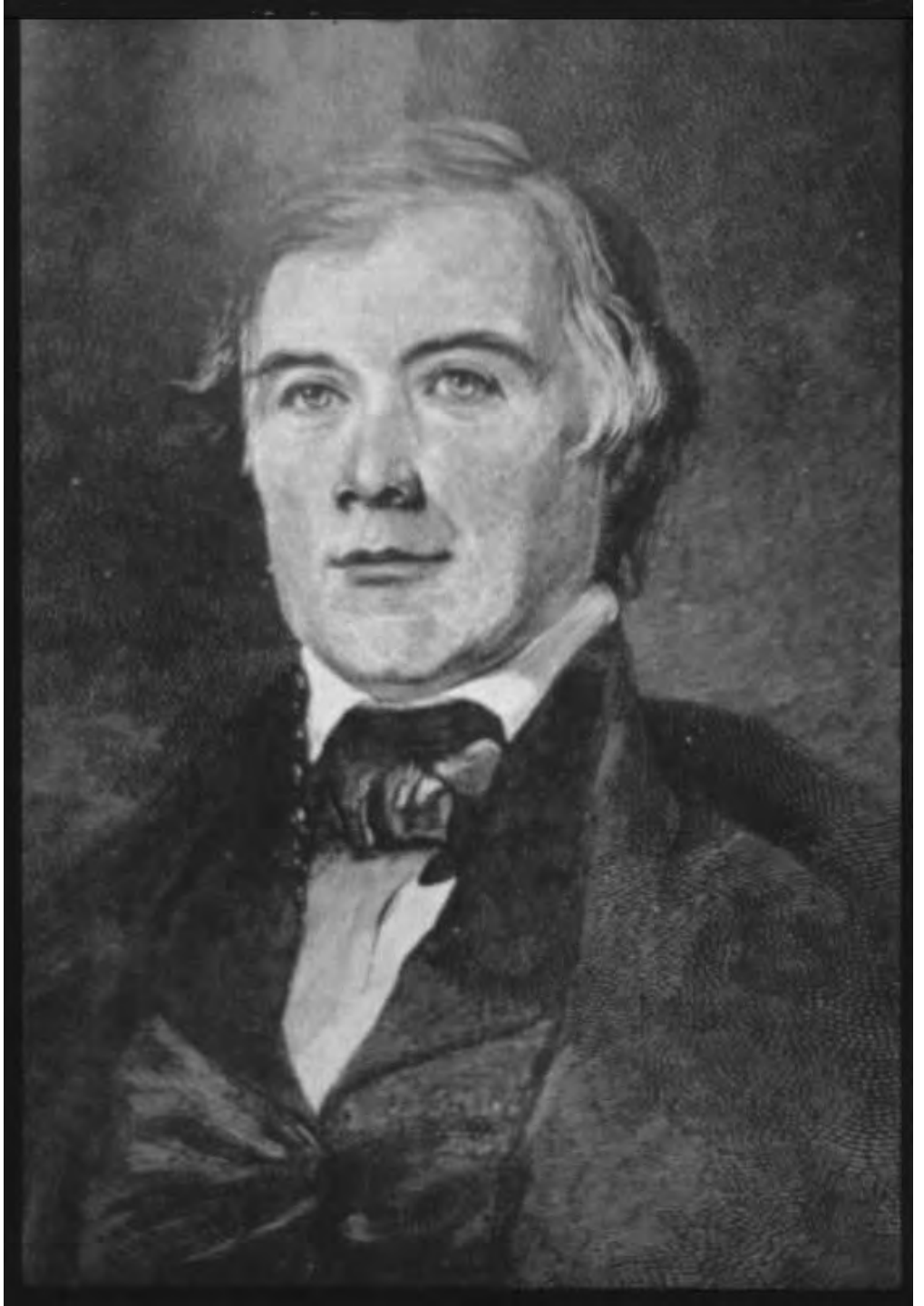
Myth and History

Hubris and Nemesis

Phaeton's Blunder



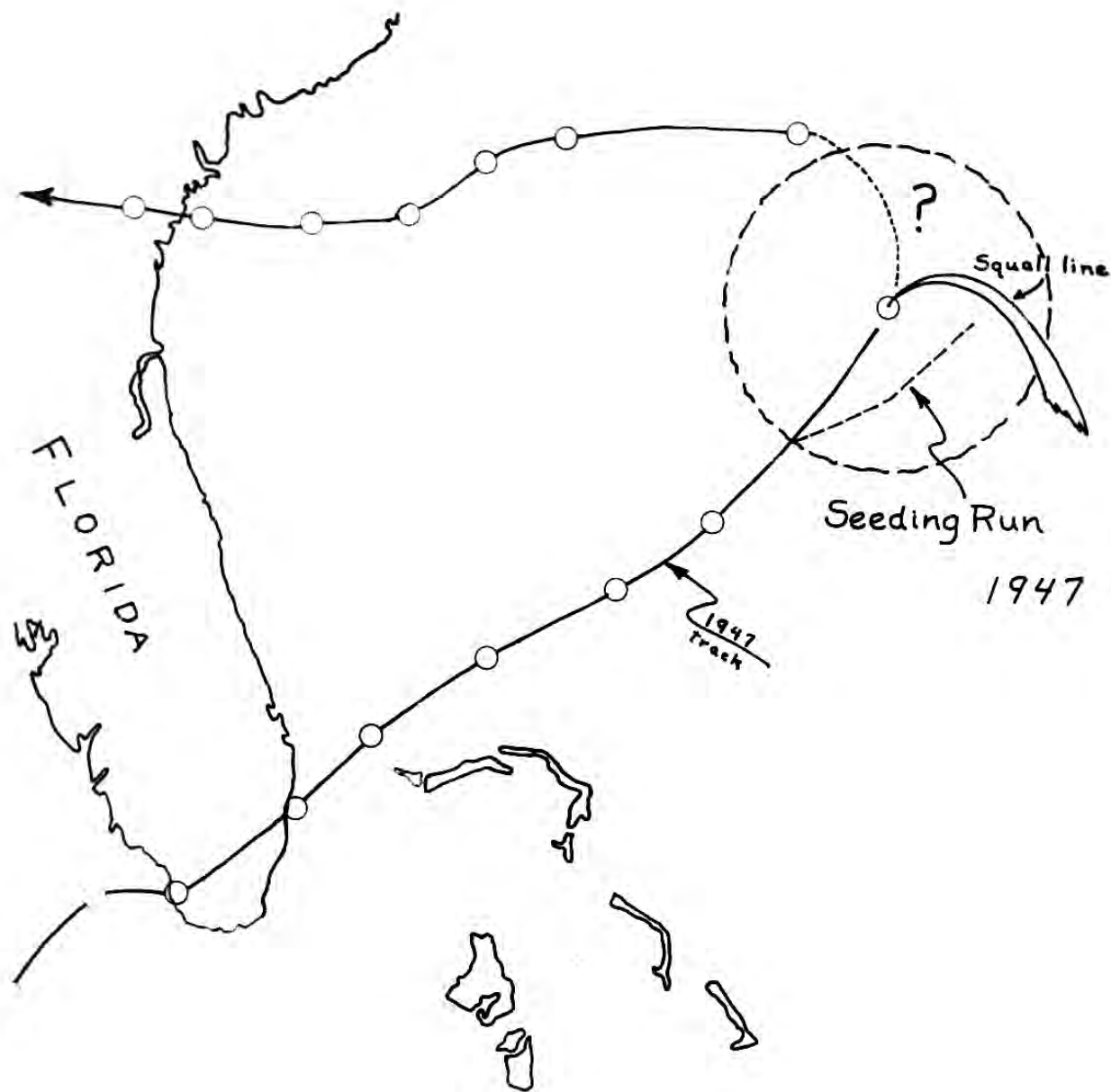
In 1839 James Espy, the first meteorologist employed by the US government, proposed rain-making by lighting massive fires.





