UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

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Informational

MAY 17 1968

Memorandum

To: Directorate and All Regional Directors

From: Acting Assistant Director, Operations

Subject: Statement on "New Applications of Science"

"New Applications of Science" is the subject of the enclosed statement and the outline from which the statement was developed. These summarize where the Service now stands and what it expects to do in the future about problems and challenges emerging from activities in fields such as weather modification, sonic booms and other aircraft noise disturbance, nuclear energy installations and earth-orbiting satellites.

The subject expanded in the outline and accompanying statement is one of a number of topics discussed on April 17 during a session of the Advisory Board on National Parks, Historic Sites, Buildings and Monuments under the general theme of "Tomorrow's Problems and Challenges." In view of the interest generated in the discussion, the Advisory Board has asked that information on these topics be updated during subsequent meetings. This request prompts us to give wider distribution within the Service to the enclosed outline and statement, in the interest of improved communication on matters of this kind.

Much of the value derived from the distribution of this information will be lost unless substantial feedback is generated. A free two-way flow of information will enable all levels within the Service to respond and adjust more effectively to the many new problems posed by the ever-expanding activities in nuclear and space age science.

Involvement in these activities in many instances is a new venture for the Service. This is one reason why a feedback of information on nuclear and space age scientific activities affecting areas in the National Park System and suggestions as to how the Service should respond to them will be of help to everyone concerned. Your comment on this subject is solicited.

An additional 75 copies of this memorandum and enclosure are being sent under separate cover to each Regional Office for distribution to each park within the Region.

This informational memorandum is cancelled on December 31, 1968.

Leslie P. Arnberger

Enclosure

New Applications of Science

*General Session - Wednesday April 17, 1968

Outline

I. Nuclear and space age science and technology

A. Discoveries and developments

1. New problems and challenges
2. Adverse or beneficial influences
3. Response by necessity or choice

B. Nature of response

1. Utilize to advantage
2. Resist or neutralize influences
3. Endeavor to adjust to the inevitable

II. Implications of discoveries and developments

A. Weather modification

1. Present state of the art

a. Increase or decrease in normal precipitation
b. Control of hail, lightning, tornadoes and hurricanes

2. Potential influences

a. Ecological impact
b. Alteration of physical environment
c. Possible creation of safety hazards
d. Neutralization of damaging weather and climatic phenomena

3. Current status of Service response

a. Summarization of state of the art
b. Analysis and evaluation of influences
c. Formulation of position and policy statement

B. Sonic booms and other aircraft disturbance

1. Potential damage to natural and cultural features

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*Advisory Board on National Parks, Historic Sites, Buildings and Monuments under general theme of "Tomorrow's Problems and Challenges."

2. Disturbance of wildlife and ecosystems
3. Noise pollution effects on human populations
4. Service response

    a. Data accumulation
    b. Identification of critical situations
    c. Discussions and consultations

        i. Science Adviser to Secretary
        ii. Federal Aviation Administration
        iii. Department of Defense

C. Nuclear power plants and appurtenant works

1. Location and extent
2. Reactor type and size
3. Appurtenant works

    a. Desalting facilities
    b. Aquaducts and discharge installations
    c. Electric power transmission lines

4. Radioactive and other waste products

    a. Kinds and quantities
    b. Intensity and duration of radioactivity
    c. Thermal pollution potential
    d. Disposition

5. Service activity in meeting situations

    a. Assistance with interagency agreements
    b. Evaluation of AEC hazards analysis reports
    c. Contemplated development of criteria
    d. Assessment of potential harm or benefit

        i. Ecosystems and visitors
        ii. Desalted water as park waters substitute

D. Earth-orbiting satellites

1. Park resources observation by remote-sensors

    a. Types of remote-sensors

i. TV cameras, infrared, radar, microwave and laser
ii. Capability evaluations

2. Department's EROS Program

a. Feasibility studies
b. Objectives and program development
c. Satellites to supplement aircraft and ground observations

