July 1, 1977

EN-009

GRADUATE SCHOOL OF OCEANOGRAPHY
UNIVERSITY OF RHODE ISLAND
KINGSTON, R.I. 02881

EN-009

CRUISE REPORT EN-009

PROJECT: Microbiology of dissolved and particulate organic matter.

SCHEDULE: Left Narragansett 2 June 1977. Arrived West Palm Beach 22 June 1977

FUNDING: National Science Foundation Biological Oceanography Program, Grants Nos. OCE-74-01537A02 and OCE-7681779 (JMS) and 020-706-A (DB).

SCIENTIFIC PARTY:

John McN. Sieburth	Chief Scientist	GSO
Duncan Blanchard	Visiting Scientist	SUNY/ALBANY
James Hannon	Marine Technician	GSO
Kenneth Johnson	Marine Research Specialist III	GSO
Roger Babbitt	Graduate Student	GSO
Curtis Burney	Graduate Student	GSO
David Caron	Graduate Student	GSO
Paul Davis	Graduate Student	ZOO/URI
James Fontaine	Graduate Student	AnPath/URI
Richard Heffernan	Graduate Student	MICRO/URI
Kenneth Hinga	Graduate Student	GSO/URI
Peter LeMay	Graduate Student	MICRO/URI
Evelyn Lessard	Graduate Student	MICRO/URI

SHIP's PERSONNEL:

H.P. Bennett	Master
John Symonds	Chief Engineer
Patrick Roberge	Chief Mate
Stephen Kosinski	Second Mate
Terry C. Ziegler	Asst. Engineer
Theodore A. Rebelowski/ John V. Puzas	Asst. Engineer
Jack Wolfe	Bosun
Michael K. Welch	A/B
Lawrence B. Martin	A/B
Irwin Bryson Hall	A/B
João H. De Barros	Steward/Cook
David R. Lizotte	Cook/Messman

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I. WORK PLAN: The work was divided into four major parts.

A. The microorganisms in the neuston, bacterioplankton and nanoplankton were characterized in the discrete water masses of bays, the shelf at the 40 fathom line and the deep waters beyond the Gulf Stream during three transects (Stations 2,3,4; 6,5,8; 9,10,13) from protected to deep waters.

B. The occupation of three drifting stations east of the Gulf Stream were used to characterize diurnal changes (2 or 3 hr intervals) in dissolved organic matter and its production and uptake by microorganisms. Discrete water masses marked by parachute drogue buoys were slope water entrapped in a "cold ring" (Station 4 - 48 hrs), a more southerly meander of the Gulf Stream (Station 8 - 99 hrs), and the more slowly moving water behind the Little Bahama Bank (Station 13 - 74 hrs).

C. The respirometer-sediment trap arrays were deployed adjacent to the 3 diurnal study sites. Attempts were made to characterize the sedimenting organic matter at these stations, to determine the rates of respiration that they support and to observe nutrient flux from the sediment.

D. Copepods and their remains were collected at discrete depths in order to study the microbiota of their fecal pellets, the incidence of dead copepods and exoskeletons and to follow the microbiological decay of copepods throughout the water column.

II. LOGISTICS:

A. Ship Departure. To a hand who is practiced at 2-6 week waits for ship departures, the departure of EN-009 was another frustrating experience. This was due to necessary repairs of aging and hazardous winch equipment transferred from R/V Trident (deepsea winch conked out immediately, hydrowinch operable but difficult and hazardous), the continual breakdown of the bowthrusters at sea which have been paid for although nonserviceable (required for EN-001, EN-009, and EN-015 -- but no hope in sight) and the servicing of over-age radio equipment as well as repairs to the Loran C and A sets. The 13 May sailing was repeatedly postponed to ones for the 17th, 23rd, 28th and 31st before the final 2 June sailing. The excuse that the delays are due to the problems associated with a new ship does not hold up as many of the problems are with secondhand and reconditioned equipment. Steering failure at departure on the 31st was an exception and threatened the recovery of the respirometer/sediment trap arrays deployed on EN-008 (at 3 weeks time expense). Arrangements were made with the Coast Guard Cutter Bibb to recover the arrays upon their release (2 of 3 were recovered).