**Eliza Leslie
(1787-1858)**

“The Rain King”
of 1942

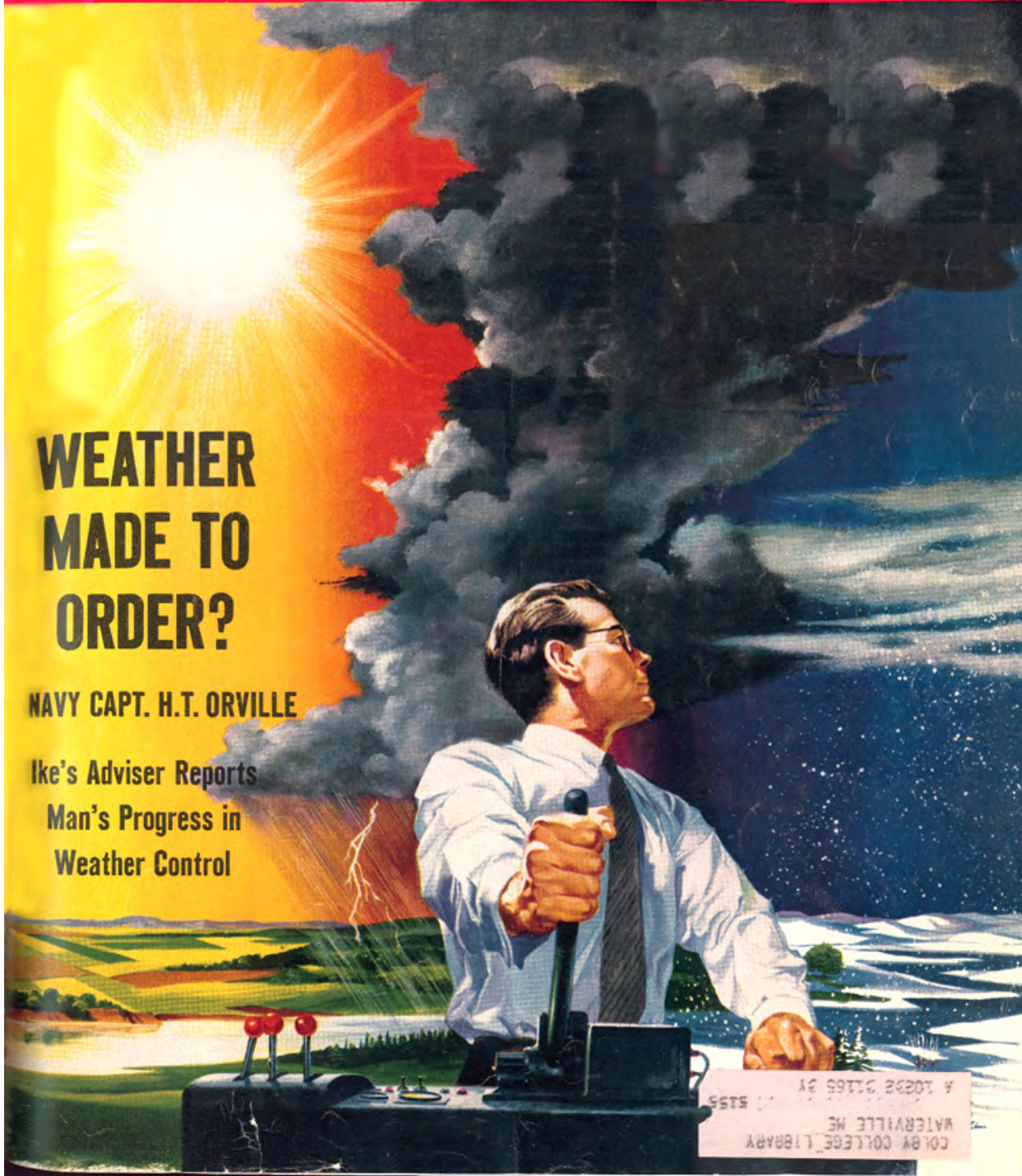


**1947
military
seeding of
a hurricane
by Project
Cirrus**

WEATHER MADE TO ORDER?

NAVY CAPT. H.T. ORVILLE

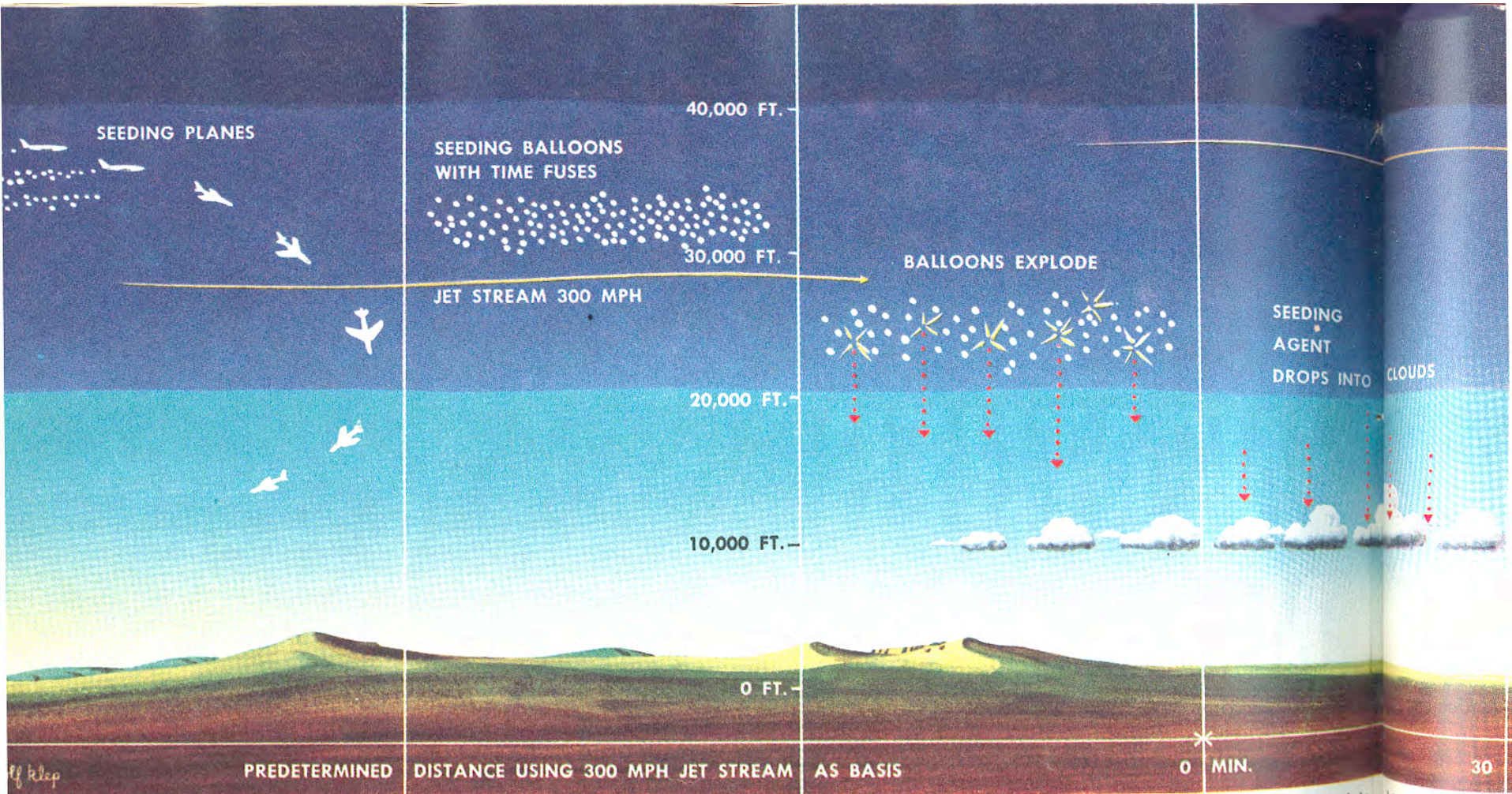
Ike's Adviser Reports
Man's Progress in
Weather Control



