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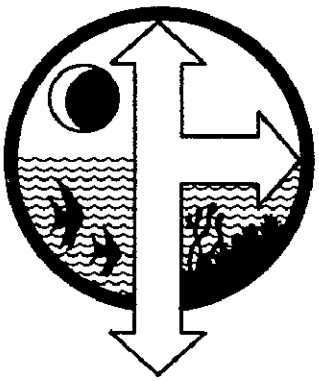


BOMEX BULLETIN NO. 8

October 1970

Prepared by
THE BOMAP OFFICE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ROCKVILLE, MD. 20852 TELEPHONE 301-496-8871

CONTENTS

ILLUSTRATIONS

TABLES

I. BOMEX PARTICIPANTS INFORMATION EXCHANGE

The status and progress of BOMEX experiments as reported by the participating scientists through February 1970 was described in BOMEX Bulletin No.6. This section brings the progress up through September 1970. The experiment numbers used are those listed in BOMEX Bulletins Nos. 4 and 5.

EXPERIMENT 1: Energy Exchange (Surface-Air Interaction)

PRINCIPAL INVESTIGATORS: Mr. R. Alexander[1] and Dr. R. Pease[2]

AFFILIATION: [1]U.S. Geological Survey, and [2]University of California at Riverside

PROGRESS AND CURRENT STATUS: The first analysis of remotely sensed radiation data over the Island of Barbados is complete.

DATA AVAILABILITY: Radiation scans and PRT-5 profiles available from Earth Observation Division, Manned Spacecraft Center (MSC), National Aeronautics and Space Administration (NASA), Houston, Texas.

REPORTS OR PAPERS:

A technical report, "Mapping Terrestrial Radiation Emission With the RS-14 Scanner," which maps radiation over Bridgetown and adjacent rural lands for one test flight on June 27, 1969, has been completed. A limited number of this report, to be submitted for publication, is available from Dr. R. Pease, Department of Geography, University of California at Riverside, California 92502.

EXPERIMENT 2: Spectra of Vertical Motions as a Function of Space and Time

PRINCIPAL INVESTIGATOR: Mr. Louis Banchero

AFFILIATION: U.S. Naval Oceanographic Office

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6. Data were not recovered for this experiment.

EXPERIMENT 3: Spectra of Horizontal Motions as a Function of Space and Time to Determine Horizontal Current Scales

PRINCIPAL INVESTIGATOR: Mr. Louis Banchero

AFFILIATION: U.S. Naval Oceanographic Office

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 4: Water Vapor Flux Transport

PRINCIPAL INVESTIGATOR: Dr. Brad R. Bean

AFFILIATION: Environmental Research Laboratories (ERL), National Oceanic and Atmospheric Administration (NOAA)

PROGRESS AND CURRENT STATUS: The computer printout of water vapor flux values and associated spectra for 191 5-min runs and 20 10-min runs from the first, second, and third phases have been received. The printouts are being checked for internal consistency and obvious systematic variations, and the consequences of the several mechanisms that can account for vapor transport in the BOMEX area are being investigated.

REPORTS OR PAPERS:

Short discussion given at Scripps Institution of Oceanography, June 17, 1970, on preliminary observations of water vapor flux values and spectra.

Progress report on contract with BOMAP is being prepared.

EXPERIMENT 5: Cloud Physics Experiment

PRINCIPAL INVESTIGATOR: Dr. H. Blau, Jr.

AFFILIATION: Arthur D. Little, Inc.

PROGRESS AND CURRENT STATUS: Completed.

DATA AVAILABILITY: See paper listed below.

REPORTS OR PAPERS:

Blau, H.H. Jr., M.L. Cohen, L.B. Lapson, P. von Thüna, R.T. Ryan, and D. Watson, "A Prototype Cloud Physics Laser Nephelometer," Applied Optics, Vol. 9, No. 8, August 1970, pp. 1798-1803.

EXPERIMENT 6: IR Mapping of Sea Surface Temperature

PRINCIPAL INVESTIGATOR: Miss Barbara Brennan

AFFILIATION: Goddard Space Flight Center, NASA

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 7: Lamont Radon Experiment

PRINCIPAL INVESTIGATOR: Dr. W. Broecker

AFFILIATION: Lamont-Doherty Geological Observatory

PROGRESS AND CURRENT STATUS: Measurements have been completed.

DATA AVAILABILITY: See paper listed below.

REPORTS OR PAPERS:

Broecker, W.S., and T.-H. Peng, "Vertical Distribution of Radon in the BOMEX Area," To be submitted to Earth Planetary Science Letters.

EXPERIMENT 8: Field Testing of a Balloon-Borne Optical Dew Point Hygrometer

PRINCIPAL INVESTIGATOR: Mr. F. Brousaides

AFFILIATION: Air Force Cambridge Research Laboratories

PROGRESS AND CURRENT STATUS: Experiment essentially complete as reported in BOMEX Bulletin No. 6.

EXPERIMENT 9: Trade Wind Structure and Mixing Processes During BOMEX

PRINCIPAL INVESTIGATOR: Dr. A. Bunker

AFFILIATION: Woods Hole Oceanographic Institution

PROGRESS AND CURRENT STATUS: Turbulence and fluctuation records have been read and values of the fluxes and root-mean-squares of parameters have been computed. In all, 97 1-min runs have been measured. See report listed below for these results and height averages of the values.

Sea surface temperatures observed by the PRT-5 infrared radiometer have been read, corrected for reflected cloud and intervening atmosphere radiation. A sea temperature chart is being constructed. The temperature data will be forwarded to the BOMAP office.

Cross sections of the clouds are nearly completed and should be ready for reproduction within a month.

DATA AVAILABILITY: The turbulence results are ready for distribution. Data on sea temperatures, cloud heights, types, and amounts should be ready for distribution soon.

REPORTS OR PAPERS:

A report has been written presenting the turbulence values. Copies will be filed in the BOMAP Office and sent to participants as soon as it is reproduced.

A paper on averages of solar radiation observed from the WHOI aircraft was presented at the American Geophysical Union (AGU) 51st Annual Meeting, Washington, D.C., April 20-24, 1970.

Bunker, Andrew F., "BOMEX Meteorological Data," Reference No. 70-34, Technical Report submitted to National Science Foundation, Grant GA 1700, August 1970.

EXPERIMENT 10: Radon-222 and African Dust in the North Atlantic Trade Winds

PRINCIPAL INVESTIGATORS: Dr. Joseph M. Prospero[1] and Dr. Toby Carlson[2]

AFFILIATION: [1]Rosentiel School of Marine and Atmospheric Sciences, University of Miami, and [2]National Hurricane Research Laboratory, NOAA, Miami, Florida

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 11: Theory of Large Scale Atmospheric and Oceanic Processes

PRINCIPAL INVESTIGATOR: Dr. Jule Charney

AFFILIATION: Massachusetts Institute of Technology

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 12: Microwave Radiometer Measurement of Rain Cells

PRINCIPAL INVESTIGATOR: Dr. J. Conaway

AFFILIATION: Goddard Space Flight Center, NASA

PROGRESS AND CURRENT STATUS: See paper listed below; work dormant.

DATA AVAILABILITY: Will be furnished to each investigator upon written request.

REPORTS OR PAPERS:

"Observations of Tropospheric Water Vapor Contrasts Near the ITC from Aircraft and Nimbus 3 During BOMEX," Paper presented at AGU 51st Annual Meeting, Washington, D.C., April 20-24, 1970.

EXPERIMENT 13: Air-Sea Interaction: (1) Air Flow Over Wind Waves and Swell; (2) Horizontal Temperature Fluctuation in the Surface Layers of the Ocean

PRINCIPAL INVESTIGATOR: Mr. G.S. Cook

AFFILIATION: Naval Underwater Systems Center, Newport Laboratory

PROGRESS AND CURRENT STATUS: Awaiting completion of signal processing electronics for ducted meter so the d.m. pulsed signal can be converted to analog. The analog voltages from the hot film anemometer, wave staff, and ducted meter will be digitized and processed on a CDC 3300 computer.

DATA AVAILABILITY: Expect data late 1970 or early 1971.

REPORTS OR PAPERS:

Preliminary paper presented at the Symposium on the Early Results From BOMEX, Seattle, Washington, November 20-21, 1969.

EXPERIMENT 14: High Frequency Sea Scatter Experiment

PRINCIPAL INVESTIGATORS: Dr. D. Crombie and Mr. J. Watts

AFFILIATION: Environmental Research Laboratories, NOAA

PROGRESS AND CURRENT STATUS: About 50 percent of the spectra have been computed and study of them is proceeding.

DATA AVAILABILITY: Contact principal investigators. List of data on hand also in BOMAP Office.

REPORTS OR PAPERS:

Paper presented at AGARD EM Wave Propagation Panel Specialists Meeting On Electromagnetics of The Sea, Paris, June 22-26, 1970.

Watts, J.M., "Instrumentation for Observing HF Sea Scatter," ESSA Technical Memorandum ERLTM-ITS 223.

EXPERIMENT 15: Directional Spectra of Surface Waves

PRINCIPAL INVESTIGATOR: Dr. Russ E. Davis

AFFILIATION: Scripps Institution of Oceanography

PROGRESS AND CURRENT STATUS: One-dimensional (frequency) spectra available for month of May. Work is in progress on directional spectra and FLIP's response to waves.

DATA AVAILABILITY: From Dr. Davis at Scripps; any desired one-dimensional statistic can be monitored through May.

EXPERIMENT 16: Momentum Flux Measurements From a Ship

PRINCIPAL INVESTIGATOR: Mr. P.S. Deleonibus

AFFILIATION: U.S. Naval Oceanographic Office

PROGRESS AND CURRENT STATUS: Data processing has been completed. Since total amount of data is very small, it will be presented together with results of an earlier, but entirely similar, experiment.

DATA AVAILABILITY: Expect to complete work ready for publication by about January 1, 1970.

EXPERIMENT 17: Profile of Steady-State Sea on Windward Side of Island and Limited Fetch State on Leeward Side

PRINCIPAL INVESTIGATOR: Mr. P.S. Deleonibus

AFFILIATION: U.S. Naval Oceanographic Office

PROGRESS AND CURRENT STATUS: Will be reported later under Experiment 42.

EXPERIMENT 18: Spectral Albedo Measurement Program

PRINCIPAL INVESTIGATORS: Dr. A.J. Drummond and Mr. J.R. Hickey

AFFILIATION: Eppley Laboratory

PROGRESS AND CURRENT STATUS: All data obtained on magnetic tape have been evaluated in energy units, computerized, and tabulated in serial form. A selection of the more accurate basic paper tape digital printout is in preparation. It is anticipated that analysis of the results will be completed by the end of August, as part of the Final Report to NASA's Goddard Space Flight Center, the project sponsor.

DATA AVAILABILITY: Eight copies of the complete magnetic tape serial values were prepared and six were distributed in April 1970 (one each to the University of Wisconsin and Colorado State University, and two each to the BOMAP Office and NASA's Goddard Space Flight Center).

REPORTS OR PAPERS:

A preliminary report was prepared for the Symposium on the Early Results From BOMEX, Seattle, Washington, November 20-21, 1969.

"The BOMEX Spectral Albedo Measurement Program," Paper presented at the AGU 51st Annual Meeting, Washington, D.C., April 20-24, 1970. An expanded version will be submitted for publication later this year.

EXPERIMENT 19: Study of Tropical Weather Systems During Project BOMEX

PRINCIPAL INVESTIGATOR: Dr. M.A. Estoque

AFFILIATION: University of Miami

PROGRESS AND CURRENT STATUS: Preliminary synoptic analysis has been completed; see paper listed below. Radar analysis of selected disturbances is in progress. Detailed synoptic analysis will be started as soon as radiosonde and other data become available.

REPORTS OR PAPERS:

"A Preliminary Report on Meteorological Conditions During BOMEX, Fourth Phase (July 11-28, 1969)," Paper presented at AGU 51st Annual Meeting, Washington, D.C., April 20-24, 1970.

EXPERIMENT 20: Nimbus 3 Study of Cross Section of Sea Surface Reflection

PRINCIPAL INVESTIGATORS: Mr. D. Evans[1] and Dr. W. Nordberg[2]

AFFILIATION: [1] Manned Spacecraft Center, NASA, and [2] Goddard Space Flight Center, NASA

PROGRESS AND CURRENT STATUS: See paper listed below.

REPORTS OR PAPERS:

Nordberg, Conrath, "Review of Nimbus 3 Measurements of Vertical Profiles of the Atmosphere and High Altitude Aircraft Meteorological Observations Made During BOMEX," Preliminary paper presented at the Symposium on the Early Results From BOMEX, Seattle, Washington, November 20-21, 1969.

EXPERIMENT 21: Investigation of Thermal Patterns in the Upper Layers of the Ocean

PRINCIPAL INVESTIGATOR: Dr. T.D. Foster

AFFILIATION: Scripps Institution of Oceanography

PROGRESS AND CURRENT STATUS: Experiment complete.

DATA AVAILABILITY: Infrared scanner film of sea surface temperature patterns near FLIP, May 24, 25 and 26, 1969.

EXPERIMENT 22: Vertical Variations of Current Profiles

PRINCIPAL INVESTIGATORS: Dr. F. Fisher and Dr. T.D. Foster

AFFILIATION: Scripps Institution of Oceanography

PROGRESS AND CURRENT STATUS: Experiment not conducted.

EXPERIMENT 23: Determination of the Turbulent Fluxes Near the Ocean Surface

PRINCIPAL INVESTIGATOR: Dr. R.G. Fleagle

AFFILIATION: University of Washington

PROGRESS AND CURRENT STATUS: For BOMEX Period I, all profiles have been corrected for sampling errors, and fluxes and other properties have been calculated. Sonic anemometer data are being processed for calculation of turbulence statistics. Temperature and humidity statistics are also being analyzed. The plan is to analyze ≈ 10 tapes and then make decisions about further analysis.

DATA AVAILABILITY: Profiles and results of profile calculations are being prepared; see report listed below.

REPORTS OR PAPERS:

Leavitt, E., Report on analysis of spectrum from 3-D sonic and thermocouple sensors presented at the National Adademy of Sciences/ National Academy of Engineering/ Environmental Science Services Administration Advisory Committee Meeting, San Diego, California, June 1970.

Paulson, C., Report on profile calculations is in preparation.

EXPERIMENT 24: Radiation Balance, All-Sky Photography, and Rainfall on FLIP

PRINCIPAL INVESTIGATOR: Dr. Guy A. Franceschini

AFFILIATION: Texas A&M University

PROGRESS AND CURRENT STATUS: Radiation data have been processed and are being tabulated (incoming and reflected solar, and net total). Selected all-sky photos (8-mm film) are at hand.

DATA AVAILABILITY: Technical data-report will be available when data have been tabulated.

EXPERIMENT 25: Diurnal Variation of Momentum Flux

PRINCIPAL INVESTIGATOR: Dr. Guy A. Franceschini

AFFILIATION: Texas A&M University

PROGRESS AND CURRENT STATUS: Processed data have not yet been received from MTF computer facility. Two 15-min periods have been examined by hand computations.

DATA AVAILABILITY: When received, the data can be made available.

REPORTS OR PAPERS:

"Preliminary Results of BOMEX Observations," Paper presented at the Symposium on the Early Results From BOMEX, Seattle, Washington, November 20-21, 1969.

"Momentum Fluxes Determined from Time and Space Structure Functions (BOMEX/FLIP)," Paper presented at AGU 51st Annual Meeting, Washington, D.C., April 20-24, 1970.

EXPERIMENT 26: Exploration of Inverted V cloud Patterns in the Central North Atlantic Ocean

PRINCIPAL INVESTIGATOR: Mr. N. Frank

AFFILIATION: National Hurricane Center, NOAA

EXPERIMENT 27: Energy Dissipation in the Boundary Layer

PRINCIPAL INVESTIGATOR: Dr. P. Frenzen

AFFILIATION: Argonne National Laboratories

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6. Analysis work temporarily suspended during present field work season. Experiments now in preparation, in which a tower mounted 2000 ft off the eastern shore of Lake Michigan is used, should provide a further check of the BOMEX energy budget observation.

EXPERIMENT 28: Satellite and Terrestrial Photogrammetric Study of Clouds over the Area of BOMEX

PRINCIPAL INVESTIGATOR: Dr. T. Fujita

AFFILIATION: University of Chicago

PROGRESS AND CURRENT STATUS: A case study is being made of the motion of cirrus clouds in the vicinity of Barbados on July 26, 1969, based on whole sky, wide angle, and ATS-3 cloud pictures. The computed cloud motions will be compared with rawinsonde reports to see whether such cirrus clouds can be used to determine winds at this level. Case study is expected to be completed during November 1970.

DATA AVAILABILITY: July 12-27, 1969, inclusive, during daylight hours, approximately 13 hours per day. Interval between frames: whole sky, 14.4 sec; wide angle, 12 sec. Data are available to other scientists upon request. Must state specific date and time needed.

REPORTS OR PAPERS:

Preliminary report given at the Symposium on the Early Results From BOMEX, Seattle, Washington, November 20-21, 1969.

EXPERIMENT 29: Current Trajectories in BOMEX for Search and Rescue

PRINCIPAL INVESTIGATOR: Mr. A. Garcia

AFFILIATION: U.S. Coast Guard Oceanographic Unit

PROGRESS AND CURRENT STATUS: Of a total of 160 hours of data, 83 hours are suitable for reduction. These will be used in the CGOU Search and Rescue Project.

DATA AVAILABILITY: Contact Mr. Robert Still, Special Projects Section, U.S. Coast Guard Oceanographic Unit, Bldg. 159E, Navy Yard Annex, Washington, D.C. 20390.

EXPERIMENT 30: Energy Budget of Barbados

PRINCIPAL INVESTIGATOR: Dr. B.J. Garnier

AFFILIATION: McGill University

PROGRESS AND CURRENT STATUS: Data reduction completed for remote sensing experiments of June and December 1969. Analysis continuing.

DATA AVAILABILITY: Available by arrangement with Dr. Garnier.

REPORTS OR PAPERS:

Garnier, B.J., and Atsumu Ohmura, "Estimating the Topographic Variations of Short-Wave Radiation Income: The Example of Barbados," Technical Report No. 1, Contract N00014-68-C-0307, NR 389-152, Office of Naval Research, Geography Branch, 1969.

Weiss, M., "A Report on Airborne Measurements of Earth Surface Temperature (Ocean and Land) in the 10-12μ and 8-14μ Regions," Barnes Engineering Company, Stamford, Connecticut.

EXPERIMENT 31: Synoptic Scale Energy Fluxes Between Tropical Oceans and Atmosphere

PRINCIPAL INVESTIGATOR: Dr. M. Garstang

AFFILIATION: Florida State University

PROGRESS AND CURRENT STATUS: Considerable reduction of data is being accomplished. Papers in preparation are listed below.

REPORTS OR PAPERS:

Echternacht, Kenneth, "Periodicities in Near-Surface Currents," Masters Thesis (in press).

Garstang, M., K.L. Warsh, and P.L. Grose, "A Sea-Air Interaction Deep-Ocean Buoy."

Warsh, K.L., K.L. Echternacht and M. Garstang, "Structure of Near-Surface Currents East of Barbados."

Garstang, M., N.E. La Seur and R. Hadlock, "Results From A Comprehensive Tropical Field Experiment."

Garstang, M., et al., "Atmospheric-Oceanic Observations in the Tropics," To appear in American Scientist, September/October 1970.

EXPERIMENT 32: Radiative Balances and Fluxes in the Tropics

PRINCIPAL INVESTIGATORS: Dr. M. Garstang[1] and Dr. J.C. Gille[2]

AFFILIATION: [1]Florida State University and [2]National Center for Atmospheric Research (visiting); to return to Florida State University in December 1970.

PROGRESS AND CURRENT STATUS: Magnetic data tapes have been edited. Quantities measured are being reduced to physical quantities. All data are cataloged as to dates and times. Boundary layer flux divergence for May and June has been computed and found to correlate with near-surface dust concentrations. Radiometersonde data reduction by Dr. P.M. Kuhn is nearly complete. Two theoretical models to compute infrared ($\lambda > 4\mu$) fluxes and

heating rates in the free atmosphere have been programmed and are now operational. Comparison with radiometersonde measurements in a few cases shows calculated downward fluxes are smaller than the observed, but the radiative cooling rates, at least to 8 km, are in good agreement with the measurements.

DATA AVAILABILITY: Preliminary results of calculation for the free atmosphere available December 1970; surface observations, June 1971.

REPORTS OR PAPERS:

"Preliminary results of F.S.U.-BOMEX Radiation Experiment," Paper presented at AGU 51st Annual Meeting, Washington, D.C., April 20-24, 1970.

Symposium is being organized in October to discuss measurements by BOMEX experimenters of particulates and radiation.

EXPERIMENT 33: Direct Dissipation Measurement

PRINCIPAL INVESTIGATORS: Dr. C.H. Gibson[1] and Dr. G.R. Stegen[2]. Note new address of Dr. Stegen:

Princeton University
James Forrestal Campus
Princeton, N.J. 08540

AFFILIATION: [1]Scripps Institution of Oceanography and [2]Colorado State University

PROGRESS AND CURRENT STATUS: Data analysis not yet complete.

