what singing ranges are feasible for the individual. This almost invariably leads to vocal difficulty, ranging from simple laryngitis to chronic, profession threatening vocal pathology. This presentation will discuss normative data on the singer's voice, particularly with respect to the physiological and acoustic limits of the instrument measured in a "F_0-SPL Profile." Examples of professional performers' voice profiles will be used to illustrate the usefulness of the technique in estimating a type of damage risk criteria for voices.

11:45

BB9. Studies of pulmonary function and the singer. W. J. Gould (Lenox Hill Hospital, New York, NY 10021)

The relationship of the efficiency of pulmonary function to the singing voice was studied at a school for vocal training. The class in training was evaluated primarily by the period of time spent in studies of the individual groups under observation and then compared to professional singers. The residual pulmonary volumes were determined to be of highest importance in this assessment. This study then was correlated to experience with situations in which impairment of this pulmonary volume measurement existed, such as pulmonary asthma. The group of asthmatics in the singing profession was higher than that encountered in the average population group. The importance of these findings is primarily for the understanding of the physiology of the singing voice.

THURSDAY MORNING, 29 NOVEMBER 1979 BONNEVILLE ROOM 3, 9:00 A.M. TO 12:35 P.M.

Session CC. Physical Acoustics V and Underwater Acoustics IV: Acoustic Remote Sensing III: Ocean Remote Sensing

Robert C. Spindel, Chairman

Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543

Chairman's Introduction—9:00

Contributed Papers

9:05

CC1. Remote measurement of water currents using correlation sonar. J. A. Edward (General Electric Co., HMED, Syracuse, NY 13221)

In correlation sonar the relative velocity between a source/receiver platform and an ensemble of scatterers distributed over the transmit beam pattern is obtained from the spatial and temporal cross correlations over an array of hydrophones. With a two-dimensional array and suitably encoded transmissions, it is possible to measure the three components of the mean-velocity vector plus the variation within the resolution volume of the radial component. For remote current profiling, one can measure the velocity components in a water volume bounded in angle by the transmit beam pattern and in range by the signal waveform and integration window parameters using a simple monostatic array configuration. If desired, a complete velocity profile can be measured during each transmission cycle. This paper will review the basic theory of correlation velocity measurement and will discuss system design contraints and operating parameters and their relationship to such performance measures as volume and depth resolution, profiling range, and measurement accuracy. In addition, results from a limited number of in-water measurements will be presented. [Work supported in part by the National Oceanic and Atmospheric Administration.]

9:20

CC2. Doppler sonar measurements from FLIP. R. Pinkel (University of California, San Diego, Marine Physical Laboratory, Scripps Institution of Oceanography, San Diego, CA 92152)

A pulse-to-pulse incoherent Doppler sonar has been developed at the Marine Physical Laboratory for use in the observation of oceanic internal gravity waves. Mounted on the Research Platform FLIP, the sonar transmits at frequencies between 65 and 90 kHz at a peak power of ~32 kW. During preliminary tests, measurements have been made out to a range of 1.6 km, depths of 1.2 km, with a range resolution of 25 m. The sensitivity of the sonar measurements to a given internal wave group depends on both the orientation of the sonar beam and the direction of propagation of the wave packet. Since the vertical angle of wave propagation is a function of frequency, a predictable pattern can occur in sonar derived estimates of the interal wave frequency spectrum. These can be used to infer a limited amount about the azimuthal directional properties of the wavefield. A more direct approach is to use multiple sonars, operating simultaneously but pointed in different directions. A four sonar system is currently being constructed for use on FLIP. This should permit accurate estimates of azimuthal directionality of waves up to kilometer scales.

9:35

CC3. Reflection coefficients of upper ocean sound-speed variability. G. T. Kaye and J. Northrop (Code 5311, Naval Ocean Systems Center, San Diego, CA 92152)

Profiles of temperature and conductivity with depth were measured at two-minute intervals in June 1977 off R/P FLIP at a position 100 nautical miles west of San Diego. The profiler was developed by R. Pinkel of the Marine Physical Laboratory for upper ocean internal wave measurements. From these data, acoustic reflection coefficients were calculated for angles of incidence near normal for acoustic impedance changes on a one-meter vertical scale. Coefficients of these reflective layers, which ranged from about −75 dB to less than −110 dB, were observed to vary slowly in the presence