B. The Cruise Track is shown in the accompanying chart. It consists of three loops to deep waters:

1) The northern transect consisted of the mid-Narragansett Station 2, the 40 fathom shelf Station 3 and the "cold ring" drift Station 4. The removal of materials for 2 back-up buoys by Smayda (no notice) and loss of our one buoy through navigational error and bad weather caused a premature end of diurnal Station 4.

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2) A brief pit stop at Norfolk, Virginia, to buy buoy materials enabled Steve Imms to repair the much needed UGR depth profiler while permitting a mid-Atlantic states transect from Chesapeake Bay (Station 6), across the shelf at the 40 fathom line (Station 5) and the diurnal Station 8. The two surviving respirometers were deployed at the mid-Gulf Stream Station 7 and during the incubation period a diurnal station (8) was conducted in a southern meander of the Gulf Stream.

3) A brief pit stop at the Savannah Light for the necessary exchange of assistant engineers 16 June permitted a third transect starting at Sapelo Sound (Station 9), the 40 fathom station (10, at edge of shelf and influenced strongly by Gulf Stream) and the east of the Gulf Stream Station 13, above the Little Bahama Bank. A makeup neuston Station 11 and a deepsea net tow for stressed copepods (Station 12) were also made.

C. STATION POSITIONS:

Station	Date	Time (GMT)	Latitude	Longitude
2	5/31/77	1400	41°33.5'N	71°24'W
3	6/2/77	2245	40°32.8'N	70°57.1'W
4a	6/5/77	1945	35°54.3'N	68°45.7'W
(Diurnal) 4	6/5/77 - 6/7/77	0400 - 2400	35°40.1'N - 35°34.2'N	69°20'W - 69°15.1'W
5	6/8/77	1310	36°32.5'N	74°48.1'W
6	6/9/77	1900	37°12.6'N	67°10.9'W
7	6/10/77	2330	33°30'N	76°15'W
8a	6/11/77	1918	32°53.3'N	74°31.2'W
(Diurnal) 8	6/12/77 - 6/13/77	1000 - 1955	32°41.2'N - 32°13/6'N	74°31.6'W - 73°40.5'W
9	6/16/77	2134	31°02.2'N	81°10.7'W
10	6/17/77	1237	30°02'N	80°15.6'W
11	6/17/77	1926	30°03'N	78°53.5'W
12	6/18/77	0200	29°14'N	78°49'W
13a	6/18/77	1100	27°42'N	78°54'W
(Diurnal)	6/19/77	1400	27°45.7'N	78°58'W
13	6/21/77	1100	27°47'N	78°59'W

PRELIMINARY RESULTS:

1) The 12 stations occupied yielded some 54 hydrocasts and 150 samples. These samples were characterized for dissolved organic carbon, dissolved inorganic carbon, monosaccharides, polysaccharides, bubble signature (Blanchard), plant pigments, adenosine triphosphate assay for bacterioplankton and protist biomass, epifluorescence counts of bacterioplankton, bacteria on debris, photosynthetic and heterotrophic flagellates, the culture of epibacteria, flagellates, yeasts and fungi, as well as oxygen, temperature and salinity. The magnitude of the profiling and sampling program is indicated by the use of 96 XBT's, 900 ATP assays ($3000 for enzyme with some $1500 needed for adenylate energy charge assays on the pertinent samples) and some 2000 carbon samples for assay which along with the carbohydrate analyses will take several months to complete.