The Technocrat
Collier's (1954)

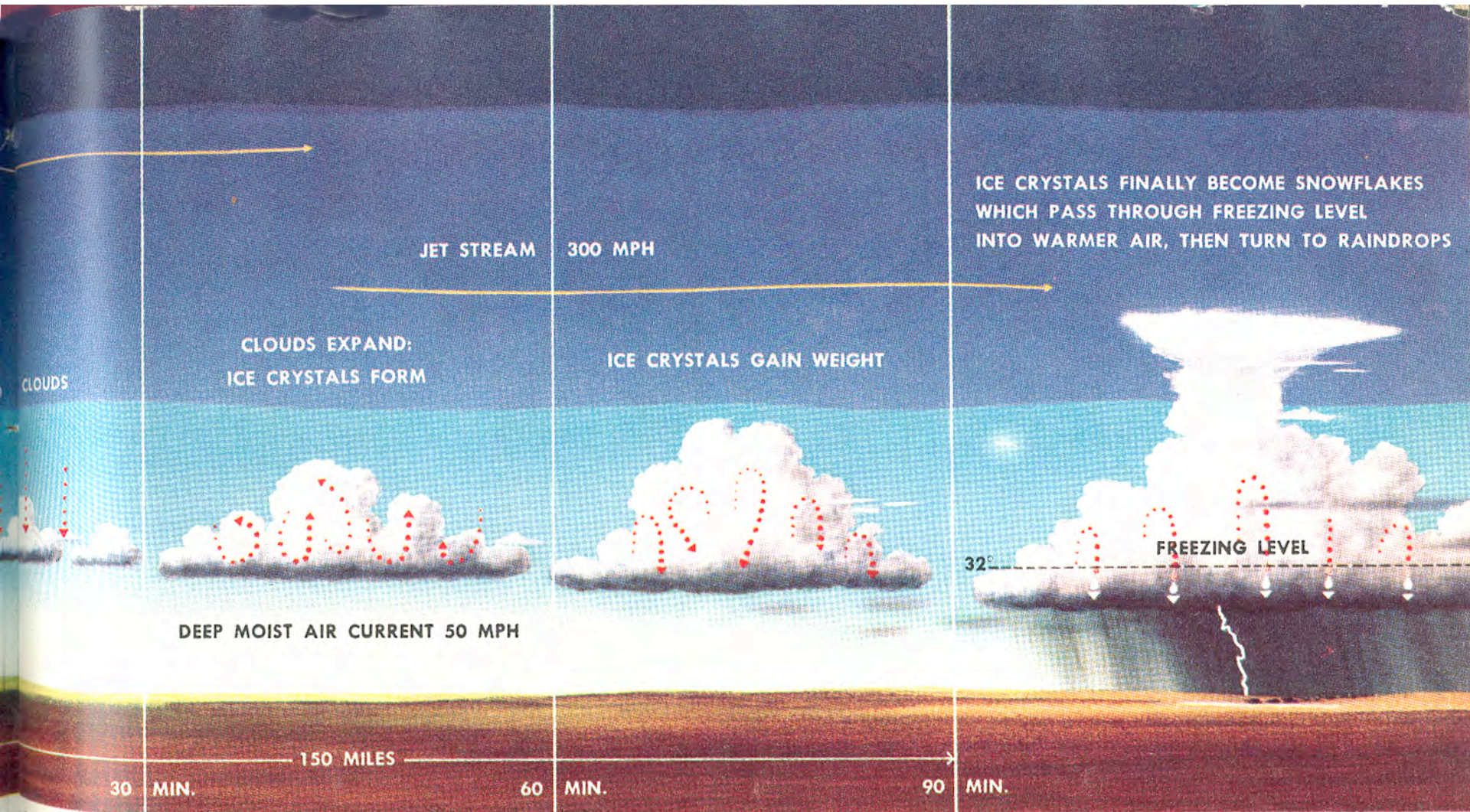
174

Weather Warfare? Aircraft seed clouds...