3. Service response

a. Cooperation with Geological Survey
b. EROS Program Coordinator designated

4. Anticipated benefits

a. Ecological monitoring
b. Detection of thermal and other changes
c. Fire prevention and suppression
d. Archeological reconnaissance

III. Summary

A. Nuclear and space age as a new era
B. New challenges posed requiring new approaches
C. Transition of Service response from passive to active phase

Robert H. Rose
Chief Geologist
April 17, 1968

*New Applications of Science

Introduction

This phase of the discussion of "Tomorrow's Problems and Challenges" focuses on certain aspects of modern science and technology and their application to programs of the National Park Service. The influences and implications evolving from the crescendo of discoveries and developments in science and technology during the past few decades must be understood and evaluated in terms of their potential benefit or harm to the areas of the National Park System.

The Service is having to respond to these influences and implications today more and more as a matter of necessity rather than choice. A great many of the forces causing imbalances and impairment within the national parks in the past were largely localized in their origin and impact. Today there are new forces which originate and spread under circumstances beyond our control. We can no longer rely on geographic insulation and isolation of the national parks to provide the degree of protection required. Moreover, if we respond to these new forces passively or negatively we will eventually find ourselves unprepared to do the right things at the right time in meeting our resources preservation and management responsibilities.

We must understand and evaluate these influences and implications in a manner which enhances the best interests of the Service. In some cases the discoveries and developments can be utilized to advantage. In other instances those forces can be identified which should be resisted or neutralized. And, of course, new influences beyond our immediate control will be encountered in which our only recourse is to adjust to the inevitable as effectively as possible.

Weather Modification

Weather modification is a good illustration of an activity in modern science and technology with which the Service is becoming involved to a greater degree today than in the past. Developments in this field continue to unfold at a rapid pace. As recently as 1946, Langmuir and Schaefer discovered the spectacular visual effects of cloudseeding with dry ice, silver iodide and certain other cloud nucleation particles. Historically, cloudseeding originated with the famed cloud chamber experiments of C. T. R. Wilson and other European physicists prior to the turn of the century. Cloud chamber methods and techniques were applied to a study of smoke and smog concentrations in the industrial sectors of London and elsewhere in the British Isles. This indicates that the gathering of data on air pollution is not new.

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*One of series of presentations on "Tomorrow's Problems and Challenges" before April 1968 meeting of Advisory Board on National Parks, Historic Sites, Buildings and Monuments

The discoveries of Langmuir and Schaefer sparked an explosive growth of interest and experimentation in cloudseeding in the United States and throughout the world. The major thrust since that time has been directed toward scientific research. However, weather practitioners have also been engaged in a swelling tide of activity which today involves literally hundreds of projects aggregating millions of dollars.

With respect to the present state of the art, it has been definitely established that under certain special conditions increases in precipitation upward of 10 to 15 percent can be produced by the seeding of winter-type storm clouds in mountainous areas. Increases in precipitation have unquestionably been produced under a variety of conditions and situations differing from those upon which the claim stated in the underscored lines above is based. Reports from Australia claim that cloudseeding has produced a 30-percent increase in winter snowfall. From Israel comes word that a 15-percent augmentation of normal rainfall is anticipated in connection with a large cloudseeding project covering the northern half of that nation.

Claims that cloudseeding increases rainfall are difficult to substantiate. The variables involved are numerous, diverse and complex making it very difficult in most instances to express the results in reliable quantitative terms. However, competent observers believe that there is substance to a great many of the claims and these experts are of the opinion that further significant breakthroughs in weather modification are imminent.

Weather modification in its broader sense also includes the efforts to control hail, lightning, tornadoes, hurricanes and other atmospheric phenomena. The influences on the national parks stemming from these activities could be profound. Cloudbursts and heavy rainfall or floods which might be unwittingly produced could change the physical and biological environment and create serious hazards to human life and property. Entire ecosystems could be disastrously affected.