DATA AVAILABILITY: Data on analog tape are not suitable for distribution. All data are being published as soon as analysis is complete.

EXPERIMENT 34: BOMEX STD Program

PRINCIPAL INVESTIGATOR: Dr. D.V. Hanson

AFFILIATION: Environmental Research Laboratories, NOAA

PROGRESS AND CURRENT STATUS: Project requires receipt of verified STD data from BOMAP Office.

EXPERIMENT 35: Wisconsin Atmospheric Radiation Divergence Study (WARDS)

PRINCIPAL INVESTIGATORS: [1]Dr. K. Hansen, [2]Dr. S. Cox, [3]Dr. V. Suomi, and [4]Dr. T. VonderHaar

AFFILIATION: [1]Atlantic Oceanographic and Meteorological Laboratories, NOAA, Miami, Florida, [2]Colorado State University, and [3]University of Wisconsin.

PROGRESS AND CURRENT STATUS: Analysis has just begun. A few calculations of heating rates have been made under certain meteorological conditions; see report listed below, pp. 23-26.

DATA AVAILABILITY: The ATS-3 analog data are archived at the University of Wisconsin. Data can be obtained (at cost of reproduction) by writing to Space Science and Engineering Center, University of Wisconsin, Madison, Wisconsin.

REPORTS OR PAPERS:

Cox, S., V. Suomi, and T. VonderHaar, "Radiation Experiment in the Vicinity of Barbados," Final Report, NSF Grant GA 12603, April 1970.

EXPERIMENT 36: In Situ Water Vapor Measurements by Means of an Aluminum Oxide

PRINCIPAL INVESTIGATOR: Mr. E. Hilsenrath

AFFILIATION: Goddard Space Flight Center, NASA

EXPERIMENTS 37, 38: Basic Synoptic Scale Water Vapor, Energy and Momentum Budgets

PRINCIPAL INVESTIGATORS: Dr. Joshua Z. Holland and Dr. Eugene M. Rasmusson

AFFILIATION: BOMAP Office, Environmental Research Laboratories, NOAA

PROGRESS AND CURRENT STATUS: The digitization of the fixed-ship SCARD data is completed. The initial "A_0" reduction of Periods III and IV are completed. The "A" process program is being developed. Work is continuing on the manual reduction of rawinsonde data. The program to correct the rawinsonde humidity error has been started.

See section II of this Bulletin for the current status of reduction and processing of the rawinsonde, Boom, STD, BLIP, RFF line integral, Navy line integral, dropsonde, radar, high level aircraft and satellite cloud, and radiation data.

Other experiments that have a direct bearing on this experiment include:

Ocean Heat Budget, Experiments 34 and 50, Dr. D.V. Hanson

Eddy Flux, Experiment 4, Dr. Brad R. Bean, Dr. Oscar Lappe, and Mr. Leonard Rinaldi

Radiation, Experiment 46, Dr. P.M. Kuhn

Precipitation, Experiment 93, Dr. Michael D. Hudlow

Aircraft Divergence, Experiment 95, Mr. Robert W. Reeves

DATA AVAILABILITY: See section III of this Bulletin.

REPORTS OR PAPERS:

Holland, Joshua Z., "Preliminary Report on the BOMEX Sea-Air Interaction Program," Bulletin of the American Meteorological Society, Vol. 51, No. 9, September 1970.

Technical Memoranda:

Myers, Vance A., "High-Level Cloud Photography Inventory, BOMEX Period IV, July 11-28, 1969," ESSA Technical Memorandum ERLTM-BOMAP 1, September 1970.

Rasmusson, Eugene M., "Mass, Momentum, and Energy Budget Equations for BOMAP Computations" (camera copy being prepared).

Reeves, Robert W., "Reduction of Aircraft Data for the BOMEX Core Experiment" (manuscript in draft stage).

Miscellaneous publications (in preparation):

BOMEX Data Inventory.

BOMEX Period III High-Level Cloud Photograph Atlas.

BOMEX Atlas Comparison of Island, Ship, and Aircraft Radar Photographs With ATS-3 and Nimbus 3 Satellite Cloud Photograph Enlargements.

EXPERIMENT 39: Nimbus 3 Study of Atmospheric Spectral Radiance in the 8 to 16 Micron Region

PRINCIPAL INVESTIGATORS: Dr. Hovis[1] and Dr. Callahan[2]

AFFILIATION: [1]Goddard Space Flight Center, NASA, and [2]Fairfield University

EXPERIMENT 40: Mesoscale Structures in the Boundary Layer

PRINCIPAL INVESTIGATOR: Dr. Y. Hsueh

AFFILIATION: Florida State University

EXPERIMENT 41: Ocean Environmental Effects on Surface Cooling

PRINCIPAL INVESTIGATOR: Dr. J.F. Hebard

AFFILIATION: Tropical Atlantic Biological Laboratories

PROGRESS AND CURRENT STATUS: The R/V Undaunted completed two surveys west of the Lesser Antilles.

Survey I date: 22-28 June 1969
area: 11°N to 15°N
61°W to 65°W

This survey consisted of a grid of XBT stations and the continuous recording of meteorological data on magnetic tape.

Survey II date: 9-15 July 1969
area: 12°41'N to 14°70'N
61°W to 63°W

This survey consisted of an XBT and STD grid of stations and included water sampling. Meteorological data (wind speed and direction, air and dew-point temperatures, and solar radiation) were collected while the vessel was underway between stations.

DATA AVAILABILITY: The STD station data and meteorological data were being processed as of July 1970. The STD data should be ready for archiving and for analysis soon. The meteorological data tape is being edited and it also should be ready for further processing (hourly averages, etc.) in the near future.

EXPERIMENT 42: Oceanic Thermal Structure Prediction

PRINCIPAL INVESTIGATORS: Dr. R.W. James and G.L. Hansen

AFFILIATION: U.S. Naval Oceanographic Office

EXPERIMENT 43: ATS-2 Meteorological Oceanic Communications Experiment

PRINCIPAL INVESTIGATOR: Lt.Cdr. Michael R. Johnson

AFFILIATION: U.S. Coast Guard

PROGRESS AND CURRENT STATUS: Final report submitted to Cdr. Taggert, BOMEX Project Staff, September 1969.

EXPERIMENT 44: Lidar Measurements During BOMEX

PRINCIPAL INVESTIGATORS: Dr. W. Johnson and Dr. E. Uthe

AFFILIATION: Stanford Research Institute

PROGRESS AND CURRENT STATUS: Samples of collected lidar backscatter signatures have been computer-processed into vertical cross sections of aerosol optical density. Additional data are being analyzed in this manner. Comparisons between lidar data and other experimental data--particle count, ^{7}Be, temperature and humidity profiles, and satellite photographs--are being conducted.

REPORTS OR PAPERS:

Interim report, AEC Contract AT(04-3)-115, December 1969.

"Early Results From BOMEX," Paper presented at the Symposium on the Early Results From BOMEX, Seattle, Washington, November 20-21, 1969.

Paper presented at Symposium on Remote Sensing of the Atmosphere from Aircraft, Denver, Colorado, April 1970.

Johnson, Warren B., and Edward E. Uthe, "Lidar Observations of the Lower Troposphere During BOMEX," Paper presented at International Conference on Tropical Meteorology, Honolulu, June 1970.

Paper accepted for publication in Boundary Layer Meteorology, Vol. 1, No. 3 or 4, 1970.

EXPERIMENT 45: Atmospheric Electric Field and Current Measurement

PRINCIPAL INVESTIGATOR: Dr. H.W. Kasemir

AFFILIATION: Environmental Research Laboratories, NOAA

EXPERIMENT 46: Radiation Experiment

PRINCIPAL INVESTIGATORS: Dr. P.M. Kuhn and Mrs. L.P. Stearns

AFFILIATION: Environmental Research Laboratories, NOAA

PROGRESS AND CURRENT STATUS: Data reduction is complete for 273 radiometersonde ascents from the Discoverer, Rockaway, and Rainier and from the Island of Barbados and the data have been placed on magnetic tape. Data have been reduced for 50 days of incident and reflected ship solar and net total radiation. Data are still being reduced from the shipboard Boom radiometers. A three-part research analysis program is underway, including (1) adjustment of calculated radiative transfer to in situ radiometric

(radiometersonde) observations; (2) water vapor profiles from an inverse solution of the radiometersonde ascents and (3) establishment of model tropical radiating atmospheres.

DATA AVAILABILITY: Approximately 273 radiometersonde flights have now been quality checked. Dr. Kuhn should be contacted concerning these data.

REPORTS OR PAPERS:

"Airborne Radiometric Measurements of Contrail Effects on the Thermal Radiation Budget," Journal of the Atmospheric Sciences, September 1970.

"Adjustment of Radiative Transfer Calculations to in situ Radiometric Observations" (in review stage).

EXPERIMENT 47: Tropical Cloud Streets

PRINCIPAL INVESTIGATOR: Dr. J. Kuettner

AFFILIATION: Environmental Research Laboratories, NOAA

EXPERIMENT 48: Giant Convective Cells in the Tropical Atmosphere

PRINCIPAL INVESTIGATOR: Dr. J. Kuettner

AFFILIATION: Environmental Research Laboratories, NOAA

EXPERIMENT 49: Graphic Results of Oceanographic Radio Message Data

PRINCIPAL INVESTIGATOR: Mr. Robert C. Landis

AFFILIATION: The MITRE Corporation

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 50: Basic Energy Budget

PRINCIPAL INVESTIGATOR: Mr. Robert C. Landis

AFFILIATION: The MITRE Corporation

EXPERIMENT 51: Laser Radar Investigations of the Marine Atmosphere

PRINCIPAL INVESTIGATORS: James Lawrence, Jr.[1] and Michael McCormick[2]

AFFILIATION: [1]Langley Research Center, NASA, and [2]Fairchild-Hiller Corporation

EXPERIMENT 52: Near Surface Current Variations

PRINCIPAL INVESTIGATOR: Mr. A. Leetma

AFFILIATION: Massachusetts Institute of Technology

PROGRESS AND CURRENT STATUS: All the current meter data have been processed. However, a close examination indicates that most of them are not of very high quality. The STD data have been examined and a report will appear in the fall of 1970.

DATA AVAILABILITY: The STD data are on the BOMEX tapes. Because of the doubtful quality of the current meter data, persons interested should contact Mr. Leetma directly. They are available now.

EXPERIMENT 53: Mesoscale Cloud System Study

PRINCIPAL INVESTIGATOR: Dr. B. Lettau

AFFILIATION: State University of New York (SUNY), Albany

EXPERIMENT 54: Basic Large-Scale Energy Transfer

PRINCIPAL INVESTIGATORS: Dr. B. Lettau[1] and F. Ostapoff[2]

AFFILIATION: [1]SUNY, Albany, and [2]Sea-Air Interaction Laboratory, NOAA

EXPERIMENT 55: Planetary Boundary Layer Turbulence Experiment

PRINCIPAL INVESTIGATORS: Dr. D.K. Lilly[1] and Dr. J. Telford[2]

AFFILIATION: [1]National Center for Atmospheric Research and [2]Desert Research Institute

PROGRESS AND CURRENT STATUS: This experiment was not performed.

EXPERIMENT 56: Nimbus 3 Study of Various Environmental Parameters

PRINCIPAL INVESTIGATOR: Dr. W. Marlatt

AFFILIATION: Colorado State University

PROGRESS AND CURRENT STATUS: The data from this experiment are now being placed on magnetic tape for transmittal to BOMAP. The sea surface temperature, wet and dry bulb temperatures, and refractometer data are being given to Dr. W. Gray, the coinvestigator, for analysis of some aspects of these data.

DATA AVAILABILITY: The data will soon be available in their entirety at the BOMAP Office.

REPORTS OR PAPERS:

Two papers are being written. One, dealing with the effects of haze on infrared radiation will be completed within one month. Data from Experiment 57, Nimbus 3 Study of Aerosol Distribution, are also being used for these papers.

EXPERIMENT 57: Nimbus 3 Study of Aerosol Distribution

PRINCIPAL INVESTIGATOR: Dr. W. Marlatt

AFFILIATION: Colorado State University

PROGRESS AND CURRENT STATUS: The data for this experiment are now being put on magnetic tape and will soon be sent to BOMAP.

DATA AVAILABILITY: The data will be available in their entirety when sent to BOMAP.

REPORTS OR PAPERS:

Two papers are now in the process of being written. One, pertaining to the effects of haze on infrared radiation, will be completed within one month. Data from Experiment 56, Nimbus 3 Study of Various Environmental Parameters, will also be used for these papers.

EXPERIMENT 58: Measurement and Interpretation of the Sea-Surface and Air Temperature Gradients in the Sub-Cloud Layer During BOMEX

PRINCIPAL INVESTIGATORS: Dr. W. Marlatt and Dr. W. Gray

AFFILIATION: Colorado State University

PROGRESS AND CURRENT STATUS: Most of the Data have been processed. Serious evaluation will begin when the aircraft and ship upper-air soundings and other information are received.

DATA AVAILABILITY: Data available from Dr. Marlatt.

EXPERIMENT 59: Measurements of Rate of Dissipation of Energy in the Ocean

PRINCIPAL INVESTIGATOR: Mr. A.T. Massey

AFFILIATION: Naval Underwater Systems Center, Newport Laboratory

PROGRESS AND CURRENT STATUS: Data analyzed on CDC 3300 computer include temperature - horizontal velocity time series (at 20 m depth), statistics, auto and cross correlation, structure, and spectral functions. BOMEX data from other experiments not yet processed.

DATA AVAILABILITY: Punched cards, listing, computer program and results available.

REPORTS OR PAPERS:

Paper written but not yet submitted.

EXPERIMENT 60: Navy Ocean Variability Studies East of Barbados

PRINCIPAL INVESTIGATOR: Dr. Paul Mazeika

AFFILIATION: U.S. Naval Oceanographic Office

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 61: Sea Temperature and Heat Flux

PRINCIPAL INVESTIGATOR: Dr. E.D. McAlister

AFFILIATION: Scripps Institution of Oceanography

PROGRESS AND CURRENT STATUS: Data reduction finished. The papers listed below will complete reporting of BOMEX results.

DATA AVAILABILITY: All usable data obtained are contained in tables 1, 2, and 3 that follow (extracted from the last paper listed below). The raw data on magnetic tape and computer printouts are held at Scripps Institution of Oceanography.

REPORTS OR PAPERS:

McAlister, E.D., "Sea-Surface Temperature and Heat Flow - BOMEX," Paper presented at the Manned Spacecraft Center, NASA, Houston, Texas, September 16-18, 1969.

McAlister, E.D., "Heat Flow Measurements at BOMEX," Paper presented at the Symposium on the Early Results From BOMEX, Seattle, November 20-21, 1969.

McAlister, E.D., and W. McLeish, "Airborne Signal Processing in an Ocean Heat Flow Radiometer," Paper presented at the IEEE Second Annual Internal Geoscience Electronics Symposium, Washington, D.C., April 14-17, 1970. (Paper read by Dr. McLeish.)

McAlister, E.D., W. McLeish, and E.A. Corduan, "Airborne Measurements of the Total Heat Flux From the Sea During BOMEX," To be submitted to Journal of Geophysical Research.

Table 1.--Total heat flow results

Date (1969)	Local Time	Wind Speed cm sec^{-1}*	Sea-Surface Temperature °C**	Heat Flow Results** cal cm^{-2} min^{-1}	Comments
24 May	1827-1858	612	27.77 ± .02	0.05	Intermittent rain
26 May	1740-1838	890	28.06 ± .02	0.27	Rain nearby
27 May	0446-0552	830	27.71 ± .02	0.45	Best weather
29 May	1724-1834	-	28.44	0.40	Radar interference; 90% data lost
25 May	1746-1838	650	27.61 ± .13	Negative	Radar interference
19 May	1804-1855	795	27.96 ± .02	Negative	Heavy weather; altitudes uncertain
24 May	0654-0724	770	28.08 ± .05	Negative	Internal interference from power supply
28 May	0553-0623	830	27.84 ± .07	Negative	Gusty winds; spray below 200'

*Data from FLIP.
**Average over 1-mi strip 200' wide.

Table 2.--Sea-surface temperatures

19 May 1969 14.43N, 57.32W		24 May 1969 13.57N, 56.30W	
Local Time	Surface Temp. °C	Local Time	Surface Temp. °C
1804	27.94	0700	28.05
06	.95	04	.09
08	.95	08	.16
12	.94	12	.20
14	.98	17	.05
16	28.00	20	.04
18	27.96	22	.06
20	.98	24	.07
25	28.01	0728	27.99
27	27.95		28.08 ±.05
30	.98		
32	.98	1827	27.79
35	.97	31	.77
37	.94	33	.84
41	.95	40	.78
43	.96	43	.75
45	.94	45	.78
47	.94	47	.78
50	.95	50	.77
53	.90	53	.69
1855	27.92	55	.74
	27.96 ±.02	1858	27.75
			27.77 ±.02

Table 3.--Sea-surface temperatures

26 May 1969 13.57.3N, 56.33W		27 May 1969 13.58N, 56.37W	
Local Time	Surface Temp.°C	Local Time	Surface Temp.°C
1743	28.09	0446	27.70
46	.07	49	.70
49	.11	52	.70
52	.08	55	.67
55	.10	59	.69
57	.10	05	.72
1801	.04	06	.69
03	.08	08	.69
06	.03	11	.70
09	.04	14	.73
13	.06	17	.75
16	.05	20	.75
20	.05	24	.74
22	.04	27	.73
26	.07	30	.72
28	.06	33	.74
32	.01	37	.71
35	.06	40	.73
1838	28.02	43	.70
	28.06 ±.02	46	.74
		49	.70
		0552	27.71
			27.71 ±.02

EXPERIMENT 62: Interpretation of Satellite Measured Sea Surface Temperatures

PRINCIPAL INVESTIGATOR: Dr. E.P. McClain

AFFILIATION: National Environmental Satellite Service, NOAA

EXPERIMENT 63: Turbulent Flux Measurements With Airborne Sensors

PRINCIPAL INVESTIGATOR: Dr. M. Miyake

AFFILIATION: University of British Columbia

REPORTS OR PAPERS:

Miyake, M., and M. Donelan, "Airborne Measurements of Turbulent Fluxes," Journal of Geophysical Research, Vol. 75, No. 24, 1970.

EXPERIMENT 64: Wind Tunnel Test of the Superstructure of the R/V FLIP

PRINCIPAL INVESTIGATOR: Dr. Erik Mollo-Christensen

AFFILIATION: Massachusetts Institute of Technology

PROGRESS AND CURRENT STATUS: Completed and report circulated.

EXPERIMENT 65: Photographic Study of the Generation and Concentration of Oceanic White Caps

PRINCIPAL INVESTIGATOR: Dr. E.C. Monahan

AFFILIATION: University of Michigan

PROGRESS AND CURRENT STATUS: Data analysis completed. Study terminated.

DATA AVAILABILITY: Paper listed below includes BOMEX results.

REPORTS OR PAPERS:

"Oceanic Whitecaps," Submitted to Journal of Physical Oceanography.

EXPERIMENT 66: Turbulence Measurements in the Open Ocean Atmosphere Boundary Layer

PRINCIPAL INVESTIGATOR: Dr. W.A. Nierenberg

AFFILIATION: Scripps Institution of Oceanography

EXPERIMENT 67: Phase Speed Measurements in Atmospheric Turbulence

PRINCIPAL INVESTIGATOR: Dr. W.A. Nierenberg

AFFILIATION: Scripps Institution of Oceanography

EXPERIMENT 68: Numerical Simulations with BOMEX Data

PRINCIPAL INVESTIGATOR: Dr. Joseph Pandolfo

AFFILIATION: Center for the Environment and Man

PROGRESS AND CURRENT STATUS: A program to obtain horizontal gradients over the observational array by obtaining the best fit plane to constant-height data has been written. Such gradients serve as input to the simulation models. An experiment with alternative boundary layer formulations in the one-dimensional numerical simulation model has been conducted. Simulations have been run with the three-dimensional model using plane-fitted initial fields for June 21-25, 1969, from unvalidated teletype data.

REPORTS OR PAPERS:

"Simulation Experiments With a Numerical Sea-Air Planetary-Boundary Layer Model and Its Extension to Three Space Dimensions," Final Report, ESSA Contract E 22-43-69(N), February 1970.

EXPERIMENT 69: Flux Computations by Aerodynamic Profile Method

PRINCIPAL INVESTIGATOR: Dr. Joseph Pandolfo

AFFILIATION: Center for the Environment and Man

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 70: Measurement of Humidity and Temperature Fluctuations and Turbulent Transport of Latent and Sensible Heat

PRINCIPAL INVESTIGATOR: Dr. G. Stephen Pond

AFFILIATION: Oregon State University

PROGRESS AND CURRENT STATUS: About 10-12 hours of the data collected have been digitized. The analysis of these data should be completed by August 31, 1970. The University of British Columbia, Vancouver 8, Canada, has analyzed other sections of the data.

REPORTS OR PAPERS:

A joint publication giving the momentum and heat fluxes will probably be issued by the end of the year.