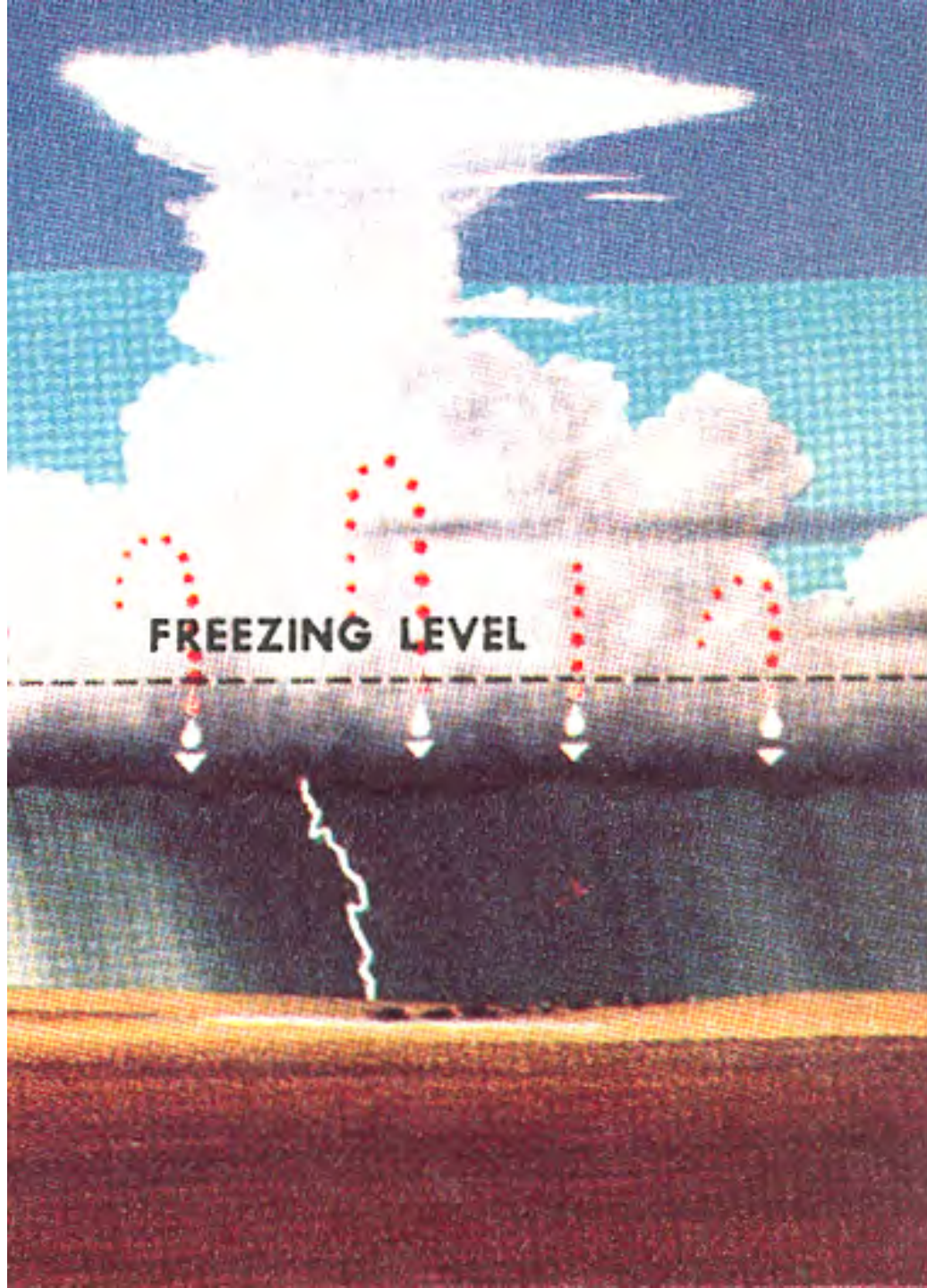


Weather control used as a military weapon: adapting civilian techniques to warfare, planes could drop balloons containing seeding crystals into high-speed upper-

Clouds turn angry



high-speed upper-air current. When fuses explode balloons, crystals drop into clouds, absorb moisture and fall as rain—miring enemy transport



**Invading force
neutralized!**

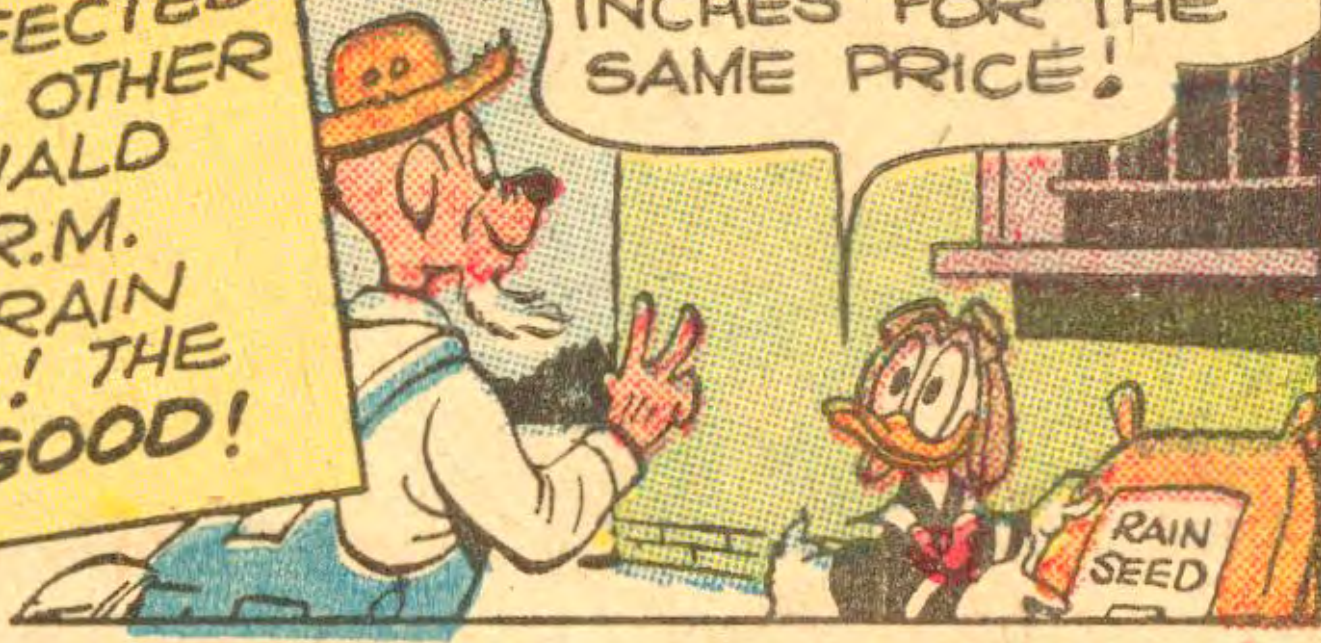
“Donald Duck, Master Rainmaker”

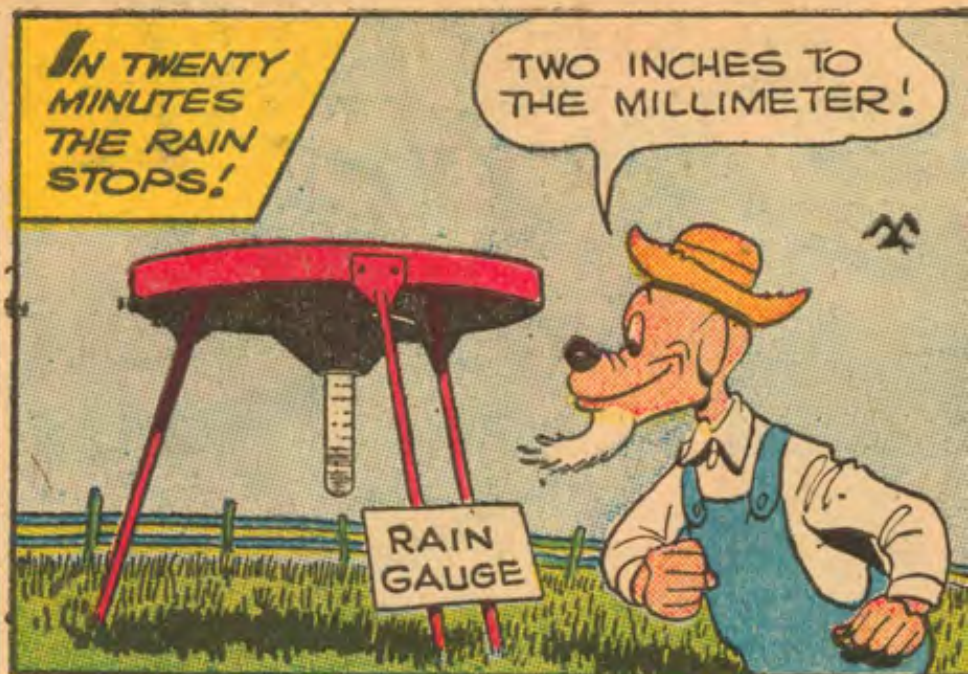
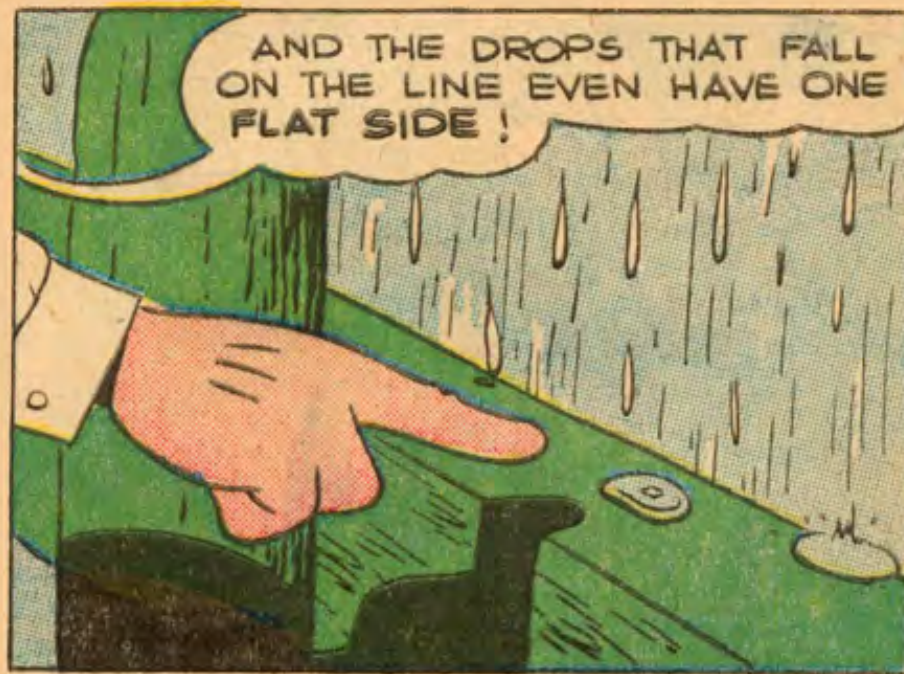
Walt Disney's Comics and Stories
(September 1953)