Looking at the brighter side of the coin, however, benefits could accrue from the regulated application of weather modification methods and techniques. Under certain conditions protracted droughts of the kind which have plagued the Everglades in recent years might be alleviated. Potentially severe hail might be broken up in its formative stages. Severe lightning, accompanied by little or no rain, which often kindles a rash of forest and grassland fires might be dissipated. And through continued refinement of the art, we can look forward to a time when the optimum seasonal and areal distribution of precipitation might be achieved.

Our current thrust in weather modification is being directed toward a summarization of the state of the art, an analysis and evaluation of the potential impact of weather modification on park ecosystems and the formulation of a Service position and policy statement. The end product of these efforts may assist the Service in determining what its response should be in the future to matters such as the ever-increasing number of applications we can expect to receive from various rainmaking practitioners and investigators.

Sonic Booms and Low-flying Aircraft Noise Disturbance

Sonic booms and low-flying aircraft noise disturbance in the national parks are another outgrowth of modern science and technology. The impact of sonic booms and related aircraft noise disturbance has thrust itself upon the Service with the suddenness of a bombshell. This impact has already attained major proportions in a great many areas of the National Park System. While most of the evidence of actual damage to natural features and prehistoric Indian ruins appears to be circumstantial, in some instances the relationship between cause and effect cannot be reasonably challenged. Reports of damage purportedly caused by sonic booms continue to be received from time to time.

A growing concern within and outside the Service is developing with regard to the impact of sonic booms and low-flying aircraft disturbance on visitors as well as the natural and cultural resources of the parks. In some areas, such as Death Valley, in which the atmosphere of quiet and solitude have long been recognized as precious assets, the situation is little short of critical. During a reporting period of six months between September 1967 and February 1968, Death Valley was strongly boomed 323 times. Sixty eight of these booms were classed as severe which means that they shook buildings, rattled windows and startled residents and visitors by the thunder-clap noise that resulted.

The Service is gathering data on sonic booms and low-flying aircraft disturbances, identifying areas where serious situations exist or are developing, and participating in discussions on the matter from time to time with the Science Adviser to the Secretary and appropriate representatives of the Federal Aviation Administration. The data we receive are being summarized, interpreted and evaluated. We are now better prepared to take steps toward the alleviation of the more critical situations. Experience teaches us that little progress can be made toward obtaining the cooperation of the Federal Aviation Administration and the Department of Defense without reliable and documented data to support the cases presented to them.

Nuclear Energy Installations and Related Matters

Proposals to build nuclear power reactors and appurtenant installations are referred to us for review when the sites suggested or chosen are located near areas administered by the Service. These developments pose new kinds of problems and challenges not encountered until the decade beginning about 1960.

The operation of nuclear reactors involves the handling and disposition of highly radioactive gaseous, liquid and solid wastes characterized by their varying rates of radioactive decay. Thermal pollution also occurs as great quantities of cool water become heated as they circulate through the reactor. This water is discharged at a much higher temperature within or near the source from whence it came. Nuclear reactors are approved and licensed by the Atomic Energy Commission after very stringent safety requirements are met. But the responsibility still rests with the Service to evaluate these reactors and appurtenant installations in terms of their potential adverse influences on park visitors and resources.

The Service has been requested on several occasions during the past few years to evaluate nuclear power reactor proposals. We have participated in drafting interagency agreements, made evaluations of Atomic Energy Commission hazards analysis reports, and are now working on criteria which might be useful in the evaluation of future proposals. We were asked to evaluate a proposal to build a nuclear power generation plant on Bodega Head near the northern tip of the Point Reyes National Seashore. We also had an opportunity recently to review an exploratory proposal which envisions the building of a huge dual-purpose nuclear power and water desalting plant which would be located either on the Pacific coast of California or on a Gulf of California shoreline site.

Should this nuclear and desalting plant be located in southern California, an electrical energy transmission line and desalted water aquaduct would skirt the edge of Joshua Tree National Monument. If the feasibility studies still in progress were to disclose cost and other advantages in building a portion of the powerline and aquaduct on monument lands, the Service would have an unquestioned interest in the proposal in its advance planning stages.