EXPERIMENT 71: Measurements of Turbulence, Turbulent Transports and Wave Heights From FLIP

PRINCIPAL INVESTIGATOR: Dr. Donald J. Portman

AFFILIATION: University of Michigan

PROGRESS AND CURRENT STATUS: All data have been digitized and are currently being processed to obtain means, variances, covariances and values of skewness and kurtosis. Computer programs have been prepared to obtain spectral, cospectral and quadrature spectral estimates and joint probability density distributions. Variables are u', v', w' and T', at one or two heights from 2 to 8 m, and wave heights.

DATA AVAILABILITY: Digitized records on magnetic tape could be made available.

REPORTS OR PAPERS:

A report describing the measurements, including equipment, procedures, and sample results is being prepared for distribution.

EXPERIMENT 72: Exploration of the Planetary Boundary Layer in the Rain Area of Tropical Disturbances

PRINCIPAL INVESTIGATOR: Dr. H. Riehl

AFFILIATION: Colorado State University

PROGRESS AND CURRENT STATUS: The aircraft soundings made during the "kite" pattern experiment of July 21, 1969, have been analyzed. All other available sub-cloud soundings made during Period IV have now been assimilated. The research is completed.

DATA AVAILABILITY: Ready for publication after September 1970.

REPORTS OR PAPERS:

A report is being written.

EXPERIMENT 73: Emergent Upwelling Irradiance

PRINCIPAL INVESTIGATOR: Mr. Richard E. Payne

AFFILIATION: Woods Hole Oceanographic Institution

PROGRESS AND CURRENT STATUS: Analysis complete.

DATA AVAILABILITY: Data now available.

REPORTS OR PAPERS:

Payne, R.E., "WHOI Solar Radiation Experiments," EOS Transactions, American Geophysical Union, Vol. 51, No. 4, 1970.

EXPERIMENT 74: Rn/Ra Measurements to Determine Vertical Mixing and Air Gas Exchange Rates (Project BODON)

PRINCIPAL INVESTIGATOR: Dr. David R. Schink

AFFILIATION: Teledyne Isotopes, Palo Alto Laboratories

PROGRESS AND CURRENT STATUS: Project essentially complete. For further details, see BOMEX Bulletin No. 6.

EXPERIMENT 75: Shipboard Buoy Rainfall Measurements

PRINCIPAL INVESTIGATOR: Mr. Willard Shinners

AFFILIATION: Sea-Air Interaction Laboratory, NOAA

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 76: Eddy Thermal Diffusion and Wind Shear Studies

PRINCIPAL INVESTIGATOR: Dr. D.H. Shonting

AFFILIATION: Naval Underwater Systems Center, Newport Laboratory

EXPERIMENT 77: Ocean Station, Salinity, Temperature, and Depth Measurements

PRINCIPAL INVESTIGATOR: Mr. J.R. Smith

AFFILIATION: Research Triangle Institute (RTI)

PROGRESS AND CURRENT STATUS: Data delivered to Dr. Paul Mazeika, U.S. Naval Oceanographic Office, for processing. No funds are available for processing at RTI.

DATA AVAILABILITY: U.S. Naval Oceanographic Office or Mr. Smith, Research Triangle Institute.

REPORTS OR PAPERS:

Paper presented by Dr. Paul Mazeika, U.S. Naval Oceanographic Office, at AGU-51st Annual Meeting, Washington, D.C., April 20-24, 1970.

EXPERIMENT 78: Air Pollutant Concentration in an Ocean Environment

PRINCIPAL INVESTIGATORS: Mr. James R. Smith and Mr. Clifford Decker

AFFILIATION: Research Triangle Institute

PROGRESS AND CURRENT STATUS: Work complete.

DATA AVAILABILITY: See report listed below.

REPORTS OR PAPERS:

Decker, C.E., J.R. Smith and G.G. Ortman, "Concentration of Trace Gases in a Marine Environment," Paper presented at AGU 51st Annual Meeting, Washington, D.C., April 20-24, 1970.

Paper being prepared for submission to Environmental Science and Technology.

"An Evaluation of Techniques for the Measurements of Low Concentrations of Trace Gases in the Atmosphere," Final report submitted to National Air Pollution Control Administration, Contract No. CPA 22-69-109, February 1970. (Copies available from NAPCA; a few available from RTI.)

EXPERIMENT 79: Reynolds Flux Measurements From FLIP

PRINCIPAL INVESTIGATOR: Dr. R.W. Stewart

AFFILIATION: University of British Columbia

PROGRESS AND CURRENT STATUS: Data runs of about 1 hour's duration have been analyzed for ten cases of u, v, w, T, and q fluctuations. The results for two runs have been compared with concurrent UBC aircraft measurements and there was good agreement. The stress measurements from the sonic anemometer give a mean drag coefficient of 1.6×10^{-3} and are approximately twice the value given by University of Washington profile measurements. The shapes of the temperature spectra and the heat flux cospectra are significantly different from results measured in mid-latitude. Further analysis is continuing.

DATA AVAILABILITY: Some results now available; others to follow.

REPORTS OR PAPERS:

"Intercomparison of Turbulence Measurements From FLIP and the Aircraft," Paper presented at the Air-Sea Interaction Workshop, Scripps Institution of Oceanography, June 16-17, 1970.

EXPERIMENT 80: Sea Photo Analysis

PRINCIPAL INVESTIGATOR: Dr. D. Stilwell, Jr.

AFFILIATION: Naval Research Laboratory

EXPERIMENT 81: Eddy Flux and Profile Measurements From FLIP

PRINCIPAL INVESTIGATOR: William J. Superior

AFFILIATION: C.W. Thornthwaite Associates

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6. This experiment is essentially complete.

REPORTS OR PAPERS:

Final report written.

EXPERIMENT 82: Detailed Sea-Surface Temperature Analysis Using Nimbus HRIR Data

PRINCIPAL INVESTIGATOR: Dr. F.M. Vukovich

AFFILIATION: Research Triangle Institute

DATA AVAILABILITY: Sea-surface temperature and salinity data for June 19 to July 2, 1969.

REPORTS OR PAPERS:

Final report being completed; should be available after October 1970.

EXPERIMENT 83: Ground Truth for Nimbus 2B Atmospheric Sounder

PRINCIPAL INVESTIGATOR: Dr. David Q. Wark

AFFILIATION: National Environmental Satellite Service, NOAA

PROGRESS AND CURRENT STATUS: Data have been obtained from the SIRS-A experiment and from BOMEX. Air temperature was calculated by the direct statistical retrieval method employing two different cloud models. SIRS-A radiances, sea surface temperature and surface air temperature were used. Currently awaiting further upper-air and surface data.

DATA AVAILABILITY: Tabulated pressure vs. temperature and the difference between retrieved and radiosonde temperature for the Oceanographer, Discoverer, and Rockaway at 1500 GMT on July 18 and 20, 1969.

EXPERIMENT 84: Nuclide Aerosol Counts

PRINCIPAL INVESTIGATOR: Dr. Helmut K. Weikmann

AFFILIATION: Environmental Research Laboratories, NOAA

EXPERIMENT 85: Classification of Environments About Tropical Cumuloform Clouds

PRINCIPAL INVESTIGATOR: Dr. V.S. Whitehead

AFFILIATION: Manned Spacecraft Center, NASA

PROGRESS AND CURRENT STATUS: All data collected by the NASA NP3A have been formated and evaluated except the data from the filter wheel spectrometer. A preliminary analysis of these data has been performed and a more detailed study is in progress.

DATA AVAILABILITY: All data except those from the spectrometer have been transmitted to the BOMEX archives. A user's guide to these data has been prepared and is awaiting publication.

REPORTS OR PAPERS:

"Data Collection by Use of the NASA NP3A Aircraft During BOMEX and Preliminary Results of Analysis," Paper presented at the Symposium on the Early Results from BOMEX, Seattle, November 20-21, 1969.

"Guide to the Use of Data Collected by the NASA NP3A Aircraft in BOMEX Between June 2 and 10, 1969," Proposed NASA Technical Memorandum.

EXPERIMENT 86: Basic Synoptic Scale Reynolds Stress Using the Geostrophic Departure Technique

PRINCIPAL INVESTIGATOR: Scott L. Williams

AFFILIATION: BOMAP Office, Environmental Research Laboratories, NOAA

PROGRESS AND CURRENT STATUS: See BOMEX Bulletin No. 6.

EXPERIMENT 87: Measurement of Air-Sea Exchange Rates With Fallout Radioisotopes

PRINCIPAL INVESTIGATOR: Dr. N.A. Wogman

AFFILIATION: Pacific Northwest Laboratory, Battelle Memorial Institute

PROGRESS AND CURRENT STATUS: The majority of the analyses for radionuclides in the air, seawater, and precipitation have been completed (see listing below). The radionuclide inventories are being calculated over each vessel, as well as the intrusion and depletion of radionuclides during each experimental period of BOMEX. These data are being used to calculate vertical diffusion coefficients in the marine environment, and the rates of wet and dry deposition.

766 air samples taken at elevations of 1000, 5000, 10,000, 20,000, 30,000, 40,000, 50,000, and 60,000 ft during Periods I and III have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{106}Ru, ^{137}Cs, and ^{140}Ba.

158 air samples taken at elevations of 1, 8, 16, 26, and 57 ft above mean sea level on FLIP have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, ^{106}Ru, ^{137}Cs, and ^{140}Ba.

77 air samples taken at elevations of 1, 10, 20, 30, and 70 ft above mean sea level aboard the Rockaway during the first period have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, ^{106}Ru, ^{137}Cs, and ^{140}Ba.

57 air samples taken at elevations of 1, 7, 25, 35, and 70 ft above mean sea level aboard the Discoverer during the third period have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, ^{106}Ru, ^{137}Cs, and ^{140}Ba.

192 air samples taken on the four corner ships during all four periods have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, ^{106}Ru, ^{137}Cs, and ^{140}Ba.

75 seawater samples obtained at 3, 33, 66, 115, 164, 213, and 289 ft aboard FLIP have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, and ^{106}Ru.

45 seawater samples obtained from the surface, 49, 98, 164, 246, 295 to 328, and 1640 ft aboard the Rockaway during the first period have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, and ^{106}Ru.

39 seawater samples obtained from the surface, 33, 49, 66, 98, 115, 131, 164, and 197 to 328 ft aboard the Discoverer during the third period have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, and ^{106}Ru.

83 rain samples collected aboard the corner vessels and Rockaway during all four periods and aboard FLIP during May have been analyzed for the radionuclides ^{7}Be, ^{95}Zr, ^{103}Ru, ^{106}Ru, and ^{137}Cs.

DATA AVAILABILITY: All data will be available soon.

REPORTS OR PAPERS:

"Pacific Northwest Laboratory Annual Report for 1969 to the USAEC Division of Biology and Medicine, Volume II: Physical Sciences, Part 2. Radiological Sciences," BNWL-1307 2, pp. 21-22, 1970.

EXPERIMENT 88: Experimental Microwave Radiometer Data in BOMEX

PRINCIPAL INVESTIGATOR: Mr. F.T. Barath

AFFILIATION: Jet Propulsion Laboratory, NASA

EXPERIMENT 89: Airborne Ruby LIDAR Measurements of Cirrus and Haze

PRINCIPAL INVESTIGATOR: Dr. Paul Davis

AFFILIATION: Stanford Research Institute

PROGRESS AND CURRENT STATUS: Contractual study completed (see report listed below).

DATA AVAILABILITY: Report copies available upon request from Dr. P.A. Davis, Location L2094, Stanford Research Institute, Menlo Park, California 94025.

REPORTS OR PAPERS:

Davis, P.A., "Airborne Ruby-Lidar and Radiometric Measurements of Cirrus and Haze During BOMEX," Final report, Contract E-263-68, Stanford Research Institute, April 1970. This report includes description of the lidar system aboard the NASA CV-990 aircraft and the techniques adopted for data analysis. Data summaries include geometric properties of observed cirrus, pertinent housekeeping information, and results of optical analyses of lidar returns. Analyses of concurrent infrared (10.2-11.6μ) radiance measurements showed that the infrared transmittance was correlated best with the geometrical thickness of the cirrus cloud. Average profiles of backscattering coefficients for cloud-free air are presented and, in a few cases, checked against in-flight particle counts by Colorado State University.

EXPERIMENT 90: Operational Use of Satellite Data in Scientific Mission Planning

PRINCIPAL INVESTIGATOR: Capt. G.J. Dittberner

AFFILIATION: U.S. Air Force

EXPERIMENT 91: Area Precipitation Estimate

PRINCIPAL INVESTIGATOR: Capt. G.J. Dittberner

AFFILIATION: U.S. Air Force

EXPERIMENT 92: Diffusion Studies in the Ocean Langmuir and Ekman Layers

PRINCIPAL INVESTIGATORS: Mr. Sam Gerard and Dr. Arnold Gordon

AFFILIATION: Lamont-Doherty Geological Observatory

PROGRESS AND CURRENT STATUS: Aerial photographs of floating cards and dye stripes at surface and 6-m depths were obtained on June 24, 1969, in the central BOMEX area, revealing Langmuir cells with dimensions of 50 ft (between the divergence and convergence portion). The scale appears to correspond to the depth of the mixing layer.

REPORTS OR PAPERS:

Measurements will be published, together with similar results obtained from experiments in the Bermuda area. The date of publication is not yet known.

A brief description of this experiment has been presented in "Wind-Drift Current Investigations," Summary Report to the U.S. Naval Oceanographic Office, Contract No. N62306-C-0296, December 1969.

EXPERIMENT 93: Weather Radar Investigations During BOMEX

PRINCIPAL INVESTIGATOR: Dr. Michael D. Hudlow

AFFILIATION: Formerly Atmospheric Sciences Laboratory, U.S. Army; now BOMAP Office, Environmental Research Laboratories, NOAA.

PROGRESS AND CURRENT STATUS: Experiment complete. See BOMEX Bulletin No. 6.

REPORTS OR PAPERS:

"Absolute System Calibrations for BOMEX Weather Radars." (Figures are complete and text is in preparation and should be ready for editing by November 1, 1970.)

"Experimental Design for Processing BOMEX Digitized Radar From Surface-Based Radar Photographs." (Eighty percent completed; draft to be ready for editing by December 15, 1970.)

"Radar Climatology East of Barbados Derived From Data Collected During BOMEX," Paper presented at the 14th Radar Meteorology Conference of the American Meteorological Society, Tucson, Arizona, November 17-20, 1970.

EXPERIMENT 94: Automatic Processing of Rawinsondes at BOMEX Field Headquarters

PRINCIPAL INVESTIGATOR: Mr. George Langer

AFFILIATION: National Center for Atmospheric Research

PROGRESS AND CURRENT STATUS: No work done on data since February 1970.

DATA AVAILABILITY: Data available on tapes OL328 through OL333. Logbook available from Mr. Langer. Format and copy program available from Mr. D. Joseph.

EXPERIMENT 95: Day-to-Day Variation of Divergence in Trade-Wind Region

PRINCIPAL INVESTIGATOR: Robert W. Reeves

AFFILIATION: BOMAP Office, Environmental Research Laboratories, NOAA

PROGRESS AND CURRENT STATUS: Processing of the RFF flights is nearing completion. This includes wind corrections based on renavigation of flights and analysis of calibration box data. The hand-tabulated Navy aircraft wind data have been checked for gross errors and new tapes have been prepared for further analysis.

DATA AVAILABILITY: Original tape listings (OTL) and final tape listings (FTL) are available for certain flights.

REPORTS OR PAPERS:

"Preliminary Velocity Divergence Computations for the BOMEX Volume Using Aircraft Winds," Technical Memorandum being edited.

EXPERIMENT 96: Current Measurement Comparisons Between Free Floating RAFT's and GEK

PRINCIPAL INVESTIGATOR: Mr. R. Ribe

AFFILIATION: U.S. Naval Oceanographic Office

PROGRESS AND CURRENT STATUS: The purpose of this experiment was to evaluate this specific Geomagnetic Electrokinetograph. No satisfactory comparison standard was available to determine the accuracy of these tests. The instrument has sensitivity to water temperature and salinity changes and other characteristics that make measurements obtained by it subject to misinterpretation. Test results are not recommended for use by oceanographers.

EXPERIMENT 97: BOMEX Atmospheric Electricity Experiment

PRINCIPAL INVESTIGATOR: Dr. Stig A. Rossby

AFFILIATION: National Center for Atmospheric Research

EXPERIMENT 98: Sea Surface and Cloud Photography from the CV-990

PRINCIPAL INVESTIGATORS: Mr. John Semyan and Mr. William Vetter

AFFILIATION: Goddard Space Flight Center, NASA

DATA AVAILABILITY: All pictures that were processed and considered satisfactory are available. There is a considerable expense incurred in duplicating data of this kind, however. Present budget will not permit general reproduction and distribution of these pictures. (As an example of the expense involved, the 70-mm reprints alone would cost approximately $6,000.00). In the near future Colorado State University will issue a document listing support data for the NASA CV-990 meteorological flights (BOMEX) that will show essentially when cameras were in operation and any conditions that might be of interest to experimenters. If the experimenter can supply specific time code information, it may be possible to supply some specific photographs. Copies of entire flights may be acquired if the expense of reproduction is absorbed by the agency or person requesting the service. If any experimenter has a need to view the photographs mentioned above, he may do so by coming to the Goddard Space Flight Center in Greenbelt, Maryland, Building 21. Alternatives to this procedure will be considered if a request is made by letter to Dr. William Nordberg, at Goddard.

Colorado State University also has a complete set of video recordings that may prove valuable to some experimenters in the investigation of their data. Mr. Don Hill was in charge of recording on the plane. Availability of data unknown.

EXPERIMENT 99: Geological and Geophysic Studies of the Ocean Bottom Layers Near Barbados

PRINCIPAL INVESTIGATOR: Dr. Watkins

AFFILIATION: University of North Carolina

PROGRESS AND CURRENT STATUS: Data being studied.

DATA AVAILABILITY: January 1, 1971.

EXPERIMENT 100: Studies of Ozone and Radiation in the Upper Atmosphere During BOMEX

PRINCIPAL INVESGITATOR: Dr. James E. Weinmann

AFFILIATION: University of Wisconsin

II. STATUS OF BASIC DATA REDUCTION AND PROCESSING

This section reports on the considerable progress made in BOMEX data reduction and processing since the last review, which appeared in section V of BOMEX Bulletin No. 7.

A. Fixed-Ship Computer Data

Digitization and initial fully automated (or "A_0") fixed-ship data reduction and processing at NASA's Mississippi Test Facility (MTF) and the NASA Computer Operations Office, Slidell Facility, Slidell Louisiana, will be completed by the end of November 1970. Present planning schedules the phase-out of the BOMAP/MTF staff and their return to Asheville, North Carolina, during November.

The raw and processed data resulting from the NASA/MTF and NASA/Slidell operation, and the "A_0" review performed by BOMAP/MTF, are being shipped to the BOMAP Office. These various output will be used to support the development of final production fixed-ship CDC 6600 software, "A" process manual inputs, and dissemination of data to users through a temporary archive.

Since this Bulletin will be the last in which details of the "A_0" fixed-ship data reduction are reported, it is fitting to pay tribute to those responsible for the realization of the "A_0" products. NASA/MTF, through effective use of managerial skill and available facilities, provided "A_0" data reduction programs and graphic displays that permit ready evaluation of the significance of the fixed-ship data. NASA/MTF also produced STD and BLIP digitized data of the highest quality, which required highly specialized attention and implementation of innovative techniques. NASA/Slidell, as a service organization with an already burdensome workload, furnished digitized rawinsonde and Boom data to NASA/MTF that allowed an "A_0" yield far greater than anticipated, assuring success to that part of the BOMEX program. The Environmental Data Service/National Climatic Center staff comprising the BOMAP/MTF group provided the necessary leadership and questioning review of the "A_0" output that resulted in the evaluation of computer programs, processing techniques, and data necessary for the development of the final fixed-ship data reduction and scientific analysis. The above achievements constituted efforts by a team of individuals who worked together effectively with dedication and motivation beyond that expected under very difficult circumstances.

B. Aircraft Data

The National Hurricane Research Laboratory program has been used in processing data from the following RFF flights:

29 out of 33 DC-6 39C flights
21 out of 24 DC-6 40C flights
4 out of 24 DC-4 82E flights

A chronological record has been prepared, listing the objectives of each of these flights - data leg, calibration box, etc. This record, together with a recently completed computer program, will be used to retrieve the RFF data according to objective from the original magnetic tape. Aircraft calibration box and leg data are now being retrieved in preparation for extensive system intercomparison studies.

The hand-tabulated Navy aircraft data are still being checked for errors. These data, now on magnetic tape, have also been listed according to objective and the calibration box and leg data written on a separate tape for use in intercomparison analyses.

C. Manual Rawinsonde Data

Formats have been designed for the output of the rawinsonde computation program, one for use in the Mesoscale Analysis Project and another for validating the "A_o" process and for use in the Core Experiment. About 60 percent of the rawinsonde data have been transcribed from microfilm copies of the strip charts for BOMEX Period III and have been coded on punched cards. Most of the preparatory work necessary to start the computer data reduction of the punched cards for Period IV has been completed; the remaining work on Period IV data depends on the receipt of copies of strip charts from MTF.