SOONER OR LATER
THE SCIENCE OF
RAIN MAKING WAS
BOUND TO BE
PERFECTED —
AND THE GUY
THAT PERFECTED
IT IS NONE OTHER
THAN DONALD
DUCK, M.R.M.
(MASTER RAIN
MAKER)! THE
BOY IS GOOD!

I'D LIKE TWO INCHES
OF RAIN ON MY
BARLEY FIELD!

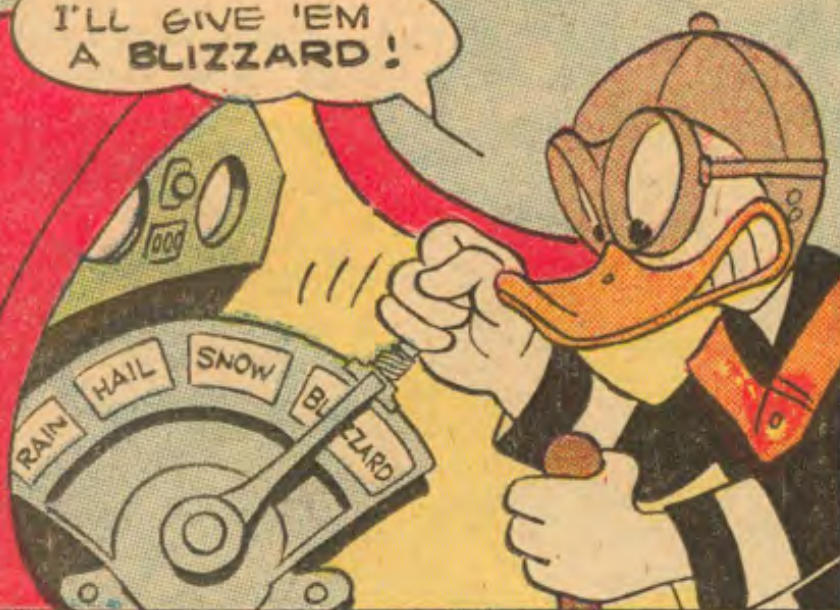
YOU CAN HAVE
TWO AND A QUARTER
INCHES FOR THE
SAME PRICE!



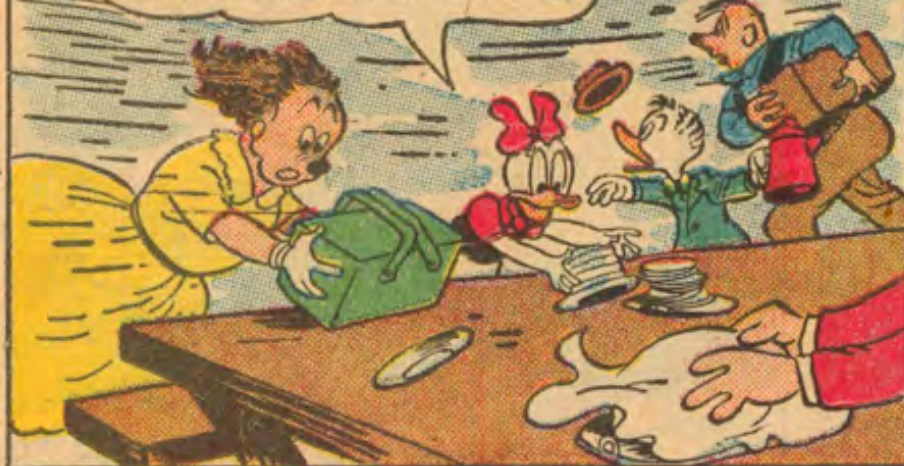


Meanwhile, Daisy has gone on a picnic with another duck, and Donald is jealous.

I'LL GIVE 'EM
A BLIZZARD!



WE'LL HAVE TO LEAVE!
SOMETHING TERRIBLE
HAS GONE WRONG
WITH THE WEATHER!



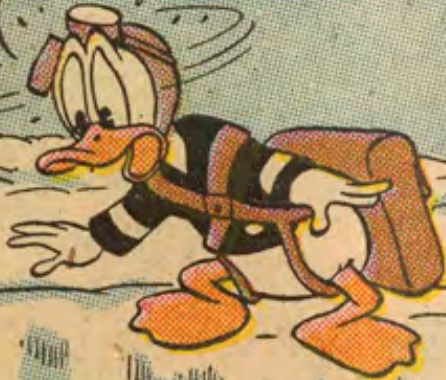
GREENWOOD
CANYON QUIVERS
BENEATH THE
ROAR OF DONALD'S
THUNDERING
HERD!

RUMBLE

GET ALONG, LITTLE
DOGIES!



GOODNIGHT! I OVERSEEDED!
THE CLOUDS HAVE TURNED INTO
A SOLID DOME OF ICE!



CRASH!

OUR CARS—
EVERYTHING
SMASHED!



HOW DID THAT DUCK KNOW
THOSE CLOUDS WERE ICE?

HA! I'VE GOT
NEWS FOR YOU,
CHUM!



YOUR RUTABAGAS
WILL HAVE TO WAIT,
MR. CORNSILK!

UNCA DONALD IS
VACATIONING
IN TIMBUKTU!





