

Weather modification as a future weapon

The military may have added the weather to its arsenal

by Louise A. Purrett

"All is fair in love and war"
—English proverb

The proverb isn't entirely true, at least not where warfare is concerned. For various reasons, men have agreed that certain weapons and methods of war should not be permitted. In some cases the reason is humanitarian—there are strict rules governing treatment of prisoners. On the other hand, some weapons, such as bacteriological, may ultimately affect large segments of terrestrial life, eventually even turning against the wielder. Now, mostly for the latter reason, Sen. Claiborne Pell (D-R.I.) and others are trying to add weather and climate modification to the list of "unfair" weapons.

Both intentionally and by accident, man has discovered ways to alter the weather. Meteorologists have found that by dropping powdered dry ice, silver iodide or certain other particulate matter into suitable clouds, they can induce or enhance precipitation. Such rainmaking has recently been used to alleviate severe droughts in Florida and Texas (SN: 12/11/71, p. 389). In Colorado, Project Skywater attempts to increase the Southwest's water supply by increasing the winter snowfall (SN: 12/12/70, p. 447). Rain enhancement techniques have become increasingly more sophisticated, and cloud seeding has been applied to a widening range of weather modification problems. Scientists in the National Oceanic and Atmospheric Administration's Project Stormfury, for example, seed hurricanes experimentally in an attempt to disperse the storm's energy over a wider area (SN: 8/21/71, p. 128), and in another study, cloud seeding is being used to try to reduce the growth of large destructive hailstones (SN: 3/20/71, p. 200).

So far, weather modification has been aimed at beneficial purposes. What can be used to benefit some, however, can be used to harm others. In 1968, Gordon J. F. MacDonald, a geophysicist who is now a member of the President's Council on Environmental Quality, described possible military applications of weather modification in a chapter of the book *Unless Peace Comes*. Precipitation could be

used to camouflage or inhibit ground operations, for example. More serious, he said, was the possibility that, by seeding clouds to remove their burden of moisture, rain could be prevented from reaching lands downwind, causing drought. He also suggested that it may one day become possible to steer hurricanes toward enemy shores.

On a larger scale, it has already been noted that man's activities have added aerosols and carbon dioxide to the earth's atmosphere, both inhibiting incoming solar radiation and preventing heat from being radiated from earth to space. Though the net effect of these changes is still disputed, there is little doubt that there are effects. The cli-

Pell and 13 other Senators have introduced a treaty to ban environmental and geophysical modification as a weapon of war.

mate is primarily determined by the balance between incoming and outgoing radiation. MacDonald suggested that a nation might decide that a worldwide warming or cooling of the climate would be to its advantage and make appropriate adjustments to the aerosol content of the atmosphere. Another possibility, said MacDonald, would be to create a hole in the ozone layer over a hostile nation, permitting the harmful radiation that this layer normally shields out to enter. He speculated that ways might even be devised to alter the ice caps and bring on an ice age.

The U.S. Department of Defense has long been active in weather modification research. Project Cirrus, sponsored by DOD and conducted by the General Electric Co., contributed much to the basic technology of cloud seeding. The DOD is co-sponsor of Project Stormfury. Defense's Advanced Research Projects Agency has a climate modification project called Nile Blue, funded at \$2.587 million for fiscal 1972. Using a powerful computer, Iliac IV, to be in-

stalled in June, Nile Blue scientists will try to develop computer models of the earth's climate. In 1969, at the request of the Government of the Philippine Islands, DOD conducted extensive rainmaking activities to relieve a drought in the islands. DOD estimates that the project produced more than 12 million acre-feet of rainfall.

Sen. Pell has expressed concern over "unofficial and unconfirmed" reports that the United States has put its weather modification expertise to use as a weapon of war in Southeast Asia. The reports range from suggestions that U.S. planes have been seeding clouds over the Ho Chi Minh Trail to increase rainfall and impede infiltrating troops from North Vietnam to more serious charges. Last August, for example, North Vietnam was subjected to its worst floods since 1945. Though there have been no reliable reports on casualties, the 1945 floods killed more than a million people. It is known that last year's floods ruined the rice crop, and because this was the first year that North Vietnam was supposed to be independent of the Soviet Union and China for its rice supply, it has been suggested that the normal monsoons were given a boost by the United States.

The consensus is that these reports are exaggerated and that the military potential of weather modification is limited. At present, weather modification is still in its infancy. Though rainfall can be enhanced or induced, the actual amount of increase is limited, and cloud conditions must fit rigid requirements for seeding to be effective. On the other hand, it is generally agreed that some military use of weather modification is being made.

