BRITISH ACOUSTICAL SOCIETY: Meeting on Tuesday, 6th June 1972 at the Gloucester Hotel, Weymouth.

UNDERWATER ACOUSTIC TEST FACILITIES AND MEASUREMENT.

REVERBERATION MEASUREMENTS - D J DUNN

The performance of any active sonar set is, to some extent, limited by the discrimination between a desired echo and the background reverberation. This reverberation can have widely differing characteristics, depending on whether it originates at the surface, sea bed or from within the volume of the sea itself, and can under certain conditions give rise to apparent 'false targets'. A considerable amount of work has gone into the study of reverberation in order that sufficient information can be obtained for maximising the signal to reverberation levels to be expected, when designing sonar sets.

Most studies have been concerned with measurements of the sea surface reverberation level as a function of acoustic frequency, grazing angle and sea state. Amongst the earliest were those of Chapman and Harris who measured the characteristics over the frequency band 400 to 6,400 cps, using explosive charges as the sound source and omnidirectional hydrophones as receivers. Unfortunately because of the lack of directivity of their equipment it was not possible to discriminate between surface and volume reverberation, at small grazing angles. More sophisticated measurements have been made by Marconi's within the last five years. By using directional sources and receivers, they have been able to discriminate between surface and volume effects. They have also related the level of the surface reverberation to the statistics of the sea surface wave heights, measured at the time of the acoustic observations. An adequate theory has been derived which can predict reverberation levels to be expected in sea states up to 4.

The determination of the mechanisms involved in reverberation from the sea bed is much more difficult. Theoretical studies have indicated that the level of reverberation is most influenced by boundary roughness having components with spatial wave numbers comparable with those of the acoustic wavelength, which are normally of the order of a few centimetres. Measurements of the sea bed topography to this order of accuracy are almost impossible in the deep ocean, so alternative parameters to characterise the sea bed topography have been sought. One novel approach suggested by Marconi's has been to specify the sea bed type in terms of its mean acoustic reflection coefficient together with the grain size of the particular sediment. Using these parameters it has been possible to predict the reverberation levels to be expected with a reasonable degree of accuracy.

Most of the work investigating volume reverberation has been done by Chapman at the Naval Research Establishment, Canada. He has measured backscatter from the deep scattering layers over a large number of sites in the North Atlantic, again using explosive sound sources and omnidirectional receiving hydrophones. The level of reverberation obtained from the volume can be comparable with that from the sea surface under certain conditions. A large amount of data has been obtained by AUWE on the depths and distributions of the deep scattering layer in the North Atlantic using a ship's echo sounder connected directly to a precision depth recorder, but unfortunately it was not possible to determine the backscattering strengths of these layers with the equipment available.

Comparisons between these various mechanisms will be presented.