D. Background Weather Analysis

Surface data from the observation cards for BOMEX Periods I through III have been plotted on mesoscale base maps ($1:2 \times 10^6$ charts that include the area from 10 to 19°N and from 50 to 64°W). Final plotting will be done from the "A" processed data.

ETAC ship and land station surface data for the area 20°S to 40°N and 0 to 90°W are now available at the BOMAP Office for plotting on synoptic scale maps. NMC upper air reports will be added. Due to the lack of data over the ocean within this area, only the surface, 4000-ft (top of Ekman layer), and 200-mb charts will be included in this synoptic-scale series for Periods I through III. Commercial aircraft data in the 300- to 200-mb layer will be added as an aid in analyzing the 200-mb surface.

E. Dropsonde Data

As a result of the analyses of the dropsonde data as described in BOMEX Bulletin No. 7, the on-board reduced data were found unsatisfactory for use in the Core Experiment. The decision was made to read significant level data manually from the strip charts and work them up by a computer program. The data reduction is about 60 percent complete, and a dropsonde computation program will be ready soon.

F. Cloud Photographs

The cloud photographs taken by the Air Force RB-57 at 60,000 ft during BOMEX Period IV have been prepared as 35-mm slides. The adjustment of flight tracks and writing of descriptive material to accompany these slides have been completed. Results are reported by Vance A. Myers in "High-Level Cloud Photography Inventory, BOMEX Period IV, July 11-28, 1969," ESSA Technical Memorandum ERLTM-BOMAP 1, September 1970.

Cloud photographs taken by the RB-57 at 50,000 to 60,000 ft during Period III have been reduced to half-size black and white prints (see section III, BOMEX Bulletin No. 7) and are being prepared as photocomposites for publication in the form of an atlas, now nearing completion.

The status of satellite data reduction is essentially the same as reported in BOMEX Bulletin No. 7. ESSA-9 cloud photographs are being used for May 23-31, a period for which ATS-3 photographs are not available.

G. Radiation Analysis

Over 35 of the high resolution infrared grid printouts from the Nimbus 3 satellite have been received (about 60 percent of the total). Dr. Kuhn has furnished samples of radiometersonde measurements of infrared flux and resulting cooling rates, and he will send a complete file of these to the BOMAP Office (see Experiment No. 46 in section I of this Bulletin).

H. STD (Salinity-Temperature-Depth) Sensor Data

See section IV of this Bulletin.

I. Radar Data

Work is continuing along the lines mentioned in section IV of BOMEX Bulletin No. 7.

J. BLIP (Boundary Layer Instrument Package) Data

Digitization of the Oceanographer and Mt. Mitchell BLIP data for Periods III and IV has been completed. The BLIP data obtained by the Oceanographer, Mt. Mitchell, Discoverer, and Rainier during Period II and by the Discoverer and Rainier during Period III will also be digitized.

Programs for converting data on wind, dry and wet bulb temperature, and relative humidity have been written. These programs have been used in processing the Oceanographer data for Period III.

Wind direction bias is being computed for each set of observations during Period III, with mast and Boom wind direction data used for comparison.

The BLIP "A_o" microfilm display software program is 90 percent complete. For samples of current BLIP data, see section IV of this Bulletin.

K. Turbulent Flux Analysis

The RFF DC-6 gust probe/refractometer data reduced by Rinaldi Data Processing Associates under contract with BOMAP (see BOMEX Bulletin No. 7), and a report from Rinaldi documenting the computation procedures, are being analyzed by the Radio Meteorology Group, Wave Propagation Laboratory, Environmental Research Laboratories, NOAA, Boulder, Colorado.

III. SAMPLES AND FORMAT OF REDUCED DATA

The samples of BOMEX data and preliminary analyses shown in this section illustrate the progress in digitization, reduction, and processing discussed in the preceding section of this Bulletin.

A. Rawinsonde and Dropsonde Data

The original rawinsonde fixed-ship data transmitted by teletype have been published in Vol. II (Parts 1 and 2) of "BOMEX Preliminary Data," a series of four compilations of messages received at Barbados during the BOMEX field operations.

All legible microfilmed copies of rawinsonde strip charts for Period III were worked up manually and coded for punching. Work is progressing on a computer program to compute soundings from the punched cards for additional analyses.

At the same time, the "A_o" (initial fully automated reduction) processing of the rawinsonde data is nearing completion at NASA's Mississippi Test Facility. Some editing and corrections will still be required, especially of winds and relative humidity.

Figure 1 shows a set of three ascents from the Rainier on June 24, 1969. This sequence illustrates how well the major features in both temperature and relative humidity are retained on the 1015, 1149, and 1320Z soundings plotted automatically from the "A_o" processed data at 5-sec intervals. The temperature error shown near the top of the 1300Z sounding was due to incorrect identification of a reference contact and should be eliminated in later "A" processing. A noisy section in the lower part of the 1149Z relative humidity curve is a result of frequency doubling, a problem that will also be largely eliminated in the "A" process. The large drop in relative humidity over the entire sounding between 1015Z and 1320Z is a systematic error caused by solar heating of the hygristor (sunrise is approximately 1000Z).

Figure 2 shows the "u" and "v" wind components (and the pressure-height curves) for the same ascent times as in figure 1. Again, major features appear to be retained, except for a development in the upper portion of the third sounding. The validity of the small features is questionable since the 30-sec averaging time used is inadequate for suppressing the 9-sec antenn hunt.

The various methods of analyzing the soundings are compared in figure 3 for 918- to 900-mb levels. The 5-sec averaged data are based on the "A_o" process, the others on the manually reduced strip charts. Results are shown for two selected soundings on the Rainier and Oceanographer. The agreement between the "A_o" and the manually reduced Rainier data for June 23, 1969 (Day 175), is good. The Oceanographer data for 1330Z on the same date represent one of the largest discrepancies noted in making these comparisons.

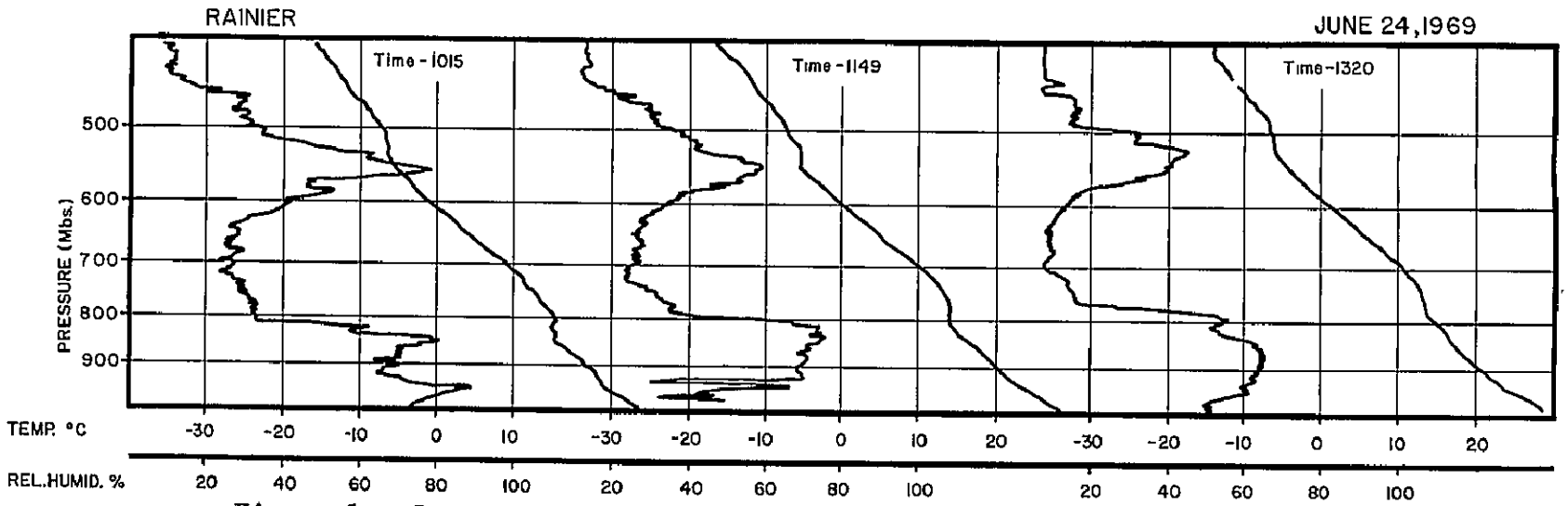


Figure 1.—Sequence of rawinsondes showing temperature and relative humidity.

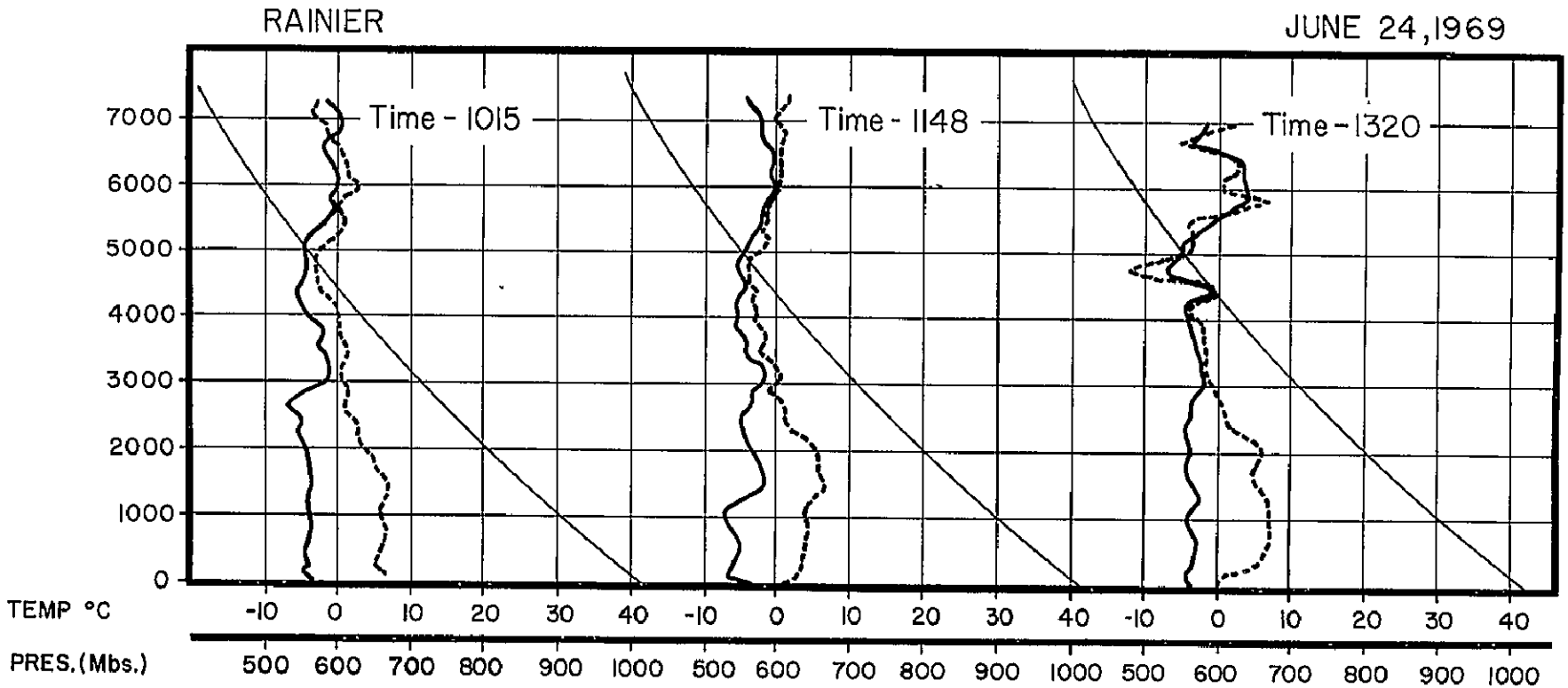
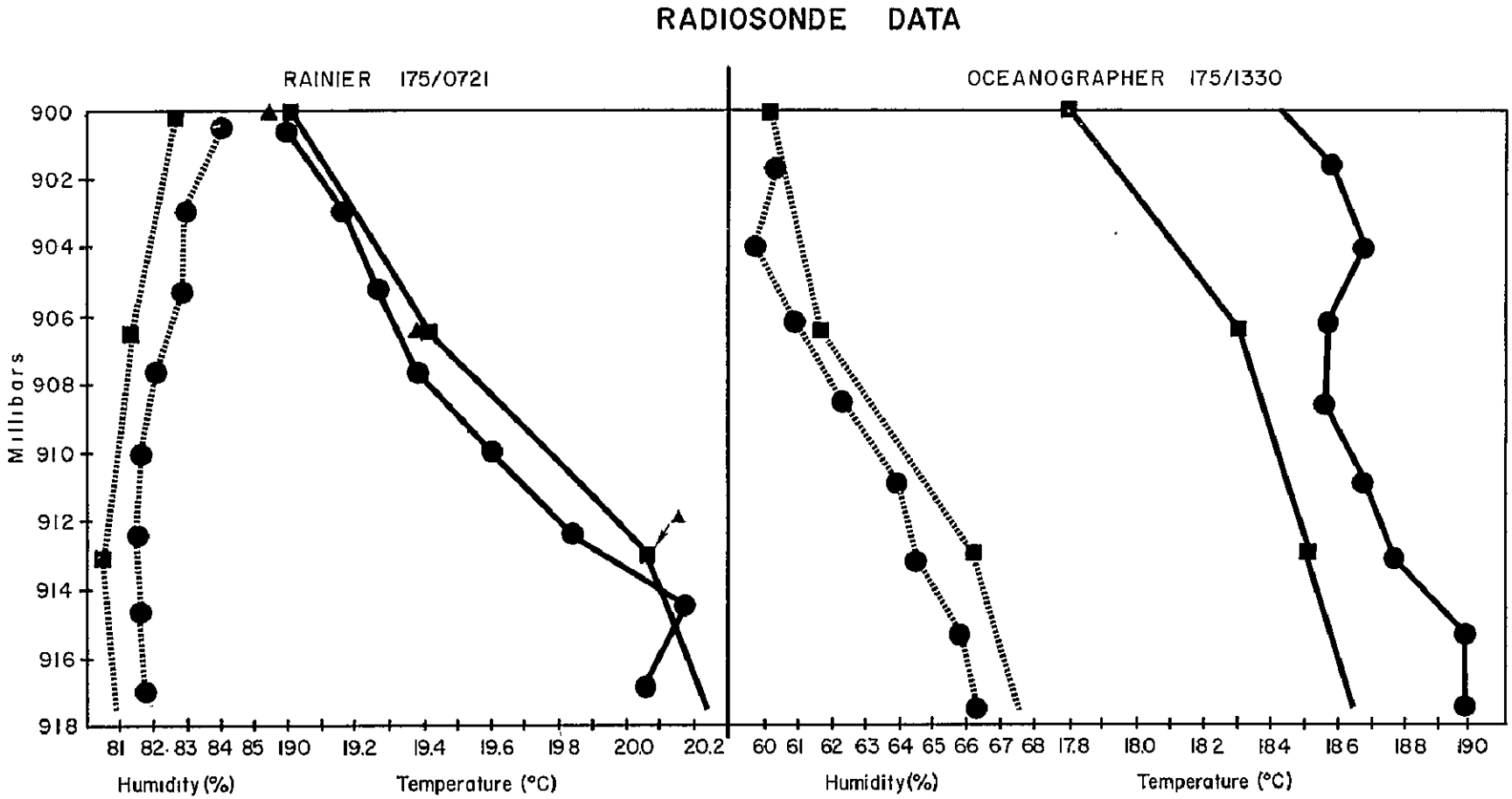


Figure 2.—Sequence of rawinsondes showing "u" (solid line) and "v" (dashed line) wind components.



NOTE- Sensor calibration correction not applied to manually reduced relative humidity data.

LEGEND-

- ● 5 second data
- ■ Manually reduced data from strip chart using evaluator
- ▲ Manually reduced data from strip chart using formulas

Figure 3.--Comparative rawinsonde computations.

Relative humidity for the entire sample and temperatures below 908 mb agree reasonably well, the most extreme variation being less than 1°C at the top of the sample.

Up to as many as 15 rawinsondes were launched daily from the five fixed ships and about 16 dropsondes were released at about the same time from approximately 20,000 ft. Sample comparisons -- in terms of dropsonde minus rawinsonde differences in temperature and relative humidity values -- based on the Mt. Mitchell original unvalidated teletype reports are shown in figure 4 for May 6 at 1200 and 1330Z and on the left in figure 5 for June 24 at 1200Z (8 AM local time). As seen in these figures, the temperature differences in most cases are between 0° and 1°C at 1330Z, while the relative humidity differences are mostly 10 to 25 percent, except for 1330Z at 800 mb, where the difference is over 35 percent. In general, the dropsonde data showed higher temperatures and relative humidities. This is another reflection of the radiosonde hygristor solar heating effect.

The comparison of temperature and relative humidity illustrated on the right of figure 5 are based on "A_0" processed rawinsonde data and reworked dropsonde data. Here the temperature differences are slightly less and the relative humidity data indicate both higher and lower values for the dropsonde than for the rawinsonde.

B. Boom and Surface Data

Boom and surface "A_0" data are shown here in comparison with independent measurements of the same kind, consisting of surface observations taken manually by technicians and ship's personnel. The problems implicit in these samples are the subject of validation studies now underway in the BOMAP Office.

Surface meteorological observations aboard the fixed ships included standard marine meteorological observations and measurements from instruments mounted approximately 10 m above the sea surface on a boom fixed to and extending from the bow of each fixed ship, and weather surveillance by radar aboard the Discoverer.

Standard marine meteorological observations were obtained visually and recorded manually. These observations were made approximately 10 m above the sea surface and at approximately 1½-hour intervals, simultaneously with rawinsonde launches.

Boom meteorological observations were recorded automatically on SCARD at 30-sec intervals. Measurements on all ships included dry bulb temperature, wet bulb temperature, relative humidity, wind speed, and wind direction. In addition, Boom instruments on the Discoverer, Rainier, and Rockaway measured incident (solar), reflected, and net radiation.

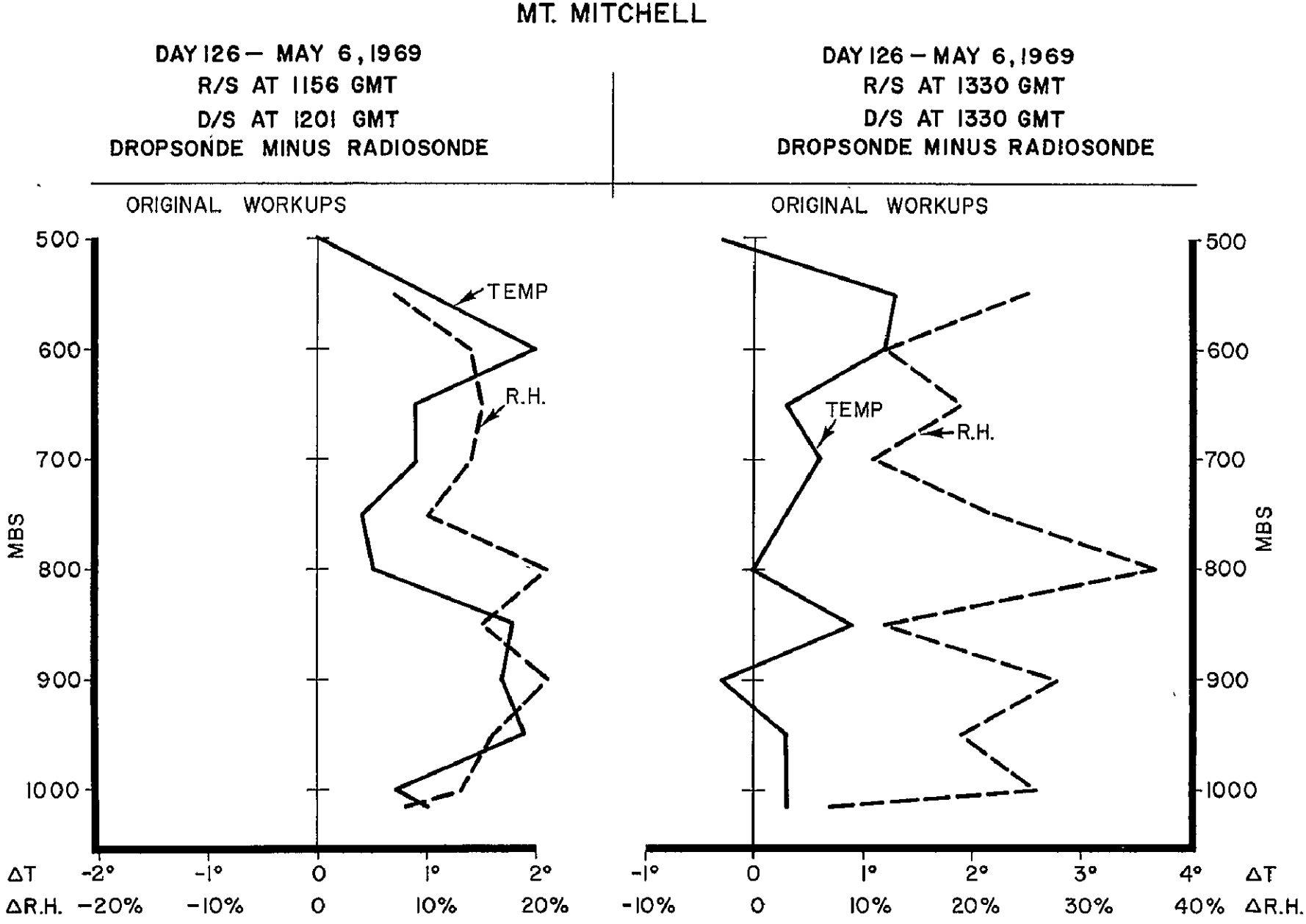


Figure 4.—Comparison between sample rawinsonde and dropsonde data.