Edward S. Epstein, chairman of the University of Michigan department of meteorology, says he has "very grave doubts" that U.S. tampering could have been responsible for the floods in North Vietnam. He does believe that some modification is probable. "Fog and cloud dispersal methods have been studied to increase aircraft safety and now are utilized regularly and successfully. Obviously, these methods also have offensive potential; if you can clear clouds to land you probably can clear clouds to bomb."

Commercial airports are often cleared of supercooled ground fog by seeding the fog with silver iodide to make it condense and fall to the ground. This method does not work on warm fogs, which are the kind found in Vietnam and other warm countries. In 1969, researchers at the Air Force's Cambridge Research Laboratories in Bedford, Mass., discovered that the downdraft created by a helicopter's rotors could blow away fog under some conditions. This method was tested at airports in West Virginia, where fog gathers in small pockets among the hills, and successfully cleared areas large enough for small planes to land. CRL chief scientist John N. Howard told SCIENCE NEWS that the method is now used in Vietnam, which has a similar topography, to pick up downed pilots and wounded ground troops. In addition, CRL meteorologists are working on two other techniques for clearing warm fog from airports: seeding with hygroscopic particles to condense the fog, and using burners along a runway to heat the air and evaporate the fog. The first method has been tested and has made holes in fog, but techniques for placing seeding to get the hole in the desired spot have not been established.

From a purely observational point of view, U.S. meteorological satellites provide pictures from which predictions of local cloud conditions can be made hours in advance—a valuable edge over the North Vietnamese, who don't have access to these pictures. In fact, one reason why there has been some competition between Governmental agencies regarding remote sensing (SN: 11/27/71, p. 362) and not over meteorological satellites is that data from the latter are available to both NASA and the DOD.

Last September, Sen. Pell wrote to Rady Johnson, assistant to the Secretary of Defense, asking about the purposes of a DOD project code-named "Intermediary—Compatriot" that is rumored to be an offense-oriented weather modification study. Johnson replied that DOD's interests in weather modification included suppression of hail and lightning to reduce damage to military equipment, dissipation of fog at airfields and harbors, and "understanding of what capabilities our potential enemies may possess in the area of weather modification operations." The letter, however, did not answer Pell's questions about "Intermediary—Compatriot." When Pell then wrote to Secretary of Defense Melvin Laird, John S. Foster Jr., director of Defense Research and Engineering, replied that "certain aspects of our work in this area are classified," and that, for national security reasons, information on certain DOD weather modification ac-

tivities would be given only to the chairmen of the Congressional committees with primary responsibility for the department.

At Nile Blue budget hearings last year, ARPA director Stephen J. Lukasik mentioned the possibility that "major world powers have the ability to create modifications of climate that might be seriously detrimental to the security of this country," but said that Nile Blue was aimed at predicting climatic effects of various actions and detecting global trends. ARPA spokesmen recently told SCIENCE NEWS that Nile Blue is strictly a computer modeling study and that no field experiments have been conducted.

Whether or not the military is now using weather modification, says Pell, "The use of rainmaking as a weapon of war can only lead to the development

of vastly more dangerous environmental techniques whose consequences may be unknown and may cause irreparable damage to our global environment."

In fact, some nongovernment scientists have expressed concern over the military uses to which their meteorological discoveries might be put, and though they believe a number of breakthroughs are imminent, they are a bit reluctant to see advances made when they might be used as weapons of war.

On March 17 Pell and 13 other Senators introduced a draft treaty to ban the use of environmental and geophysical modification as a weapon of war. Pell says his Subcommittee on Oceans and International Environment will hold hearings on the subject. "It is imperative that restraint be exercised early in the developmental stages before irretrievable precedents are set." □

MOTHER'S DAY GIFT

Lyn-Lee-Lou Publishing Co. has just released a new 45RPM record entitled "A Mother's Day Card in a Song" with words and music by Warren Colbert. Not available on the stands this year, it can only be purchased directly from Lyn-Lee-Lou. Cost \$1.00 postpaid. Lyn-Lee-Lou Publishing Co., 23 Mansion Road, Linticum Heights, Maryland 21090.

SCIENCE/WILDERNESS EXPLORING AT CAMP FOR BOYS

SPRUCE MOUNTAIN
BRYANT POND, MAINE
New knowledge, new skills, new challenges in 3 major areas—Science Exploring, Outdoor Exploring and Lifetime Sports. Boys 10-15. Field, mountain, canoe trips. Outpost at Mt. Katahdin. SAFARI I wilderness program, SAFARI II in Canadian Rockies. Ham radio, photography, plants, animals, weather, geology, ecology, astronomy. Staff inquiries invited. Catalog:

William T. Harty, Director
12 Highland St., W. Medway, Mass. 02053

LIVE IN THE WORLD OF TOMORROW... TODAY!