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2) A comparison of the glass plate and nytex screen sea-air interface samplers at 9 stations indicated that the thinner sample of the glass (27 μm vs. 270 μm for the screen) only has a 2x higher level of particulates, indicating an exclusion of particulates. We apparently have enough data to explain the discrepancies between the recent papers appearing in Science (194:1415-1418) and Canadian J. Microbiol. (22:1699-1709). Data on yeasts, fungi and coliform at the sea-air interface were also obtained.

3) The epifluorescent examination and enumeration of bacteria free in the water and on organic debris as well as photosynthetic and heterotrophic nanoplankton dominated by flagellates are very rapid and useful shipboard procedures. The presence of 10^5 bacteria per ml and 10^3 flagellates per ml was common in the photic zone. Selective filtration and agar cultures failed to confirm that colony-forming units (CFU's) are associated mainly with cells wider than 0.6 μm (Marine Biology 36:291-302). CFU's <u>are</u> found mainly in the surface samples both inshore and offshore.

4) The data of the profiling runs completed before selection of the strata for the diurnal studies included ATP for the protist fraction, plant pigments, monosaccharides and oxygen. The patterns which differed at Stations 4, 8 and 13 were consistent with the data and working hypotheses obtained during TR-170. The strata of interest were followed at 2 or 3 hr intervals by the use of XBT's. The diurnal data obtained from 5 24-hr periods at 3 locations will be used along with that obtained from the MERL tanks to explain the release and uptake of dissolved organic matter in context with microbial biomass and activities.

5) Sufficient assays, enumeration and preserved materials were obtained to permit an in depth characterization of the bacterioplankton and flagellates in the nanoplankton along the 3 transects.

6) An onboard examination and enumeration of the zooplankton showed infestation of deep samples by a large and unusual fungus while the newly dead copepods underwent a prompt attack by histophagous ciliates.

7) Plankton samples rich in distinctive microorganisms such as dinoflagellates, <u>Trichodesmium</u>, radiolaria and foraminifera among others were obtained for use in Oceanography 567.

8) The "Buoy named Sue" used to deploy the parachute drogues was heavily colonized by gooseneck barnacles at Station 8. Fouling panels attached to "Sue" before deployment at Station 13 were removed at intervals and reef fish recruitment was observed during snorkeling. There was a rapid buildup of both a boring bivalve and goose barnacle population on protected surfaces while exposed surfaces had very few attached barnacles and a lesser bivalve population. The reef fish increased from 25 individuals of 4 species at 3 hrs to some 1000 individuals of 15 species by 74 hrs.

9) A recovery rate of 70% of the respirometer/sediment trap arrays is quite good for time-release. The validity of the respiration and flux measurements requires further analysis.