The proposed dual-purpose installation poses other problems of vital interest and concern to the Service. The tentative plan calls for the delivery of 2.0 to 2.5 million acre-feet of desalted water annually and its discharge into one of the large reservoirs -- Lake Mead, Lake Havasu or Lake Mohave -- in the lower Colorado River Basin. The transportation of the desalted water and its discharge into one of the upstream reservoirs of the Colorado River Basin would improve the quality of the water at, and below, the point of discharge from the standpoint of domestic,

irrigation and industrial uses. The augmented supply would also make 7.5 million acre-feet of water available annually in the Lower Basin states and relieve the Upper Basin states of the obligation on the part of the United States to deliver 1.5 million acre-feet of water annually to Mexico.

In addition to the location of power transmission lines and the aquaduct near, or upon, Joshua Tree and Lake Mead National Recreation Area lands, the Service would be vitally concerned about the hydrological, biological and other effects of dumping huge quantities of desalted water, similar in quality to distilled water, into one of the principal recreation area reservoirs. However, in weighing proposals of this kind, we should not blind ourselves to the merits of the well-known adage which holds that "every dark cloud has a silver lining." There always exists the hopeful possibility that the production of huge quantities of desalted water by the use of nuclear power might very well relieve the pressure to build dams in the national parks to collect and store water for various uses on the outside.

EROS Program

The Service is cooperating with the Geological Survey in the extensive investigations that agency has been conducting to determine the feasibility of utilizing remote-sensors aboard earth-orbiting satellites to observe and study terrestrial resources and environments. It has been determined that there is merit in the proposal to gather data by satellites to supplement information obtained by aircraft and ground observation. By a news release, dated September 21, 1966, the Department launched the EROS (Earth Resources Observation Satellites) Program. Feasibility studies are continuing, the objectives of the program are being crystallized, and a unified program designed to meet the needs of the various bureaus in the Department is in the process of development.

The EROS Program contemplates the placing of several satellites into orbit at intervals, starting with the launching of EROS I perhaps as early as 1969 or 1970. EROS I, the first in a series, would carry a television camera and possibly a few instruments of other types. The data obtained by the camera and other types of remote-sensors would serve a number of useful purposes. Among these purposes would be: ecological monitoring; the detection of tree disease and insect infestations; thermal scanning of changing underground heat conditions in areas such as Hawaii Volcanoes, Yellowstone and Mount Rainier; fire detection and suppression; and possibly archeological reconnaissance.

The capabilities of television cameras, still cameras, radar and infrared scanners have been thoroughly tested. Other types of remote-sensors such as microwave radiometers and laser altimeters, however, are yet in their experimental stages of development. The new types of remote-sensors which prove their value in the meantime may be used in connection with some of the later satellite launches of the EROS series.

Other Scientific Developments

Many other scientific and technologic development could be included but the purpose of this discussion will be served by passing reference to only a few of them.

The past 20 years have seen the origin and development of the radiocarbon 14 method of dating materials of animal and vegetable origin and the objects closely associated with them. Radioactive fallout from hydrogen bomb detonations has accumulated in the upper portions of glacial ice masses providing a means of determining the rates of growth and decay of glaciers. Geologists have taken advantage of the slow rates of radioactive decay of the isotopes of elements, such as potassium, to determine the ages of certain types of rocks which were formed many millions to a few billions of years ago. Radioactive tracer elements, such as the isotope of hydrogen known as tritium, are being used to determine the rates of movement and other characteristics of underground water.

Conclusion

This presentation offers only fleeting glimpses into some of the scientific and technologic challenges which face the Service today. However, these may be sufficient to demonstrate that we have entered a new era to which the Service must respond and adjust with all of the knowledge and wisdom at its command. The new era into which we are entering poses new problems and new challenges which require correspondingly new approaches. These challenges concern influences and implications of science and technology of both a beneficial and harmful nature. It is hoped that this presentation may help to further define the manner and direction in which the Service must move in the future in meeting these problems and challenges.

Robert H. Rose
Chief Geologist
April 17, 1968