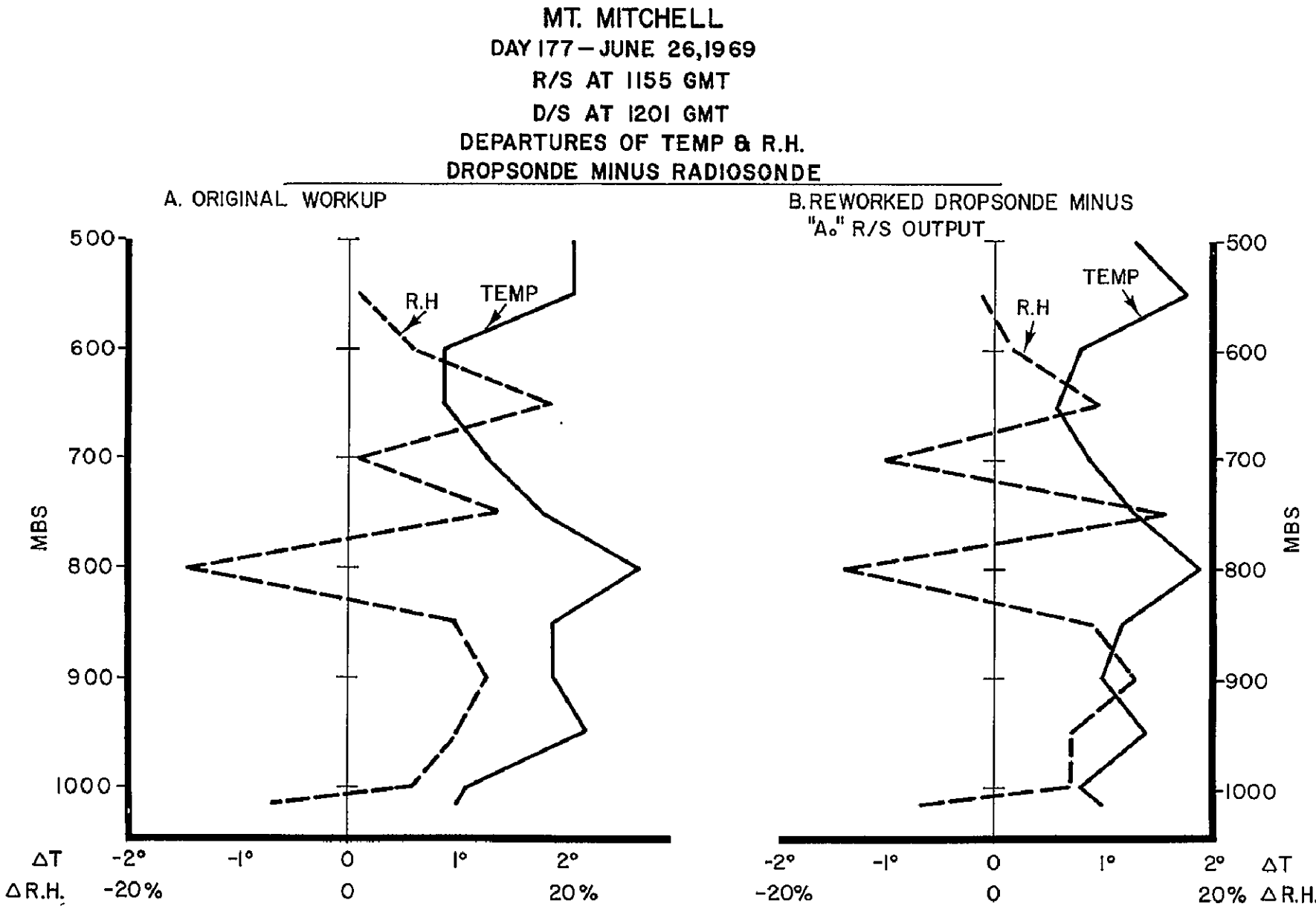


Figure 5.—Comparison between sample rawinsonde and dropsonde data.

Barometric pressure, another surface parameter, was automatically recorded on SCARD. The Oceanographer, Rainier, Mt. Mitchell, and Rockaway used the Rosemont Engineering Company capacitive pressure sensing unit and an aneroid barometer, which were attached to the same static head on the ships. The Discoverer used the NCAR DPD barometer, developed by the National Center for Atmospheric Research (NCAR).

Ship navigation data were included as part of the BOMEX fixed-ship surface data acquisition system. The five ships were initially moored by deep-sea anchor systems at assigned positions -- the four corners and center of the BOMEX square -- for Periods I, II, and III. However, failure of each mooring system forced the ships into a "drift and steam back to position" mode of operation. The primary methods of determining ship position were the Omega navigation system and celestial fixes. Two ships used anchored buoys deployed nearby for radar ranging to determine ship position relative to the buoy.

Figure 6 shows the time series of the wet bulb and dry bulb temperatures measured on June 25, 1969. Boom "A_0" data consist of 10-min averages of Boom observations made at 30-sec intervals. The sling psychrometer data consist of samples spaced approximately 1½ hours apart. This figure demonstrates not only the problem of merging data from independent sources, but suspected sensor malfunctions (note Boom wet bulb and dry bulb temperatures from 1000Z to 1400Z). A calibration period accounts for the break in the Boom data from 1400Z to 1600Z. Figure 7 shows a time series of the relative humidity, taken from humidity sensor on the Boom and from the dry and wet bulb temperature reading on the ship's surface for the Rainier on June 25, 1969.

The sea surface temperature measured by the Boom sea surface thermistor and the bucket temperature, based on a surface water sample obtained by a bucket and measured with a mercurial thermometer, are compared in figure 8. The Boom sea surface temperature curve represents 10-min averages of thermistor measurements at 30-sec intervals. The bucket temperatures were obtained every 2 hours on the odd hour. The break in the Boom data is attributable to a calibration period.

Figure 9 shows pressure data from the Rosemont transducer acquired every 30 sec and presented as 10-min averages; aneroid barometric pressure, corrected for instrument calibration, plotted at 1½-hour intervals that correspond with rawinsonde baseline periods (from #0 card); and aneroid barometer data consisting of approximately 1½-hour samples obtained 15 to 30 min after a rawinsonde launch and corrected for both instrument calibration and height above sea level (from #1 card).

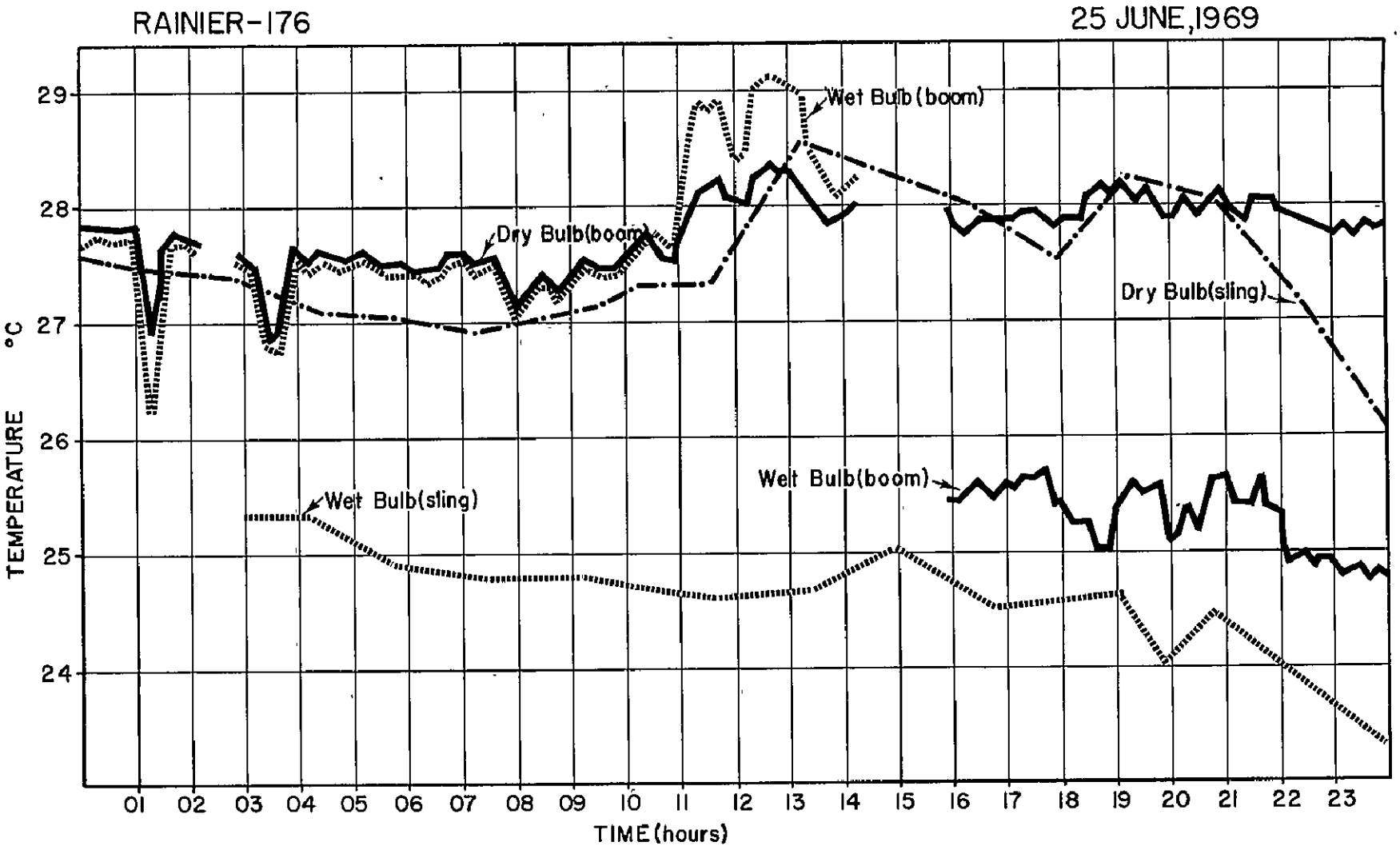


Figure 6.--Comparative Boom and ship's surface dry and wet bulb data.

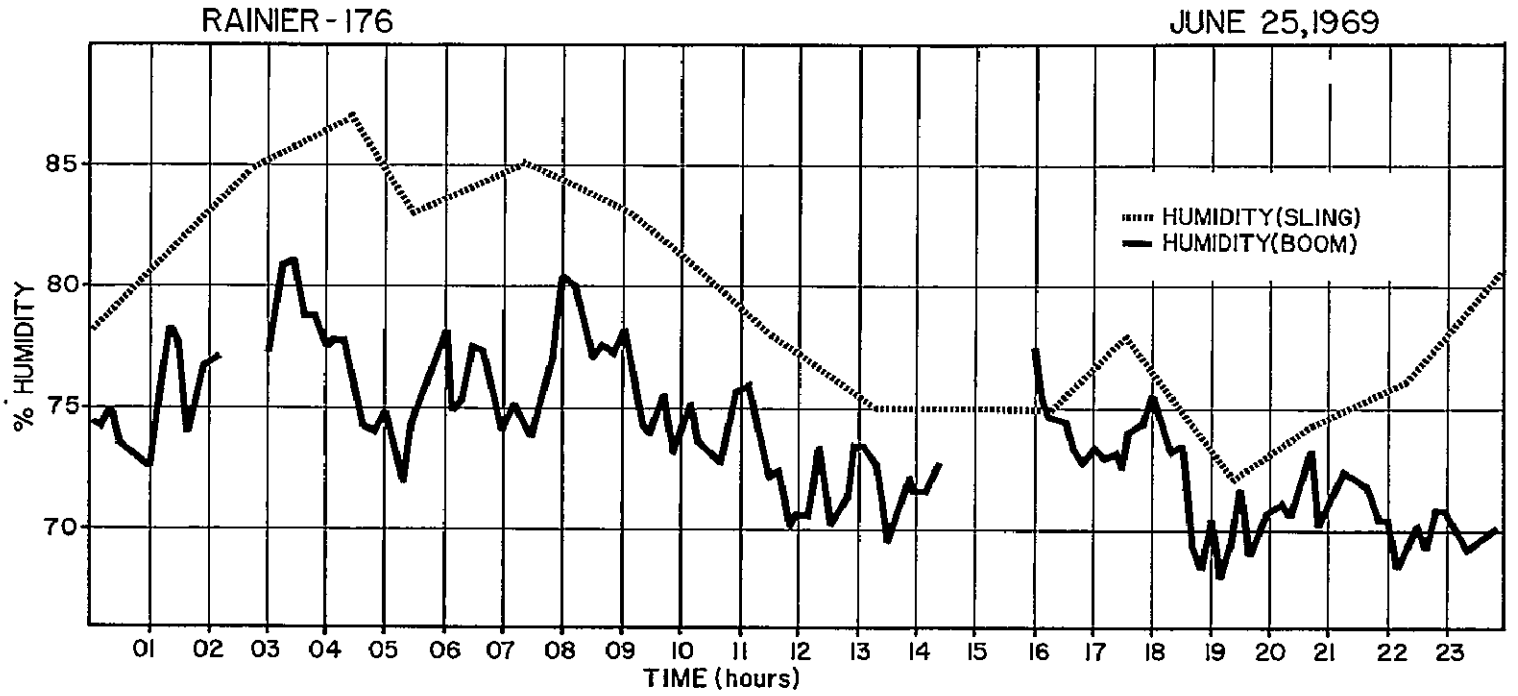


Figure 7.--Comparative Boom and ship's surface relative humidity.

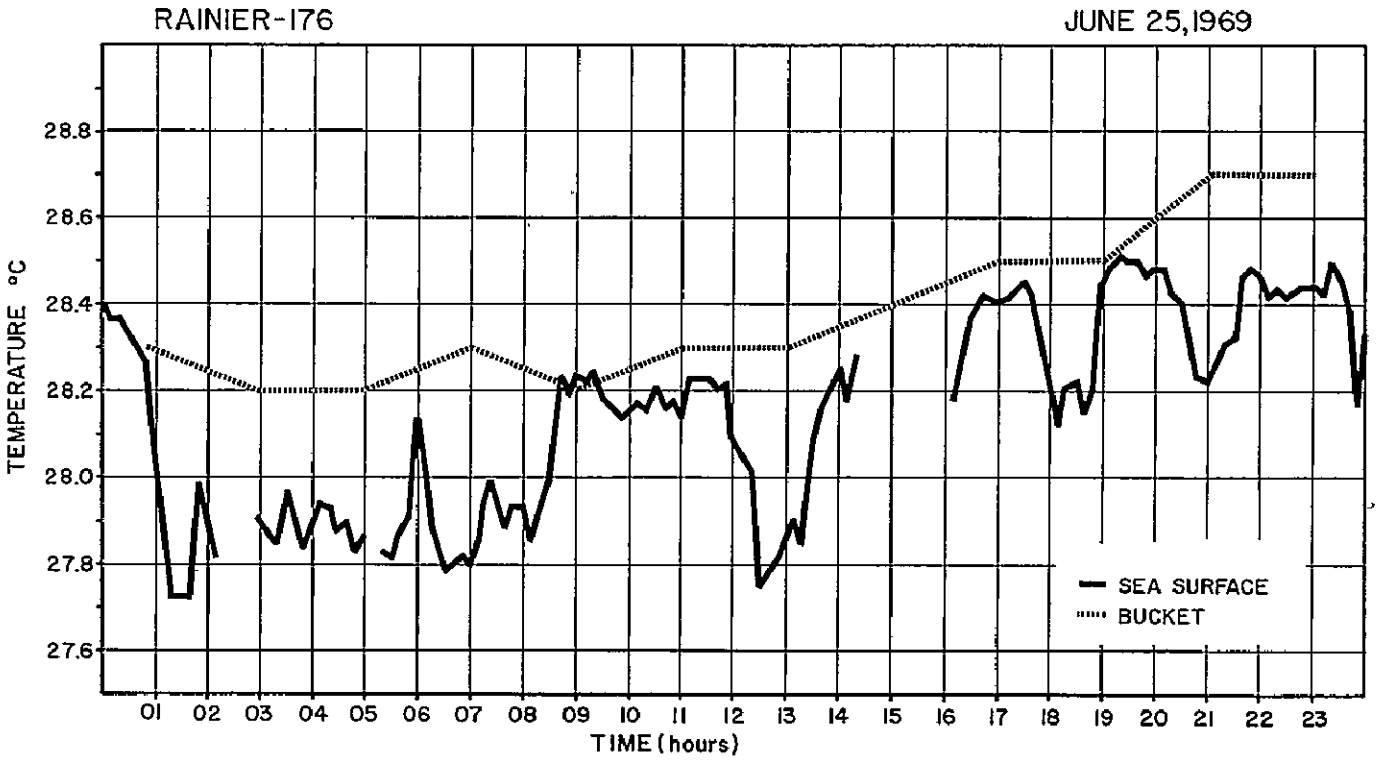


Figure 8.--Comparative sea surface and bucket temperature data.

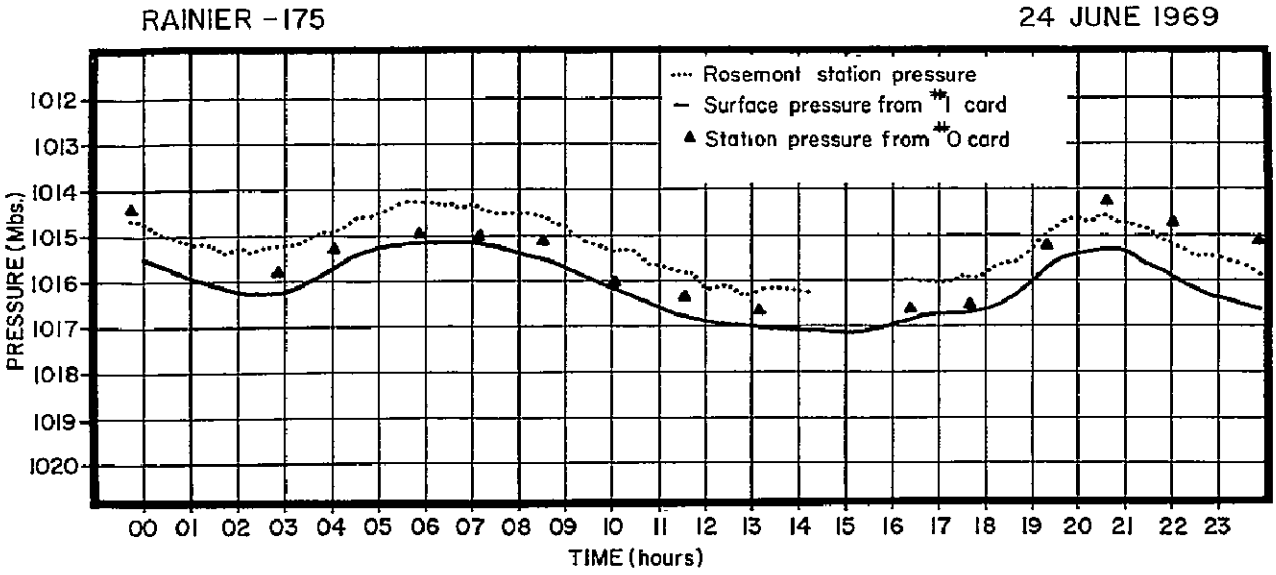


Figure 9.--Comparative Rosemont and ship's surface aneroid pressure data.

Various wind speed and direction data and the appropriate navigation parameters for periods when the fixed-ships operated in a "steam and drift" mode are shown in figure 10. No attempt has been made to correct the wind speed for ship motion; the data are plotted as measured. This figure includes the following: wind speed and direction automatically acquired from the Boom sensors approximately 10 m above sea level; wind speed and direction data acquired on strip charts from the ship's anemometer mounted on the foremast yardarm, approximately 30 m above the sea surface; periods for which rawinsonde and STD instruments were operational; navigation parameters consisting of ship's speed as indicated on the underwater log; ship's true speed as estimated by the ship's navigator from the plotting of fixes; and ship's heading as automatically acquired from the ship's gyro. Relative wind speed, relative wind direction, and true wind direction from the Boom sensors, and ship's heading from the gyro, represent 10-min averages of data automatically recorded by SCARD at 30-sec intervals. Relative wind speed and direction data from the yardarm anemometer consist of samples manually selected from strip charts at 10-min intervals. The relative wind direction curves are normalized to 180° with respect to the ship's bow, i.e., a -100° relative wind direction equals a wind from a direction that is 100° from the bow toward the stern on the port side of the ship. One reason for the obvious time lag between the relative wind direction obtained from the Boom and the yardarm is that a 10-min Boom average was assigned as the end time of the 10-min period averaged.

