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WOODS HOLE OCEANOGRAPHIC INSTITUTION

REFERENCE NO. 66-5

METEOROLOGICAL STUDIES CONDUCTED BY
CONTRACT NONR 4071 (00)

Claude Ronne

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WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts

REFERENCE NO. 66-5

METEOROLOGICAL STUDIES CONDUCTED BY CONTRACT NONR 4071 (00)

Final Report

by

Claude Ronne

February 1966

TECHNICAL REPORT

*Submitted to the Office of Naval Research
under Contract Nonr-4071 (00)*

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Claes G. H. Rooth, Assistant Department Chairman
Theoretical Oceanography and Meteorology

FINAL REPORT

Meteorological Studies Conducted by Contract Nonr 4071 (00)

The specific purpose of this contract was a photographic study of the orographic and heating effect of a tropical island upon clouds and precipitation. The island of Barbados, Latitude 13°N, Longitude 50°39'W, was selected as the base of operations, as it was felt that its geographic location, its size and topography made it especially suitable for this investigation.

Interest in this question was stimulated by the work of Drs. J. F. Black and B. L. Tarmy, who had suggested the use of asphalt ground coatings, several square miles in area, as a means of increasing rainfall by raising ground temperatures in certain selected geographical areas.

The program can be divided into three distinct phases, but in each phase the major contribution under this contract was the carrying out of the required photography. It supplied all the personnel and equipment for all the stations, whether land-based, oceanic, or airborne.

The first phase of the program in April 1963, was conducted exclusively from Barbados, with supplementary aerial photography made from a small aircraft supplied by the Barbados Flying Club.

The land-based photography was taken from the observatory tower of the Barbados Astronomy Society, who graciously offered its use for this purpose. It proved an ideal location for the work, and approximately 1600 ft. of time lapse cine film was exposed, together with many wide angle

panoramic pictures of the entire horizon. These photographs have been used to analyze the growth and distribution of the clouds over the island during the daylight hours.

The length and breadth of the cloud streets downwind of the island were determined from aircraft observations, as was also the height of base and occasionally the tops when they were below the service ceiling of the light aircraft. With these parameters known it was possible to construct cloud maps for the most interesting days from the photographs.

One important conclusion drawn by Dr. Joanne Malkus Simpson from this phase of the work was that the main cloud production of the island was an indirect dynamic consequence of the diurnal heating cycle and would not be duplicated by simple lifting of the trade winds over an equivalent thermal mountain.

The second and major phase of the program was conducted in August 1963. It was during this phase that this contract collaborated with an already existing research program investigating tropical rainfall, which was executed by FSU, NASA, ESSO, U.S. Army Signal Corps and the U. S. Weather Bureau.

The island observations during this period included rawinsondes, rainfall measurements, radar observations and time lapse and whole sky photography. Radar was also used to obtain low level cross-island trajectories of zero-lift balloon-borne targets.

The WHOI Research Vessel CRAWFORD, operating under a grant from Esso Research and Engineering Co., was stationed 250 miles east and upwind of Barbados at Lat. 15N, Long. 55W. Under the direction of the Chief Scientist, Dr. Michael Garstang, upper air soundings and oceanographic observations were made which included rainfall measurements and air-sea boundary measurements. Whole sky cloud photography was contributed by

this contract and was maintained on an hourly basis for every hour during daylight for the entire period of 28 days while the ship was on station.

Aircraft observations were made from the WHOI C-54Q aircraft under the direction of the original principal investigator, Dr. Joanne Malkus Simpson and Dr. Joseph Levine.

Cloud and turbulence measurements were made over the island of Barbados as were measurements of the surface temperature by means of an airborne radiation thermometer. Extensive photography of island and off-shore clouds, both with time lapse and still camera was carried out and on two occasions, August 27 and September 3, clouds mapping runs were made out to the R/V CRAWFORD. A similar flight, but over a hexagonal course was made on September 1 in conjunction with the aircraft of the USWB.

The third and final phase of the work was carried out in collaboration with USWB's "Project Stormfury" in July of 1965. Contract 4071 was extended so that the final Principal Investigator could participate in this program as photographer and photogrammetrist.

This investigation was also concerned with weather modification and was designed to study the effects of the seeding of cumulus clouds with silver iodide bombs. It was an ambitious program involving as many as ten aircraft for each mission. The group was based at Roosevelt Roads, P. R. and operated in the "Bravo" area of the eastern Caribbean for a period of 3 weeks. Once again, the contribution of this contract was exclusively photographic.

Photographs, amenable to photogrammetric interpretation were taken approximately once a minute after the selected cloud had been seeded with silver iodide. The photography was continued for as long as the cloud remained active, usually a period of 30-45 minutes.

The photographs were taken from the "Command" aircraft which circled the seeded cloud at a fixed distance, (25 - 30 nautical miles) determined by the aircraft's radar. As the time of each photograph was recorded, and the geometry of the camera known, quantitative measurements can be made of the rate of growth and final decay of the cloud.

In fulfillment of the agreements under this contract, the U. S. Weather Bureau was furnished with a complete set of prints suitable for computational purposes. The analysis of these photographs will be undertaken by the USWB and the data derived from them will be incorporated into the final report of the 1965 Storm Fury project.

PERSONNEL EMPLOYED ON THE PROJECT

Dr. Joanne Malkus Simpson, Original Principal Investigator

Dr. Peter Saunders, Senior Consultant

Miss Margaret Chaffee, Research Assistant

Claude Ronne, Chief Photographer and Final Principal Investigator

Paul Collins, Ship Photographer

Charles Spooner, Photographic Assistant (pro tem)

PAPERS PERTAINING TO THIS PROJECT

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and Space Administration; U. S. Weather Bureau.

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Weather modification studies as recorded
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In July 1965 further photographic studies
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1. Weather Modification
2. Time-lapse and whole-sky cloud
photography

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13. ABSTRACT

Weather modification Studies as Recorded Photographically

During April and August 1963 the Barbados Weather Modification Project made extensive use of whole-sky, time-lapse and conventional photography to investigate cloud and rain formation over tropical heat sources. These observations were made from land-based, ship-borne and aircraft stations. In July 1965 further photographic studies were carried out over the eastern Caribbean Sea to evaluate the effect of seeding cumulus clouds with silver iodide bombs.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
<p>1. Weather Modification</p> <p>2. Time-lapse and whole-sky cloud photography</p>						

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