OUTLINE OF WEATHER PROPOSAL

by

V. K. Zworykin



October, 1945

RCA LABORATORIES
RADIO CORPORATION OF AMERICA
PRINCETON N.J.





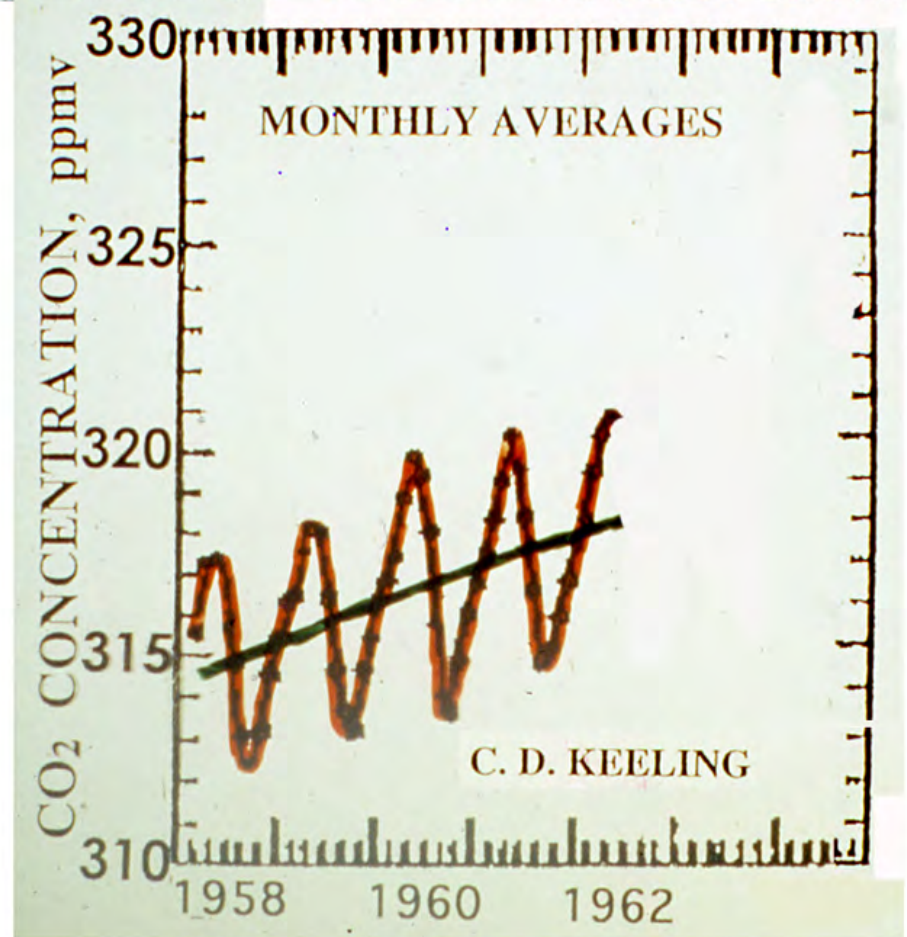
Wexler (L) with Von Neumann, Charney, ENIAC and others, 1954

Present awful possibilities of nuclear warfare may give way to others even more awful. After global climate control becomes possible, perhaps all our present involvements will seem simple. We should not deceive ourselves: once such possibilities become actual, they will be exploited.

—John von Neumann, “Can We Survive Technology?” (1955).



CARBON DIOXIDE CONCENTRATIONS MAUNA LOA OBSERVATORY, HAWAII





Wexler in the Oval Office



**World Weather Watch
Wexler and V.A. Bugaev in Geneva, Mar. 1962**

UV decomposes $O_3 \rightarrow O$

In presence of a halogen
like Br, Cl $O \rightarrow O_2$
+ so prevents O_3 from
forming.

100,000 tons Br. could then
prevent all O_3 north of $65^\circ N$
from forming.

[Climate control] can best be classified as “interesting hypothetical exercises” until the consequences of tampering with large scale atmospheric events can be assessed in advance. Most such schemes that have been advanced would require colossal engineering feats and contain the inherent risk of irremediable harm to our planet or side effects counterbalancing the possible short-term benefits.

—Harry Wexler 1962

TWENTY-FIVE CENTS

Pages 64-76

SPACE and the
RADIATION BELT



PHYSICIST
JAMES VAN ALLEN



\$7.00 A YEAR

1985 U.S. PAT. OFF.

VOL. LXXIII NO. 18

Ernie Ray #15/58

NOTE:



1958 γ

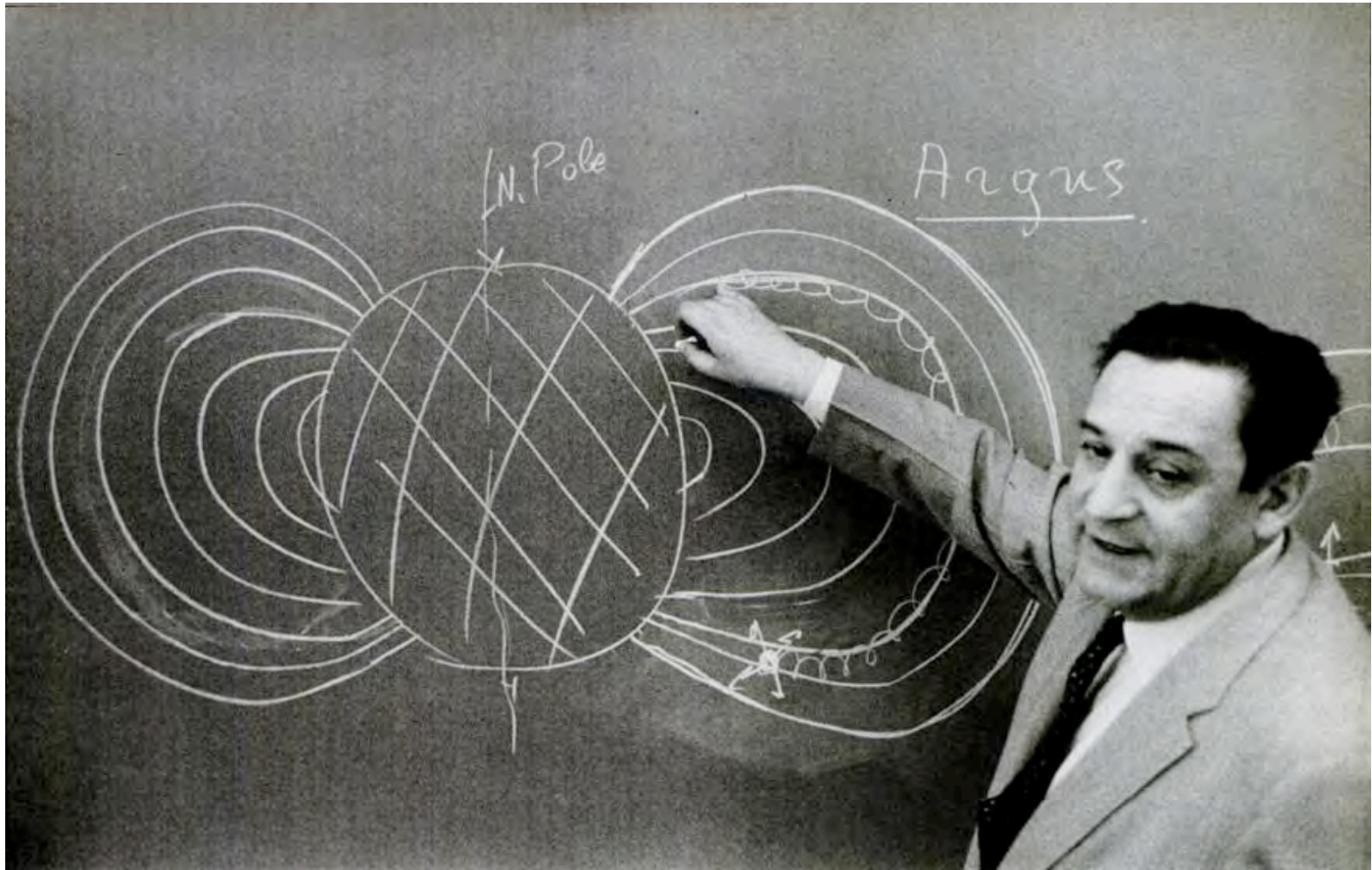
DATA

SPACE IS
RADIO ACTIVE

4/3/88

64
707 } ~ 60%

Discovering and disrupting the magnetosphere







*"But how do you know destroying the inner Van Allen belt
will create havoc until you try it?"*

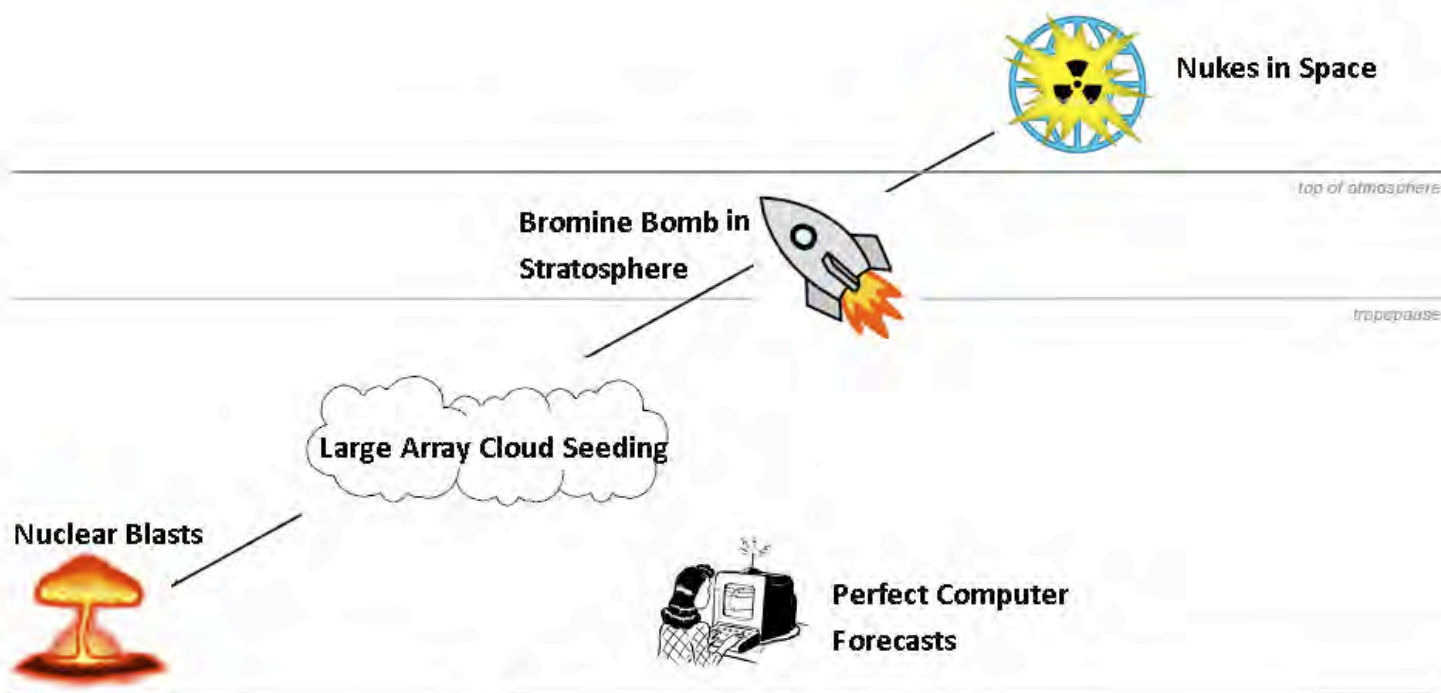
International Agreement

No country shall take any action that would cause a major disturbance of the natural environment of the earth without prior consultation with other countries –UK Government, 1963