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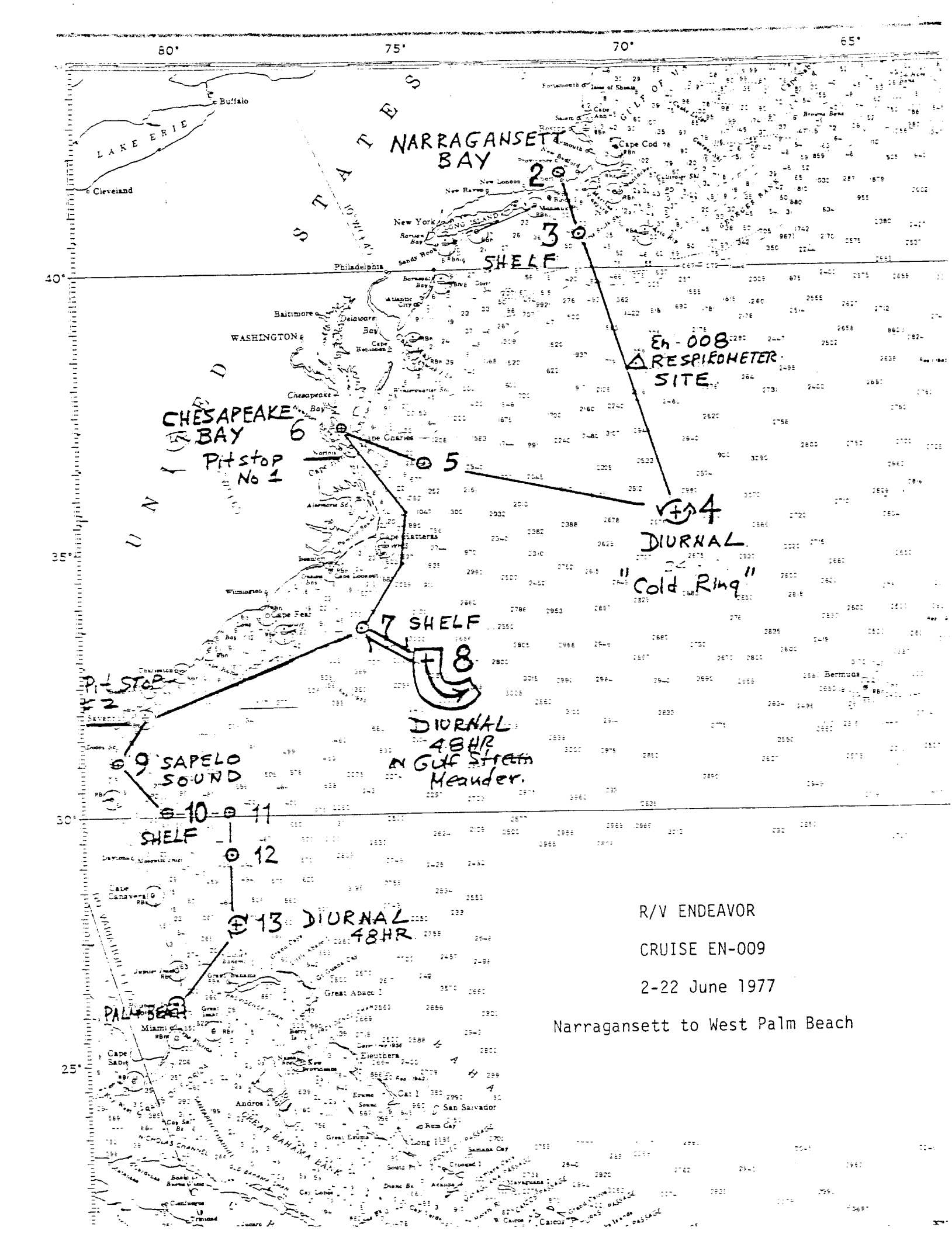
10) Brief report on the aging tube experiments of Duncan Blanchard, guest investigator:

Jet drops from bubbles bursting at the surface of the sea are the source of most of the marine aerosol. For a bubble of given size, the size of the jet drops and the height to which the top drop is ejected has been assumed to be constant. However, since bubbles in the sea may move for many seconds through the water before reaching the surface and bursting, surface-active organic material in the sea can adsorb at the surface of the bubble, producing a lowering of surface tension which, in turn, can cause a decrease in both ejection height and size of the jet drops. During the cruise of EN-009 numerous experiments were done to see if the slope of the curve of drop ejection height vs. the age of the bubble was related to the total organic carbon content of the seawater.

The experiments were done with a bubble aging tube, a device with which an air bubble could be freely held in a down-welling flow of water for any desired time. About 70 drop height - bubble age curves were obtained in many different samples of water. For each sample the organic carbon content will be obtained. Preliminary analysis indicates that the slopes of the curves are indeed correlated with the DOC of the water, or what we surmise will be a good correlation. Large slopes are found with the screen samples (high DOC), and low slopes with the Sargasso deep water (low DOC). This work may provide a link between the DOC in the oceans and the production of the marine sea-salt aerosol. Final analysis will not be completed for several months.



R/V ENDEAVOR

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2-22 June 1977

Narragansett to West Palm Beach