UNUSUAL BARGAINS

NEW PRODUCTS • NEW MATERIALS • NEW IDEAS

SCIENCE FAIR HEADQUARTERS USA

GIANT WEATHER BALLOONS



"Balls of fun" for kids, traffic stoppers for stores, terrific for amateur meteorologists. Create a neighborhood sensation. Great backyard fun. Exciting beach attraction. Amateur meteorologists use to measure cloud heights, wind speed and temp. Made of heavy-duty neoprene. Inflate with vacuum cleaner

or auto air hose; or locally available helium for high rise.
Stock No. 60,568Q (8' size) ----- \$2.00 Ppd.
Stock No. 60,632Q (16' size) ----- \$7.00 Ppd.

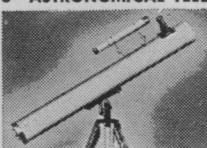
HELIUM BALLOONS MAKE A "BALL"



Anytime there's a balloon the air is festive. Especially when the "air" is helium, which makes a balloon perky and adventurous. Now here's 25 times the fun—25 various colored balloons of 4, 5, or 8" diameter when inflated. With them, a pressurized (300 lbs./sq. in.) can containing 25 liters of helium

to inflate all 25. For adults or kids' parties, giveaways, bazaars or just demonstrating "lighter than air." Helium is a safe non-toxic inert gas.
Stock No. 71, 289Q ----- \$3.00 Ppd.

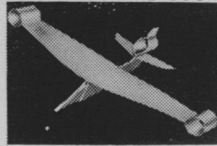
3" ASTRONOMICAL TELESCOPE



See moon shots, orbits, stars, phases of Venus, planets close up. 60 to 180 power. Aluminized, overcoated 3" diam. $\frac{1}{10}$ primary mirror, ventilated cell. Equatorial mount with locks on both axes. 60x eyepiece and mounted Barlow lens. 3x finder telescope, hardwood tripod.

FREE: "Star Chart," "Handbook of the Heavens."
Stock No. 85,050Q ----- \$32.95
DELUXE 3"
Stock No. 80,162Q ----- \$59.50 Ppd.
Stock No. 85,105Q ----- \$94.50 FOB
Stock No. 85,086Q ----- \$239.50 FOB

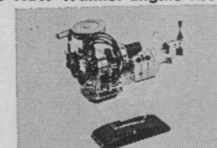
GREAT INT'L PAPER PLANE BOOK



Official fly-them-yourself book of paper airplanes from SCIENTIFIC AMERICAN'S "1st International Competition." Includes plans of all winning entries, time-of-flight records, photos, technical data, commentaries. Has 20 unusual designs on perforated pages for easy tear-out. You won't believe how some of them fly! Amusing, entertaining. 128 pages. 9" x 11 1/2".

Stock No. 9391Q ----- \$2.95 Ppd.
"STICK-PAPER AIRPLANES" BOOK
Stock No. 9427Q ----- \$4.95 Ppd.

AMAZING NEW Wankel Engine KIT



Thrill to the fun of building your own sea-through motorized model of revolutionary pistonless type engine. Only engine expert think economically modifiable to meet new pollution standards. Replaces piston, cylinder, crank assemblies with rotating discs (sections removed for firing chambers). Smaller than conventional; fewer parts, greater reliability, same speed w/less horsepower. Feet: flashing plugs, rubber fan belt, stick-shift on-off switch, Req. 2-1.5 V batt. (not incl.).

No. 71,424Q (4 1/2" 5" x 9") ----- \$6.75 Ppd.

MAIL COUPON FOR GIANT FREE CATALOG

148 PAGES! MORE THAN 4,000 UNUSUAL BARGAINS

Enormous variety of telescopes, microscopes, binoculars, magnets, magnifiers, photo components, lenses, prisms, optical instruments, parts, Science Fair kits, projects and accessories. Write for Free Catalog "Q" Edmund Scientific Co., 300 Edscorp Building, Barrington, New Jersey 08007.

Name _____
Address _____
City _____ State _____ Zip _____

EDMUND SCIENTIFIC CO. 300 EDSCORP BLDG. BARRINGTON, NEW JERSEY 08007
ORDER BY STOCK NUMBER • SEND CHECK OR MONEY ORDER • MONEY-BACK GUARANTEE