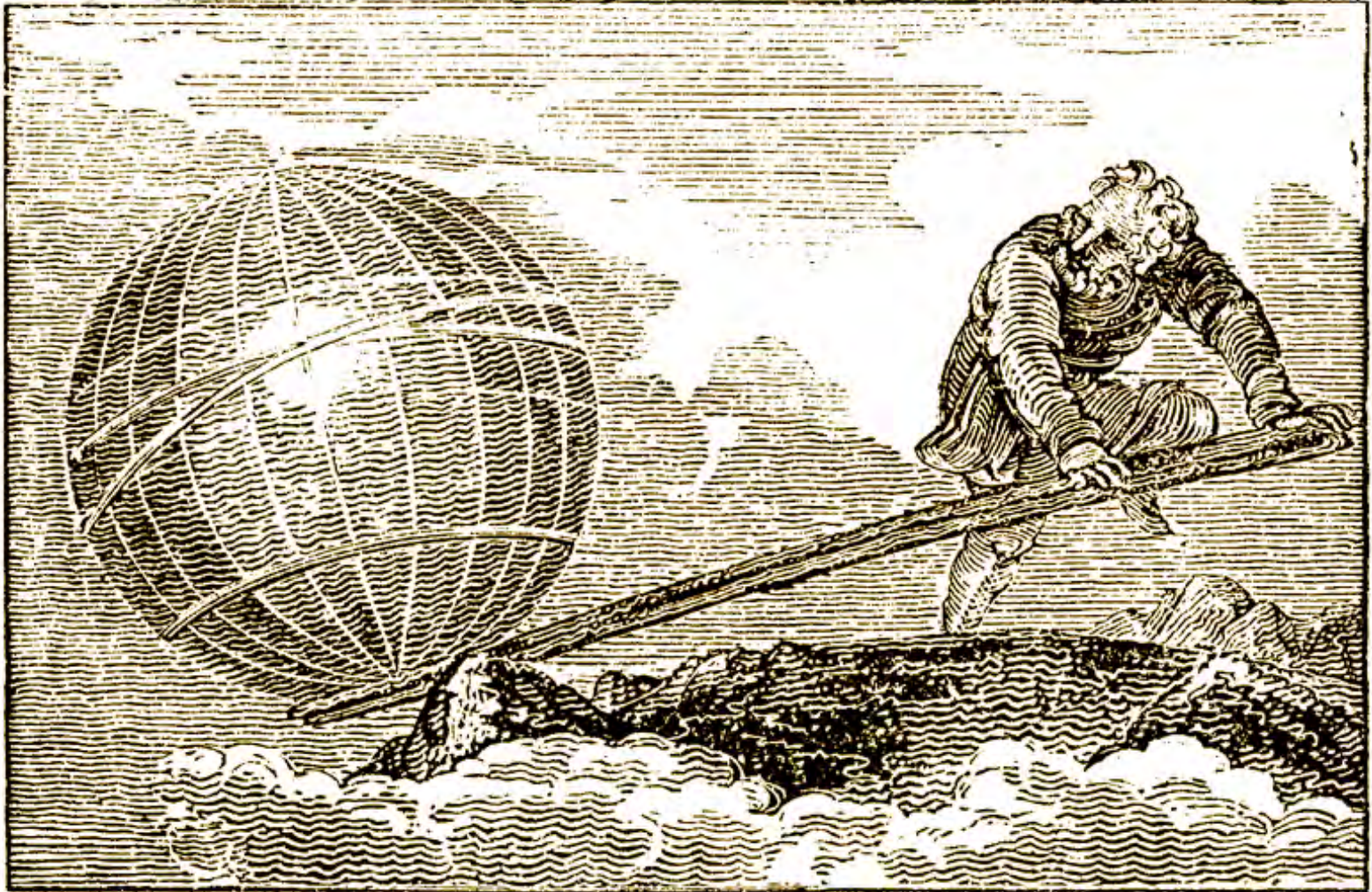
Limited Nuclear Test Ban Treaty, 1963

ENMOD (1978)

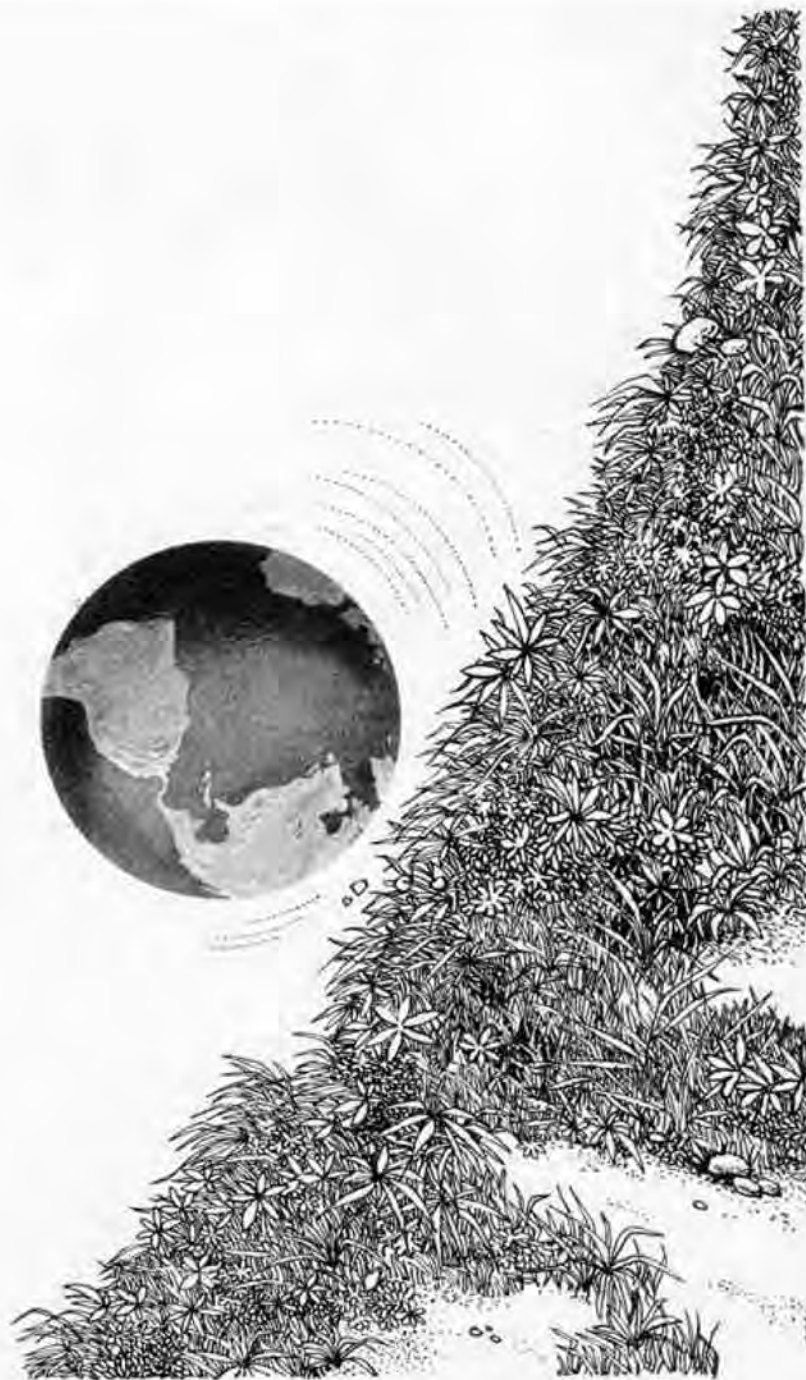
UN treaty prohibits environmental modification techniques that change “through the deliberate manipulation of natural processes—the dynamics, composition or structure of the Earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space.”



The “Tipping Point”



“Give me a place to stand and I will move the earth”—Archimedes.
Engraving from *Mechanics Magazine*, London, 1824.



Where will it roll?

WHAT SHALL WE DO?

Study the historical, ethical, legal, and social implications of geoengineering to integrate international, interdisciplinary, and intergenerational issues and perspectives and include lessons from past efforts to modify weather and climate.

-- AMS and AGU Policy Statement,
“Geoengineering the Climate System”

The Middle Course is Safest and Best – Helios

Follow the “middle course” of collective energy efficiency, environmental stewardship, and ethical choices.

Geoengineering 1945-1958: Proposed, Actual, and Notable Warnings

1945 Vladimir Zworykin proposes perfect prediction/control with digital computer

1945 Julian Huxley proposes nuclear weapons to dissolve polar ice cap

1947 Project Cirrus attempts diversion of Atlantic hurricane, followed by devastation of Savannah, Georgia

1955 Irving Langmuir proposes Pacific Basin cloud seeding to divert typhoons, alter circulation systems

1955 J. von Neumann, “Can We Survive Technology?” warns of global climate control and nuclear war

1958 Teak and Orange, 3.8 MT H-bombs detonated at 48 miles (mesosphere) and 27 miles (stratosphere)

1958 Project Argus, Three 1.7 KT atomic bombs detonated at 125-355 miles in magnetosphere creates artificial EMP

Geoengineering 1962-1967: Proposed, Actual, and Notable Warnings

1962 Harry Wexler warns that 100 KT Bromine bomb could destroy ozone layer

1962 Project Stormfury modification of Atlantic hurricanes is critiqued by Fidel Castro and government of Mexico

1962 Soviet Union detonates three H-Bombs detonated in space to generate EMP and test defense systems

1962 Starfish Prime, 1.4 MT H-Bomb detonated in magnetosphere for military advantage is directly followed by LIMITED TEST BAN treaty (1963)

1963 Project West Ford, 500 million copper needles launched into orbit to create artificial ionosphere

1965 Gordon MacDonald warns that geoengineering could be weaponized to wreck the planet

1967 Monsoonal cloud seeding over Vietnam leads to UN ENMOD treaty (1978)