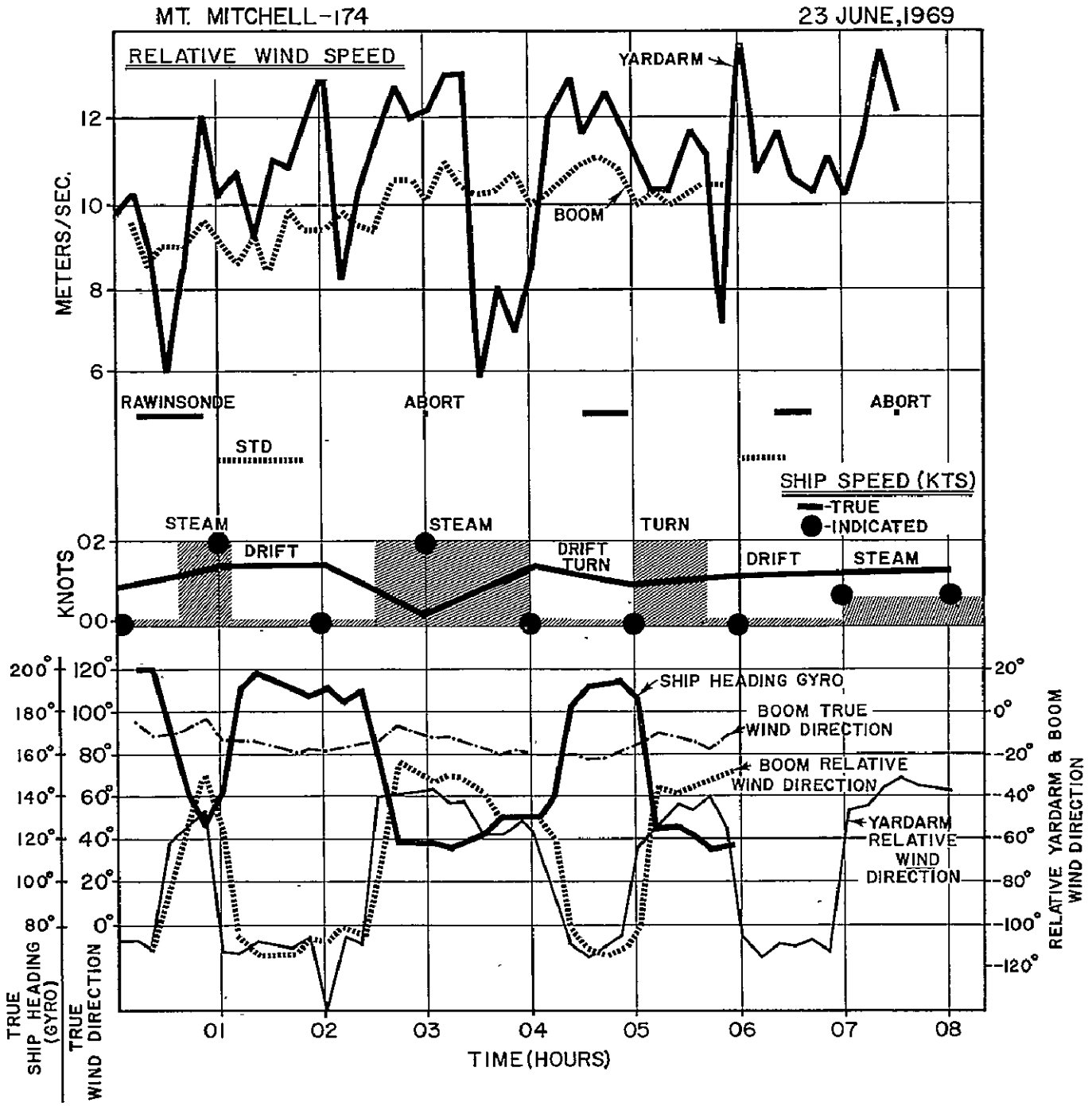


Figure 10.--Relative wind speed and direction and effect of ship's motion.

C. Radiometersonde Data

The sample IR radiometersonde plot in figure 11 shows the temperature and the infrared heating rate profiles (°C/day) obtained on the Rockaway on June 23, 1969. The cooling rate varies from 0 to 5°C/day. The position of cloud tops (Cu, Ac, Ci) is inferred from the cooling rate profile. The radiometersonde data were reduced by Dr. Peter Kuhn, Atmospheric Physics and Chemistry Laboratory, ERL, Boulder, Colorado.

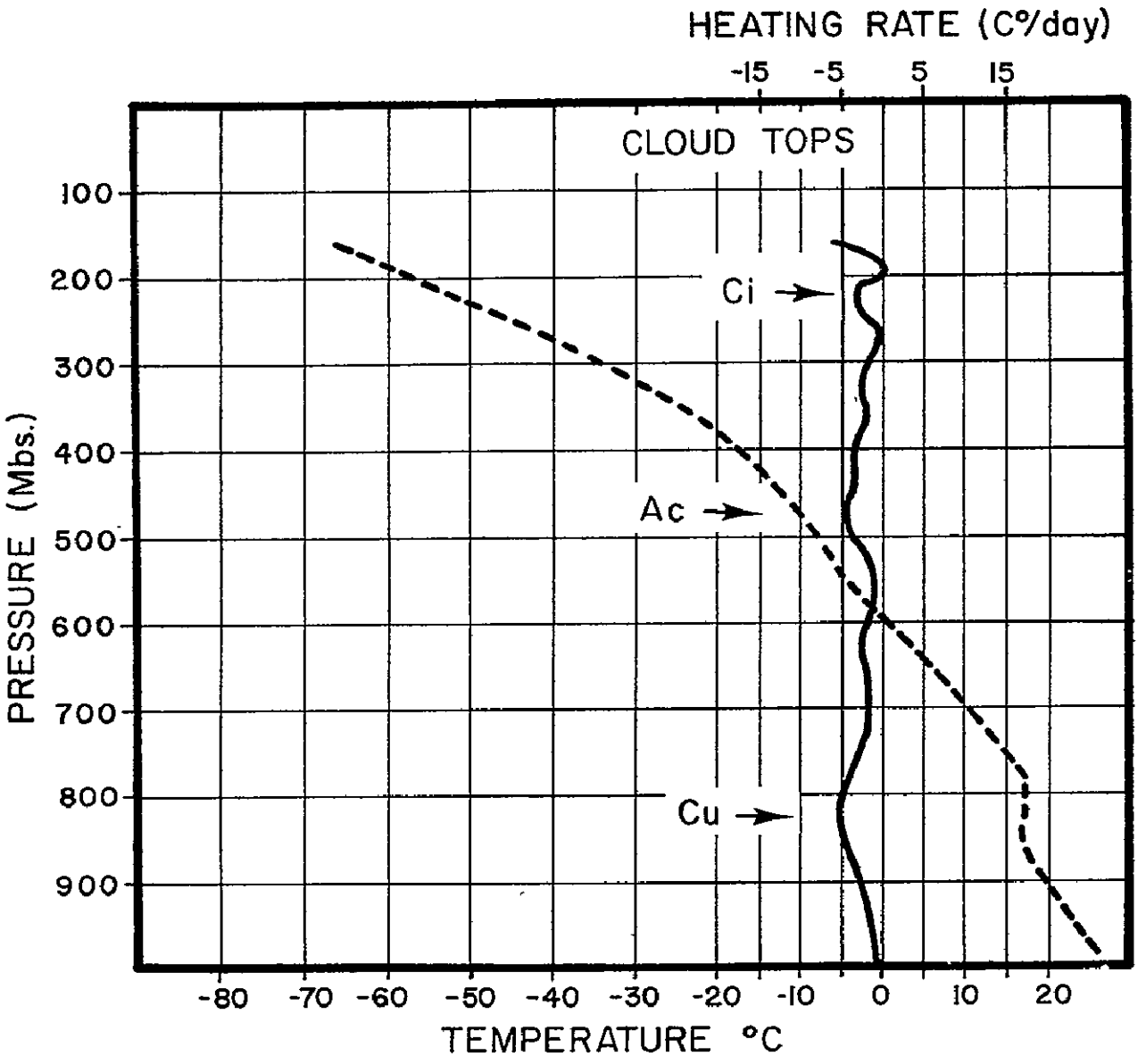


Figure 11.--IR radiometersonde run on the Rockaway June 23, 1969.

D. STD Data

The primary set of oceanographic data from BOMEX consists of about 1400 STD casts. These casts were made from each of the five fixed ships at 3- or 6-hour intervals throughout the four observation periods. With some exceptions, each cast obtained salinities, temperatures, and depths from the surface to 1000 m. The data were recorded as mixed analog frequencies on SCARD tapes. These tapes, having been digitized at NASA's Mississippi Test Facility (MTF), are filtered by the BOMAP Office to eliminate digitizing noise, transformed from frequencies into engineering units, corrected for proper header information, and generally edited into a form suitable for archiving.

The above machine reduction procedure, developed by Mr. John McHugh while temporarily assigned to BOMAP from the National Oceanographic Data Center (NODC), consists of the steps shown in table 4. The elimination of errors caused by sensor time-lag and salinity spiking will be the subject of a forthcoming paper by McHugh.

As now planned, 20 edited tapes (8 sps) are to be sent to NODC: one for each period for each ship. To date (October 1970), the tape for Period IV (July 11 to 28) of the data from the Discoverer has been completed and forwarded to NODC. It contains, in time-series, temperature, salinity (except when the salinometer failed), pressure, and time for 111 casts.

These edited STD data compare favorably with simultaneously obtained Nansen bottle data, as seen in table 5. The agreement between the STD values and those taken from the Nansen bottles is as follows:

Temperatures: Of the 84 Nansen-STD temperature comparisons made, 11% agreed within .01°, 19% within .02°, 43% within .05°, 69% within .10°, and 87% within .20°.

Salinities: Of the 45 Nansen-STD salinity comparisons made, 22% agreed within .01°/oo, 36% within .02°/oo, 56% within .05°/oo, 78% within .10°/oo, and 98% within .20°/oo.

Figure 12 shows temperature, salinity, and sigma-tee versus depth for the cast made at 0600Z on July 11 from the Discoverer, and the same information in temperature-versus-salinity format is presented in figure 13, where both South Atlantic Central Water and Antarctic Intermediate Water are evident at depths greater than about 220 m.

A 12-day time series of the temperature and thickness of the isothermal (28°) isohaline (32.1°/oo) surface layer in figure 12 is given in figure 14. Figure 15, a statistical envelope of the diurnal temperature variation of this surface layer, clearly shows a warming-cooling trend. No such simple variation in layer thickness is evident.

A 12-day time series for the depths of the isotherms recorded on the Discoverer is presented in figure 16.

Table 4.--STD data reduction and editing procedure

Step	Input	Output
1	SCARD tape (mixed analog frequency for S, T, P_1, and P_2 on single track; time; control track)	MTF tape (one 8-sps frequency track for each of S, T, P_1, and P_2; time; control track)
2	(a) MTF tape (b) Cards for sensor calibration constants	(a) Pass 1 tape (engineering units S, T, and P, corrected for digitizing noise and tape speed) (b) Surface data cards
3	(a) Pass 1 tape (b) Edit cards	(a) Edited tape (S, T, and P, free of bad stretches of data, and with corrected headers and comments inserted)
4	Edited tape	Computer printout (plots in either time-series or depth-sorted format, corrected for time lag and spiking of sensors)

Table 5.--Comparison of STD and Nansen bottle data

Date July	Time Z	Depth m	STD temp.	Nansen temp.	STD salin.	Nansen salin.
11	1200	2	27.940	28.004	32.073	32.08
		1035	5.152	5.165	34.637	34.66
12	0000	2	28.151	28.258	32.063	32.07
		1046	5.250	5.271	34.675	34.68
12	1200	2	28.072	28.050	32.297	32.28
		988	5.253	5.099	34.670	34.71
13	0000	2	28.278	28.290	32.314	32.30
		1000	5.179	5.225	34.677	34.67
14	1200	2	27.911	27.985	31.841	31.86
		1011	5.246	5.176	34.673	34.70
15	0000	2	28.257	28.292	32.102	32.13
		1038	5.263	5.266	34.690	34.68
16	1200	2	28.110	28.146	32.384	32.39
		1065	5.160	5.126	34.638	34.69
17	0000	2	28.153	28.280	32.333	32.35
		1038	5.130	—	34.644	—
18	0000	2	28.075	28.051	32.386	32.23
		985	5.261	5.289	—	34.65
18	1200	2	27.959	28.010	32.231	32.31
		1000	5.211	5.278	34.616	34.69
19	0000	2	28.088	—	32.194	32.23
		1000	5.182	5.201	34.617	34.72
19	1200	2	28.071	28.090	32.249	32.31
		950	5.311	5.247	34.610	34.63
20	0000	2	28.106	28.111	32.277	32.29
		891	5.524	5.571	34.648	34.65
20	1200	2	27.929	27.991	32.313	32.38
		1007	5.166	5.216	34.608	34.74
21	0000	2	28.270	28.305	31.875	32.04
		1010	5.240	5.235	34.595	34.76
21		300	11.186	11.606	35.145	35.31
21	1200	2	28.139	28.185	32.049	32.13
		990	5.265	5.346	34.662	34.73
22	0000	2	28.379	28.365	31.929	31.95
		684	6.917	7.073	34.608	34.78
22	1200	2	28.181	28.240	32.149	32.11
		986	5.222	5.281	34.656	34.66

Table 5 (continued)

Date July	Time Z	Depth m	STD temp.	Nansen temp.	STD salin.	Nansen salin.
23	0000	2	28.060	28.125	33.944	33.77
		1022	5.276	5.374	34.608	34.69
23	1200	2	27.993	28.085	32.996	32.82
		1033	5.280	5.353	34.670	34.71
24	0000	2	28.052	28.050	34.379	34.42
		1037	5.170	5.235	34.626	34.68
24	1200	2	27.965	28.070	34.119	33.80
		1010	5.292	5.371	34.628	34.70
25	0000	2	27.938	—	34.002	—
		963	5.218	5.391	34.629	34.69
26	1000	2	27.942	27.935	—	33.64
		1000	5.266	—	—	—
26	1200	2	27.797	27.921	—	33.70
		1000	5.278	—	—	—
26	1500	14	27.999	28.005	—	—
		23	27.915	28.105	—	34.59
		45	27.533	27.967	—	36.27
		119	24.947	26.508	—	36.85
		322	10.859	11.237	—	35.44
26	1800	2	27.926	27.955	—	33.90
26	2100	2	27.931	27.885	—	33.91
		118	25.106	24.770	—	36.97
27	0600	2	27.882	28.101	—	34.17
		954	5.455	6.396	—	34.72
27	0900	2	27.961	27.960	—	34.14
		48	27.566	27.522	—	36.27
		388	10.010	10.172	—	35.09
27	1200	2	27.877	27.920	—	33.77
		1025	5.226	5.208	—	34.81
27	1500	15	27.976	28.000	—	34.18
		25	27.973	27.925	—	36.05
		58	27.523	27.562	—	36.32
		154	21.304	21.355	—	36.93
		523	8.293	8.488	—	34.96
27	1800	2	28.341	28.299	—	—
		1024	—	5.299	—	34.80

Table 5 (continued)

Date July	Time Z	Depth m	STD temp.	Nansen temp.	STD salin.	Nansen salin.
28	0300	16	28.069	28.060	—	33.49
		27	27.862	28.000	—	34.04
		46	27.533	27.798	—	35.93
		111	25.606	25.872	—	36.98
		410	9.535	9.601	—	35.08
28	0600	2	27.983	—	—	—
		975	5.279	5.369	—	34.71
28	0900	13	28.043	27.981	—	33.48
		23	27.970	28.235	—	34.39
		42	27.639	27.699	—	36.13
		110	25.632	25.808	—	36.94
		390	9.973	10.078	—	35.11
28	1200	2	28.017	28.060	—	33.43
		989	5.290	5.350	—	34.75
28	1500	16	28.006	28.010	—	34.36
		28	27.950	27.963	—	35.35
		57	27.608	27.518	—	36.24
		151	22.321	24.274	—	36.84
		409	9.659	9.856	—	35.09

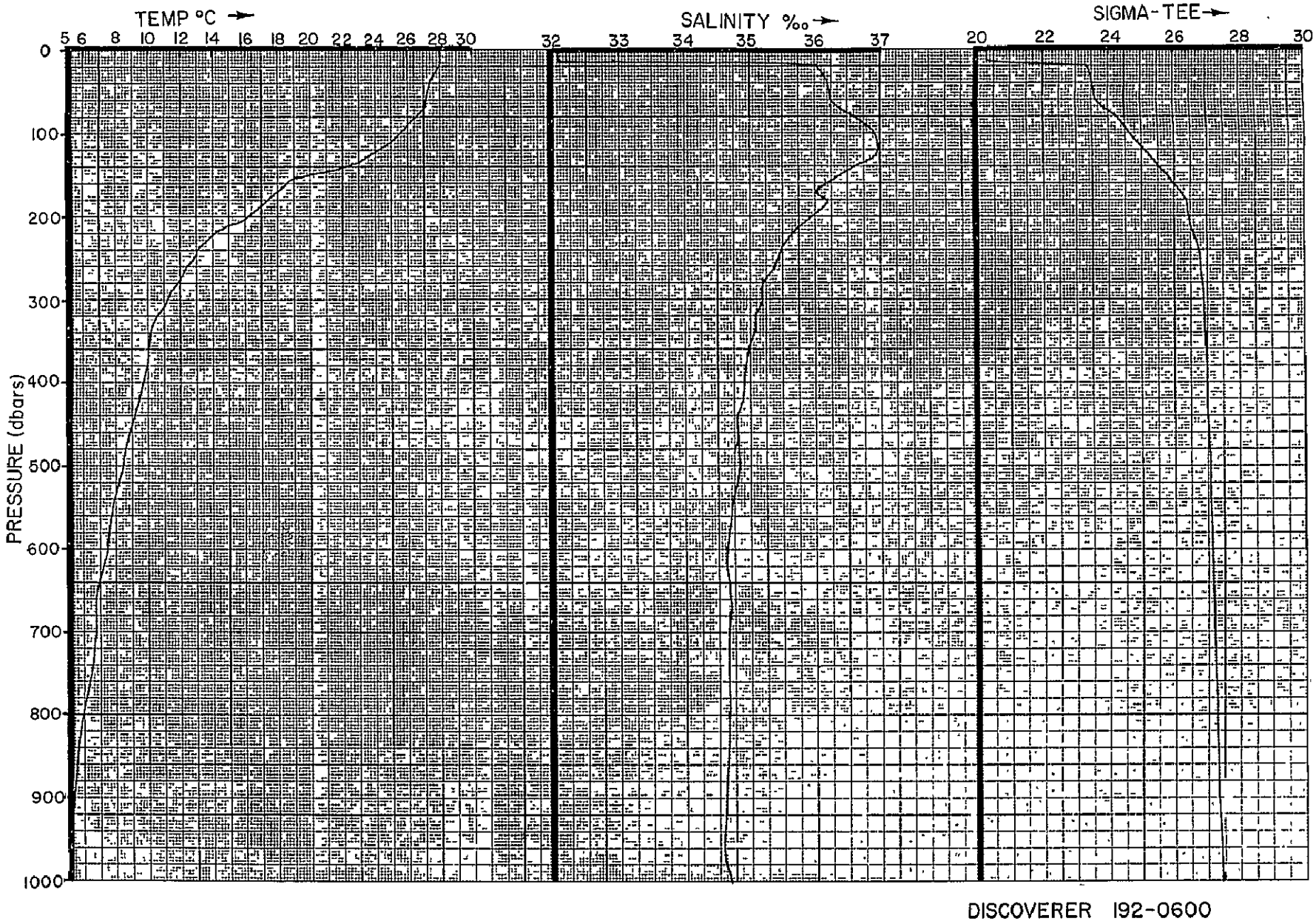


Figure 12.--Temperature, salinity, and sigma-tee as a function of depth.

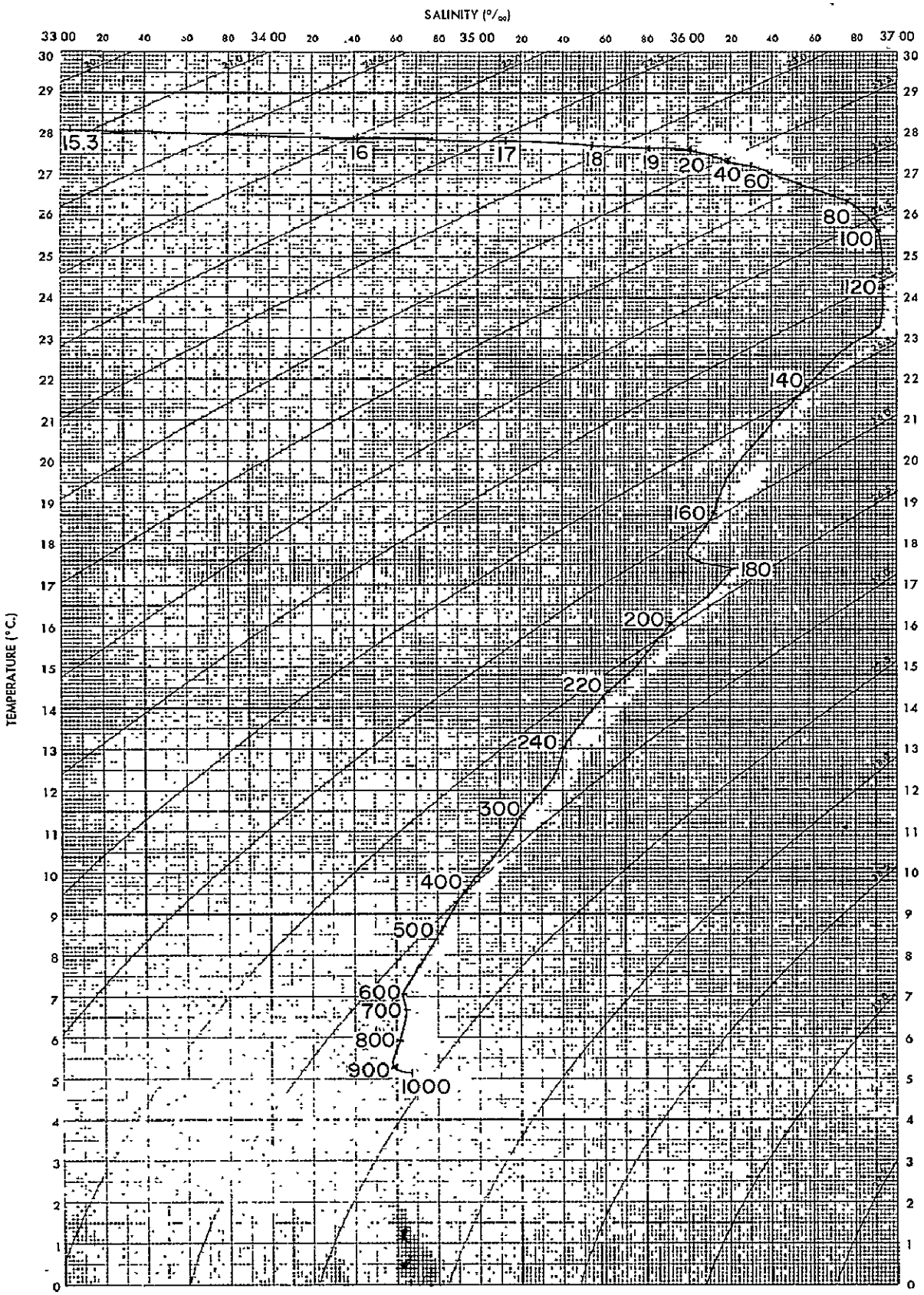


Figure 13.--Temperature-salinity diagram (depths in decibars).

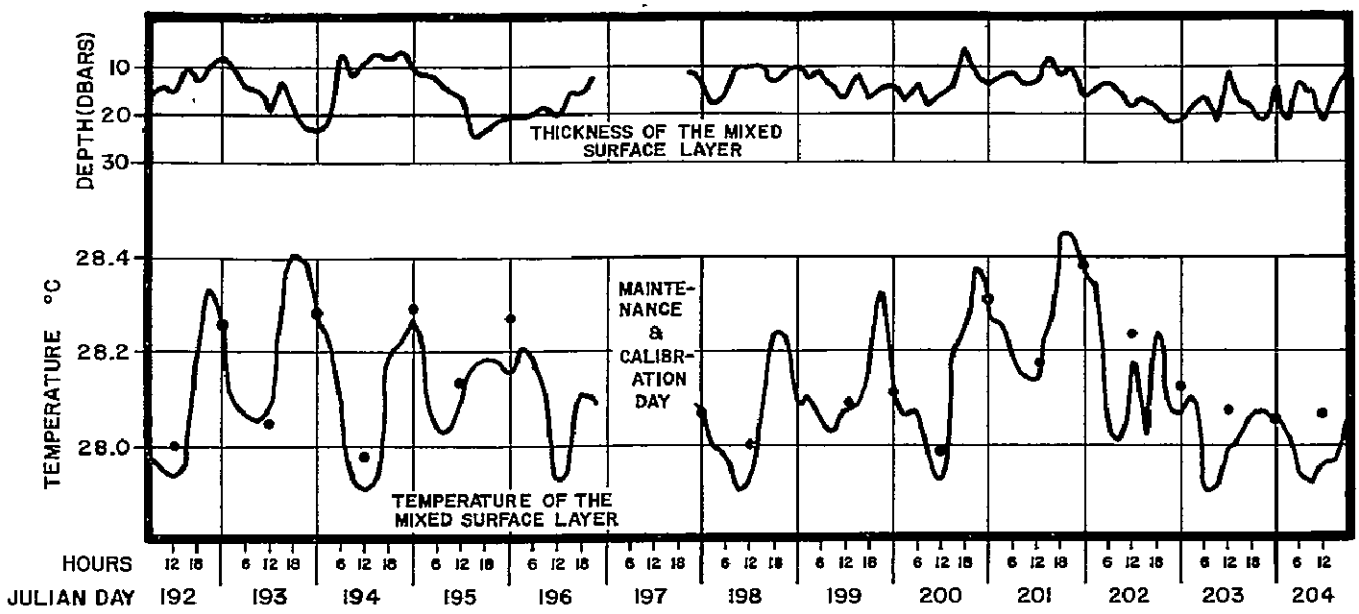


Figure 14.--Thickness and temperature of mixed surface layer. Solid line = STD data; dots = Nansen data.

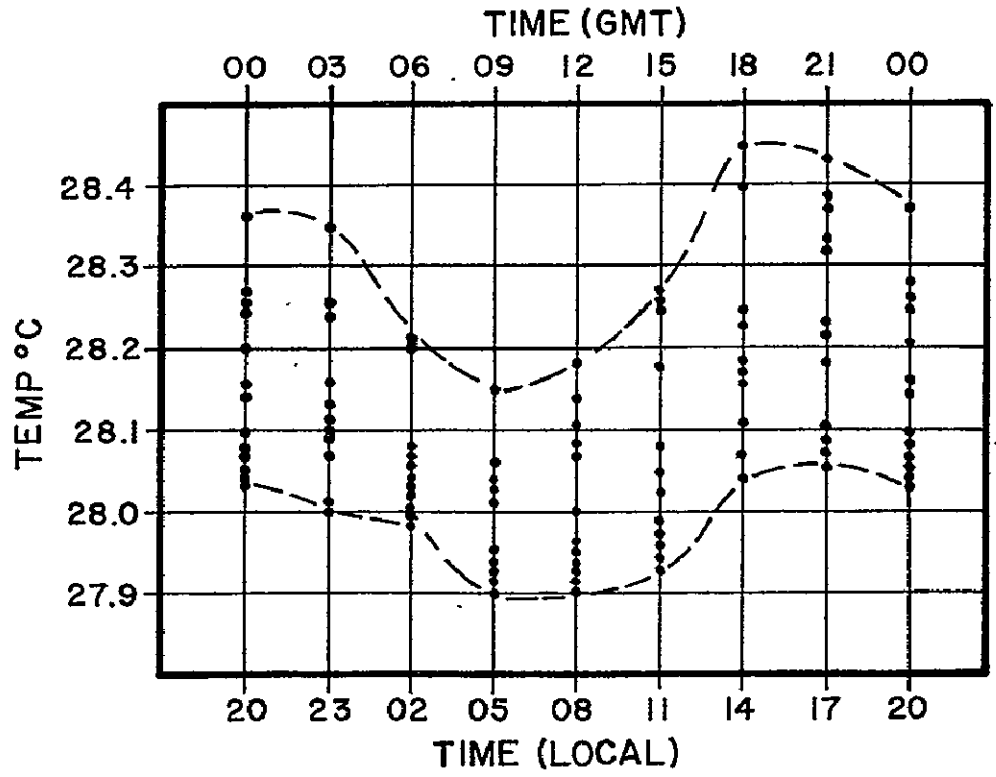


Figure 15.--Temperature of mixed layer as a function of time of day.

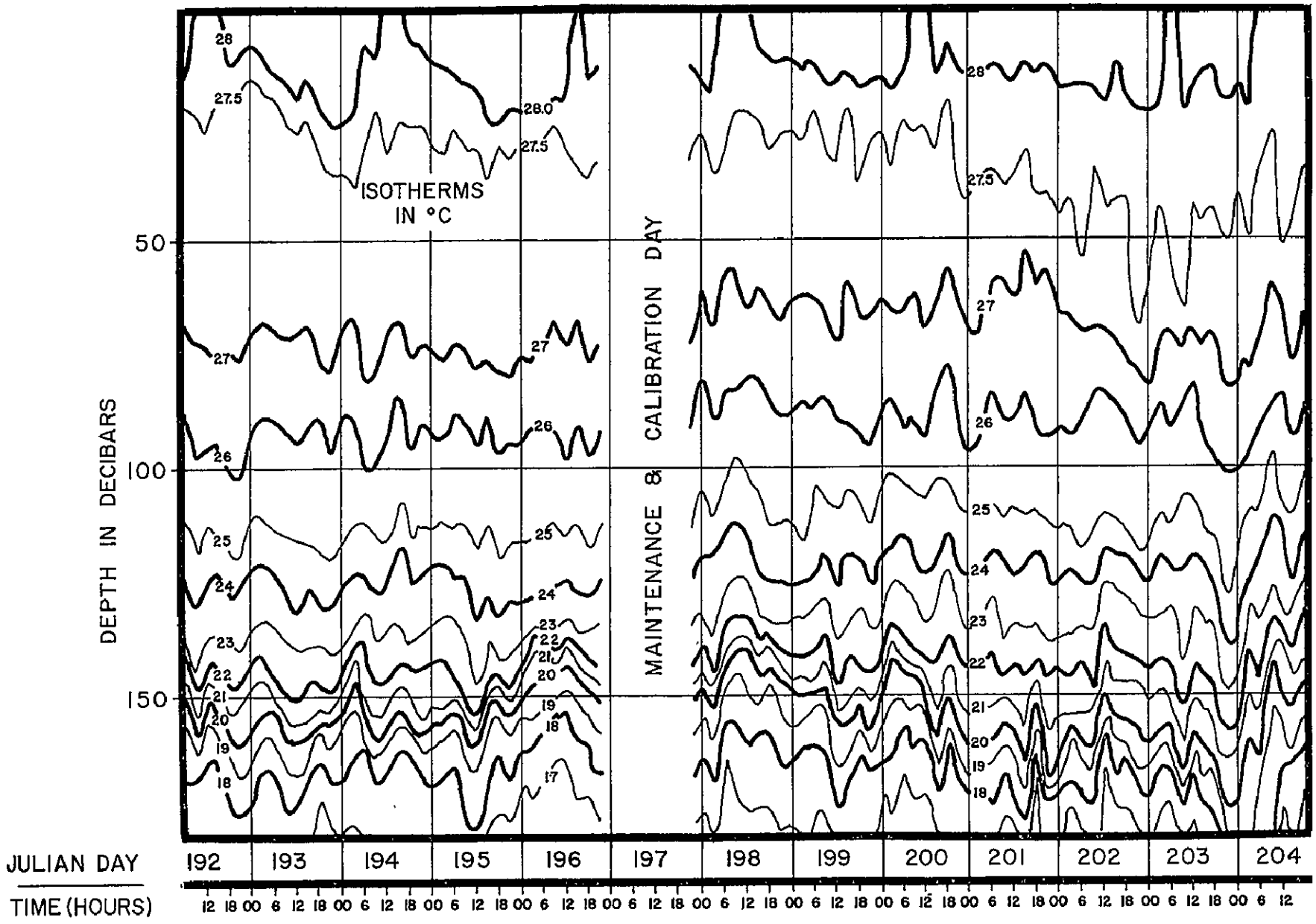


Figure 16.--Time series of depths of isotherms.

E. BLIP (Boundary Layer Instrument Package)

The BLIP system consisted of tethered, blimplike balloons flown from two of the five fixed ships -- the Oceanographer and the Mt. Mitchell -- and carrying instruments for measuring dry and wet bulb temperature, pressure, and wind speed and direction relative to the ship at one or more levels within the lowest 2000 ft of the atmosphere. The Rockaway flew a similar system called SITS (Subcloud Instrument Telemetry System) developed by Florida State University.

Data were recorded on SCARD tape aboard the ships; a typical output is shown in figure 17. The pulse amplitude modulation (PAM) in figure 17a sampled a high reference, a dry bulb thermistor, a wet bulb thermistor, a hygristor or aneroid barometer, and a low reference in sequences repeated three times per second.

The wind direction and speed transducer output is shown in figures 17b and 17c. A maghetodiode in the transducer acted in conjunction with an earth's magnetic field concentrator located in one of the arms of a 3-cup anemometer. The compass direction and anemometer speed can thus be obtained from figure 17b. The distortion in the sine wave is due to noise. The signal shown in figure 17c, produced by a reed switch mounted on the BLIP frame and activated by a permanent magnet on the rotating anemometer, indicates the frame orientation of the instrument package.

Figure 18 shows digitized PAM data based on a sounding from a BLIP package that was on the ship's deck at 1624Z and reached a height of approximately 300 m at 1653Z, where it remained for 3 hours. (The time shown at the bottom is obtained from another SCARD channel.) The pressure corresponding to the contacts is entered.

Digitized data converted to degrees Celsius and digitized wind data for the same sounding as the one shown in figure 18 are given in figures 19 and 20, respectively. Wind direction has not been converted to true north. The approximate scales on the ordinates in figure 20 were obtained by converting the signals into degrees and meters per second.

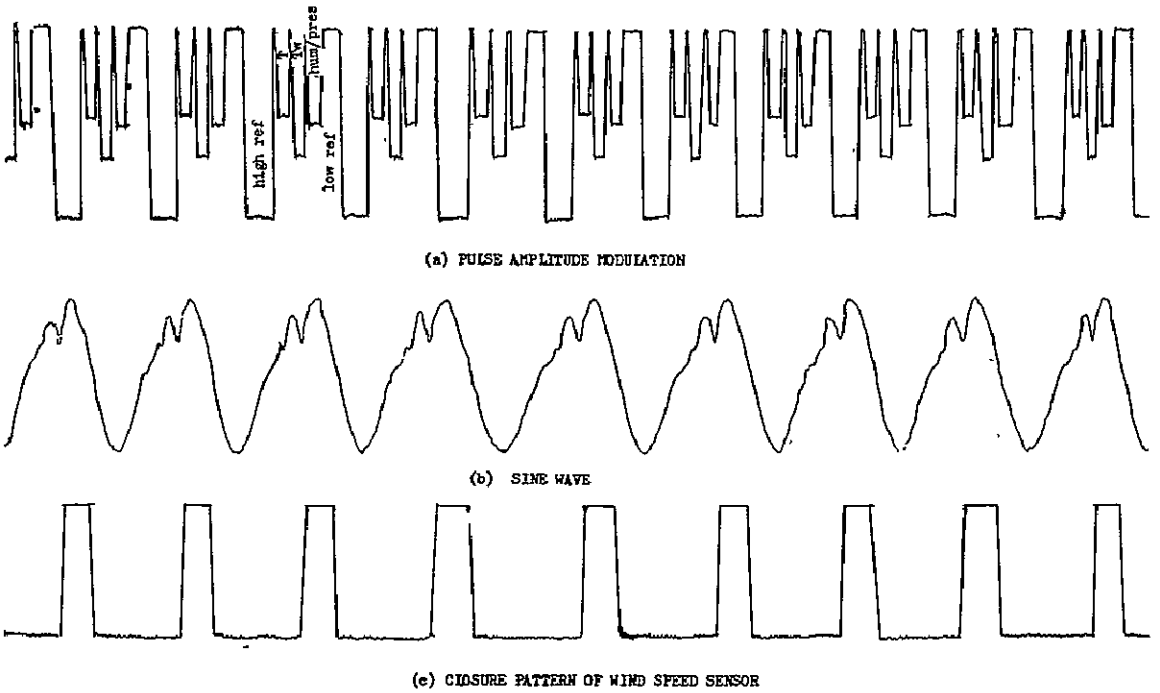


Figure 17.--Typical analog output of BLIP data.

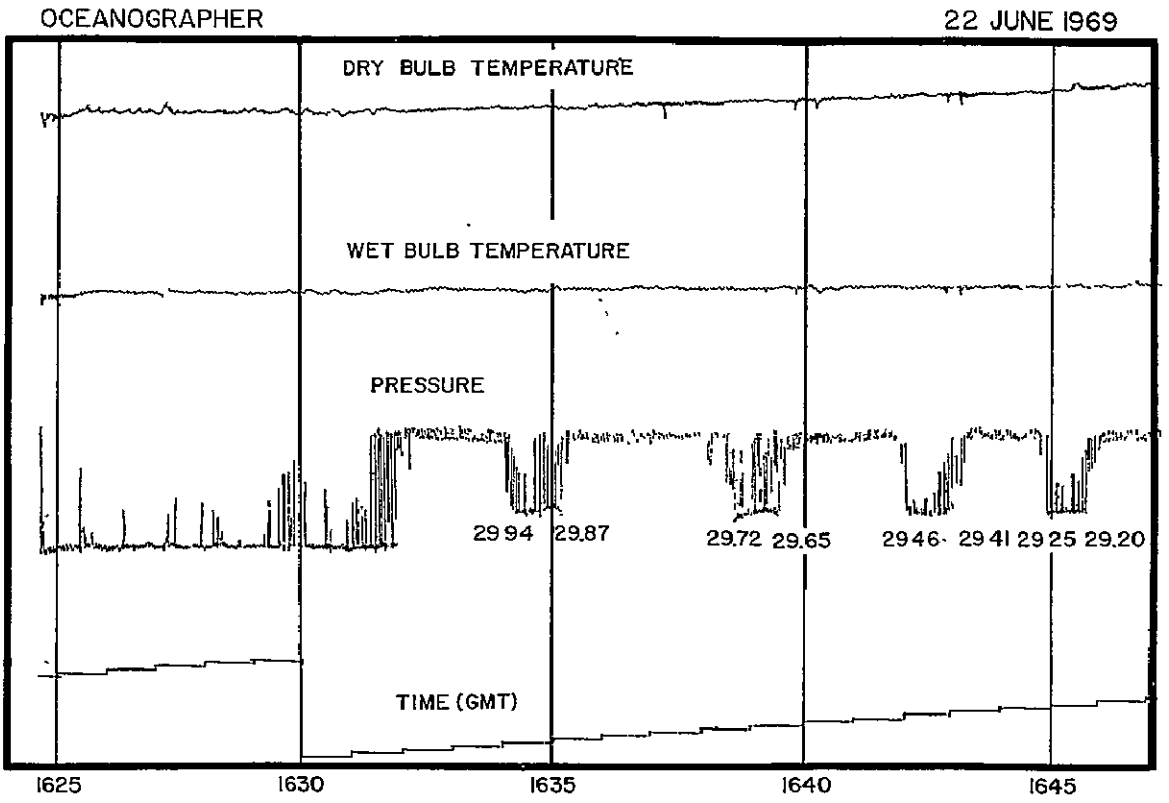


Figure 18.--Frequency pattern of PAM train.

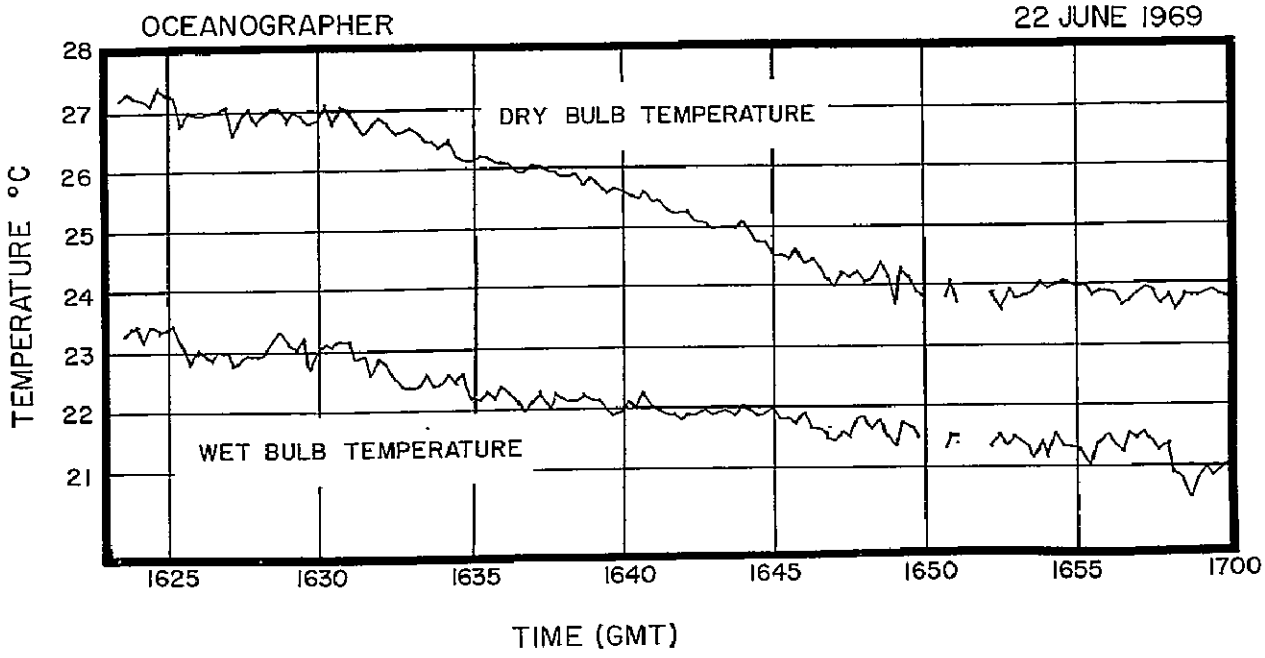


Figure 19.--Sequence of BLIP dry and wet bulb temperature data.

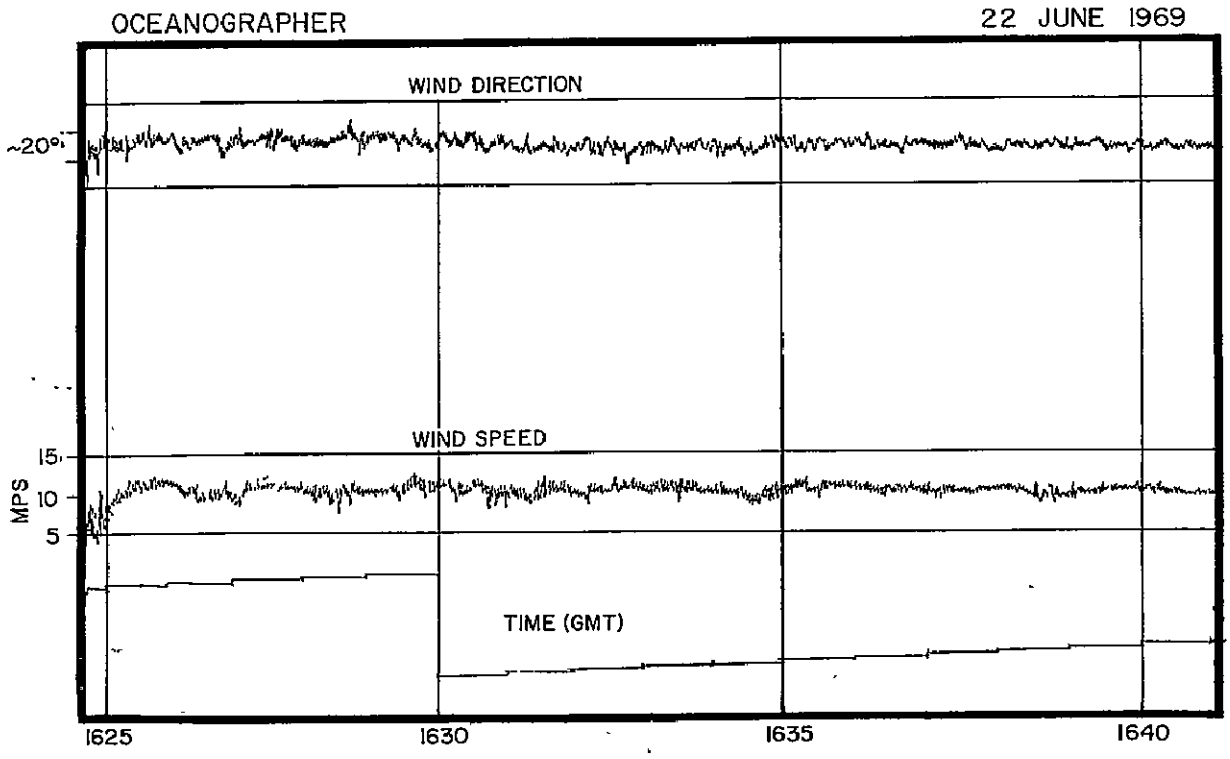


Figure 20.--Frequency pattern of wind sensor.

IV. BOMEX DATA INVENTORY AND DATA AVAILABILITY

A. The BOMEX Data Inventory

The BOMEX Data Inventory is nearing completion. Material used in the introduction to that volume is included in this section.

BOMEX was designed to carry out two major scientific investigations, with field operations divided into four data collection periods of 13 to 18 days each, separated by resupply intervals:

Sea-air interaction investigation

Period I	May 3 - May 15, 1969
Period II	May 24 - June 10, 1969
Period III	June 19 - July 2, 1969

Investigation of tropical convective systems

Period IV	July 11 - July 28, 1969

As the scientific community increased its interest and participation, BOMEX was broadened to include oceanographic, radiation, and satellite programs. Overall nearly 100 separate experiments were conducted in the five areas, including some with specialized scientific and engineering objectives. (See section I of this Bulletin.)

The BOMEX Data Inventory consists of information about data obtained by all investigators during the BOMEX field operations. It includes a description of all acquisition platforms and their locations, associated data subsystems, actual parameters measured by these subsystems, and the form in which data were acquired. Inventory sheets, constituting a significant part of the volume, show the dates, times, and types of observations. Samples of the four types of inventory sheets are shown in figures 21-24. The solid bars indicate data acquisition periods; the additional symbols on these sheets refer to data inputs from specific experiments.

B. Data Availability

BOMAP was established to conduct or supervise the reduction of all data collected under ESSA (NOAA) project direction, and the scientific analysis in support of the BOMEX Core Experiment. As BOMAP moves into its second year of existence, the amount of preliminary processed data is growing at an ever-increasing rate. Such program milestones as the completion of the BOMEX fixed-ship "A_0" processing by NASA's Mississippi Test Facility will produce large volumes of rawinsonde, STD, and Boom data. The BOMAP Office will expend every effort to make them - at all stages of processing - available to users as expeditiously as possible.

Pending completion of data reduction, the BOMAP Office has served as a temporary archive for the BOMEX data. Plans for distribution of these data through appropriate national data centers are almost complete. A special memorandum will be issued when these plans are ready for implementation. In the interim, the BOMAP Office will continue to attempt to handle requests for BOMEX data as expeditiously as possible.

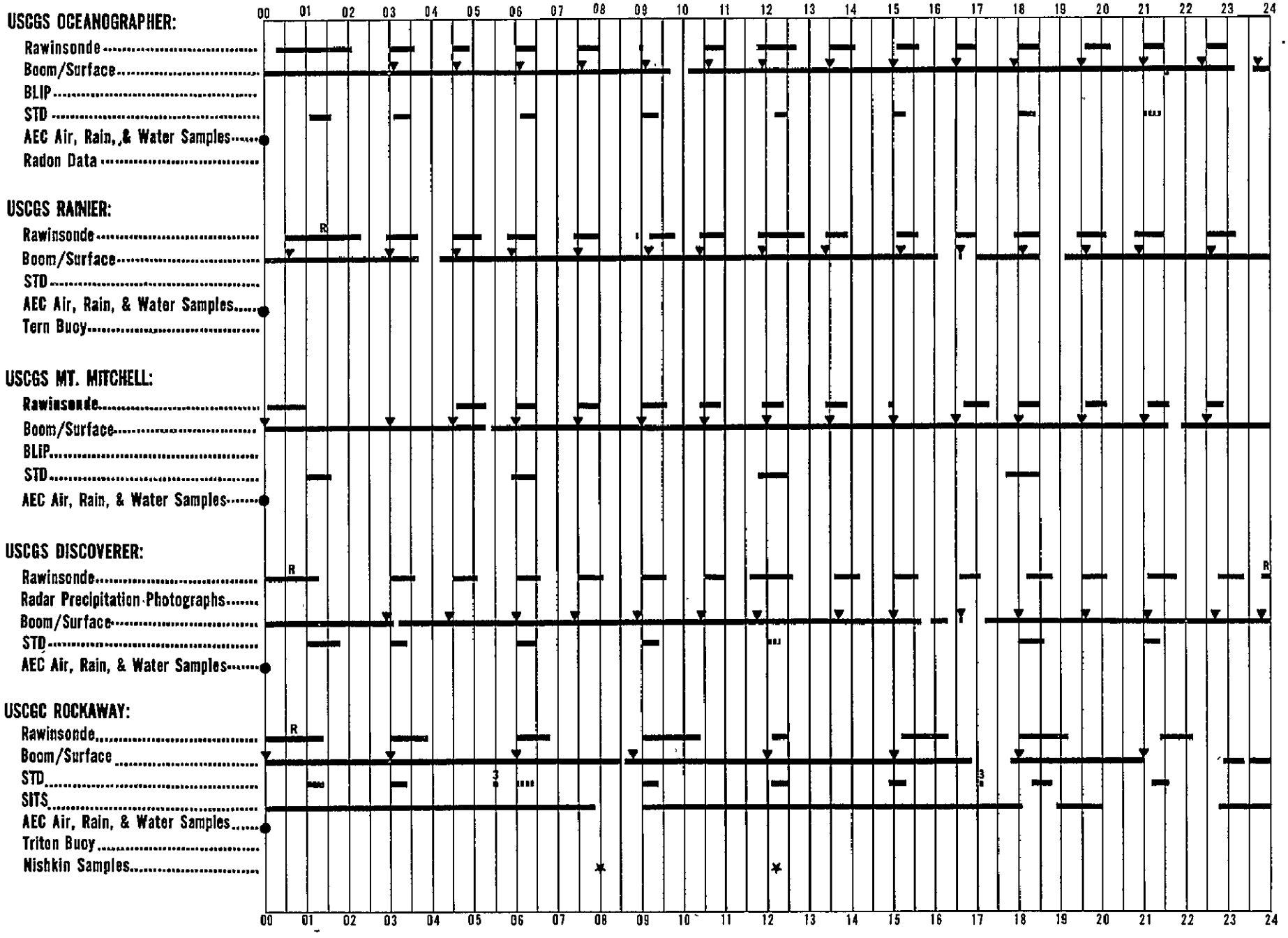


Figure 21.--Fixed-ship data inventory sample.

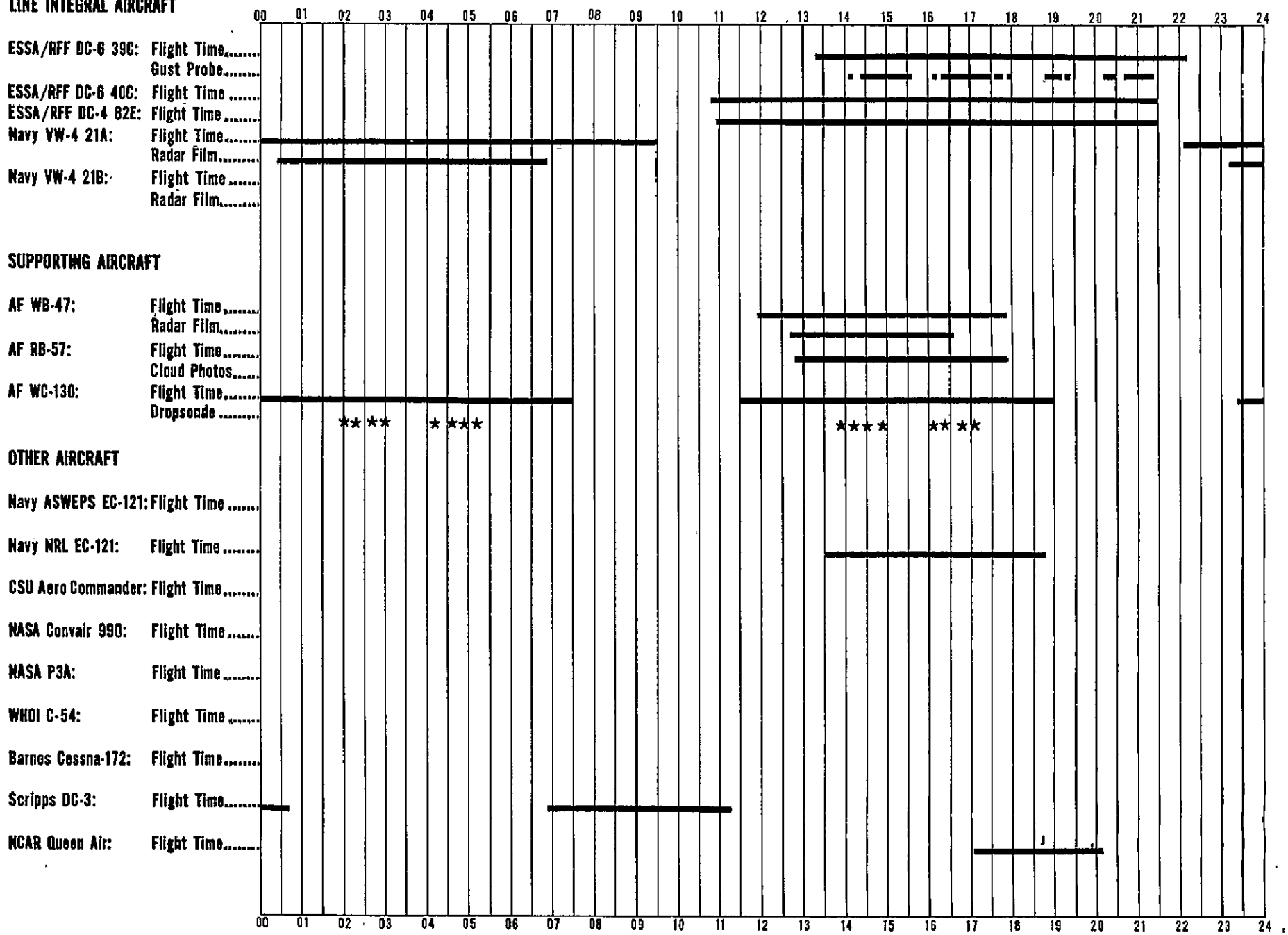


Figure 22.--Aircraft data inventory sample.

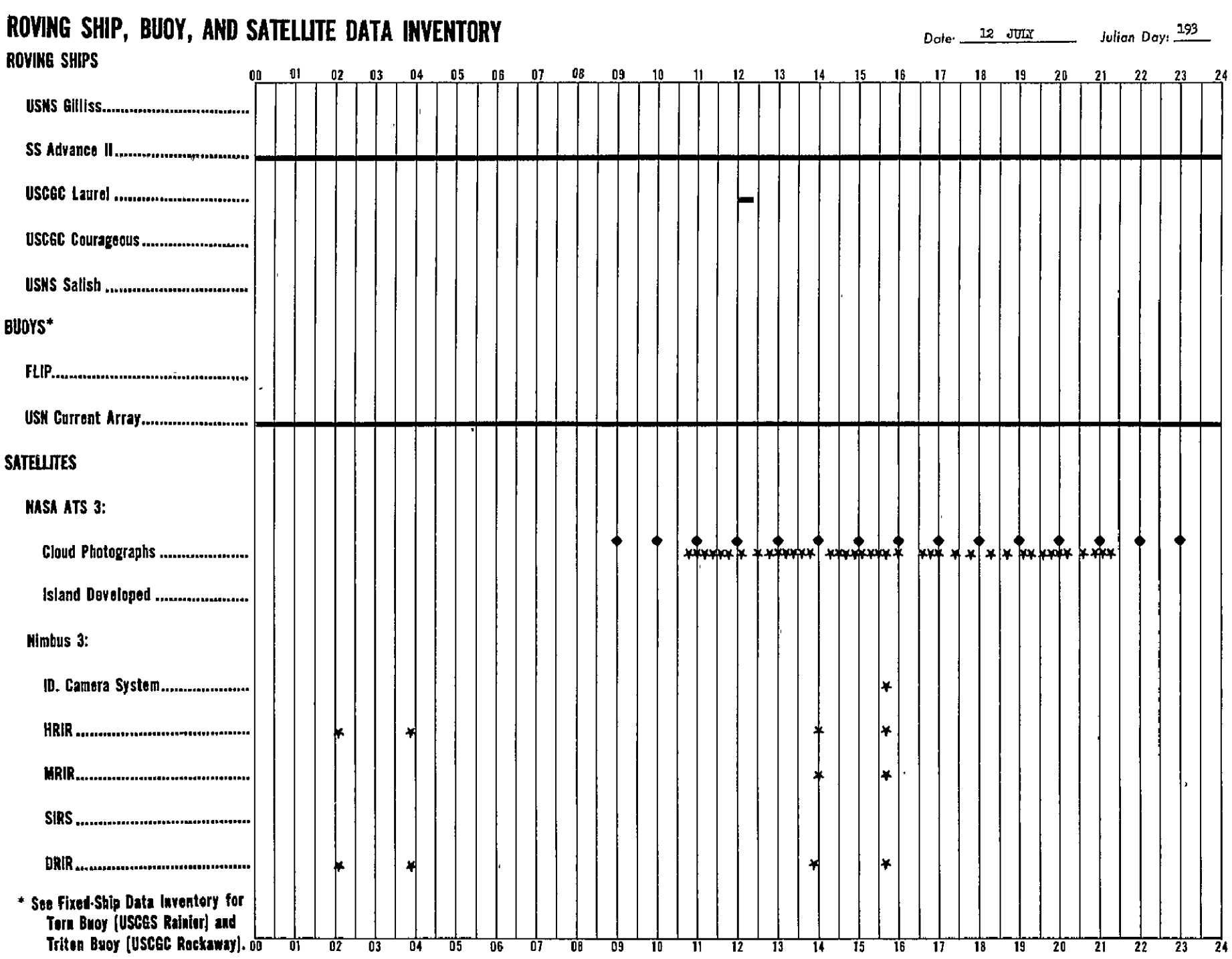


Figure 23.—Roving ship, buoy, and satellite data inventory sample.

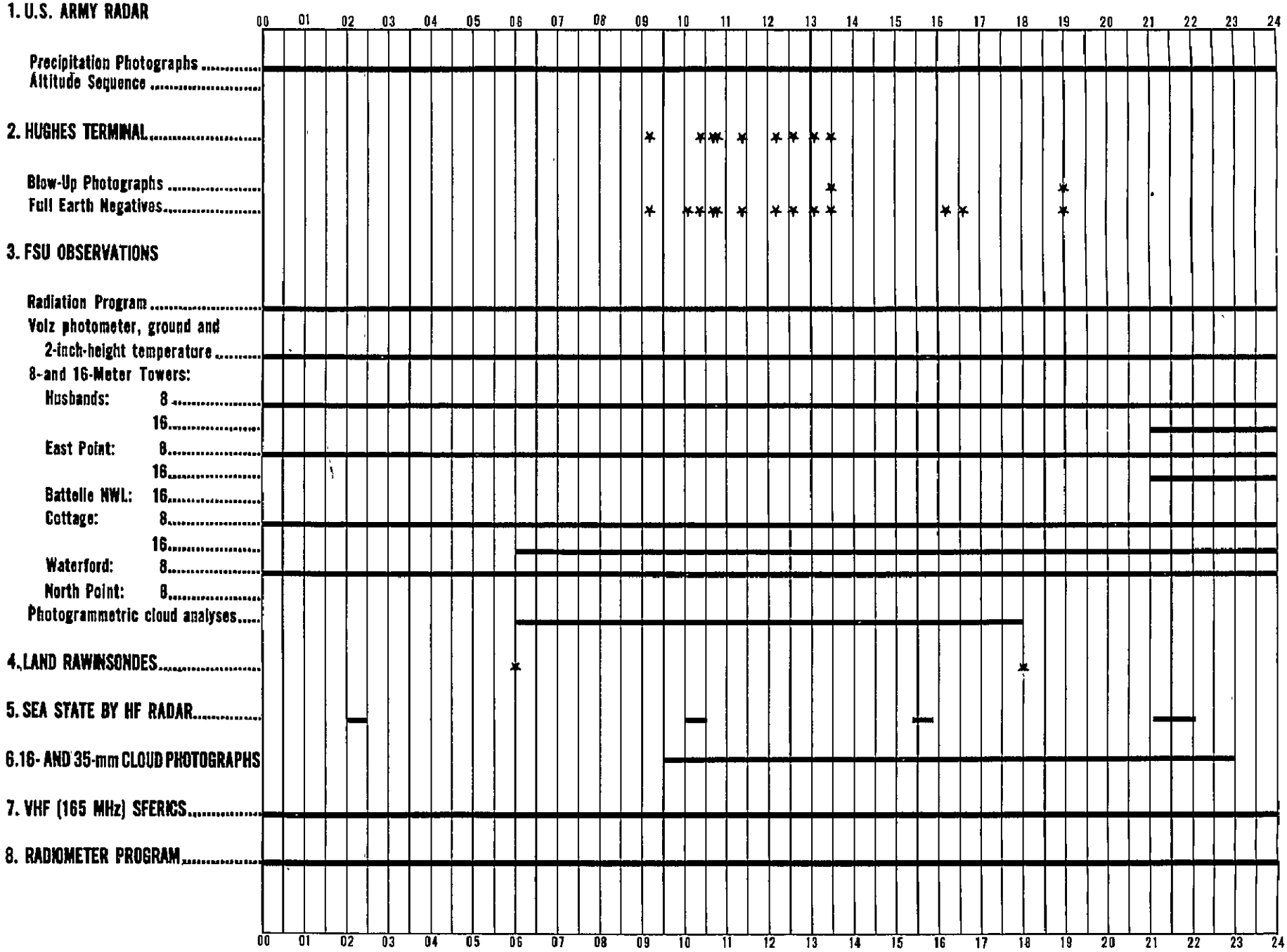


Figure 24.--Island data inventory sample.