

OBSERVATIONS OF LIGHT SCATTERING IN SEA WATER.

by

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## ABSTRACT

## OBSERVATIONS OF LIGHT SCATTERING IN SEA WATER

by

A.F. Spilhaus, Jr.

Submitted to the Department of Geology and Geophysics on November 13, 1964, in partial fulfillment of the requirement for the degree of Doctor of Philosophy.

Combination of theoretical curves of the volume scattering function for several different monodisperse systems of Mie scatterers shows that in a polydisperse system the total scattering coefficient is determined by the scattering at small angles to the direction of the incident beam. These combined curves also show that as the particle sizes increase the rise in the volume scattering function at small angles increases.

A method was devised to measure "in situ" the ratio of the volume scattering function at  $20^\circ$  to that at  $45^\circ$  and  $135^\circ$ . The results of this experiment led to a study of the shape of the volume scattering function for various types of sea water.

This study was made using a standard laboratory device on shipboard. Samples were both pumped aboard from surface waters and taken at depths up to 2000 meters by Nansen bottles. Four hundred samples were taken in a region between Woods Hole and  $26^\circ\text{N}, 63^\circ\text{W}$ .

Water in the Sargasso Sea was found to have a significantly different scattering function from that of the slope and coastal waters. In a thermal front, south of Bermuda, the water along one isotherm was different from the average of that on either side of it.

The total scattering coefficient showed banding on the continental shelf. The thermohaline front that exists on the edge of the shelf in winter is marked by a threefold change in the magnitude of the scattering.

Using a laser as the light source, forward scattering measurements were made to obtain relative total scattering. A continuous track was made between Woods Hole and Port Lewis, Mauritius.

In the proximity of land twofold fluctuations of the scattering in a range approximately three times higher than the nearly constant values found in mid-Atlantic were observed. Some fluctuations of the open sea values in the Atlantic were associated with thermal changes.

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## PART ONE

This part consists of two manuscripts, intended for subsequent publication, which have been extracted from the main body of the thesis.

## OBSERVATIONS OF LIGHT SCATTERING IN SEA WATER

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## ABSTRACT

A study of the volume scattering function was made using a standard laboratory device on shipboard. Samples were both pumped aboard from surface waters and taken at depths up to 2000 meters by Nansen bottles. Samples were taken from a region between Woods Hole and  $26^{\circ}$  N.,  $63^{\circ}$  W.. Water in the Sargasso Sea was found to have a significantly different scattering function from that of the slope and coastal waters. In a thermal front, south of Bermuda, the water along one isotherm was different from the average of that on either side of it. The thermohaline front, on the edge of the shelf in winter is marked by a threefold change in the magnitude of the scattering.

## INTRODUCTION

A study to define the variability of the volume scattering function for a variety of sea water types has been made, and the shape and magnitude of this function have been correlated with concurrently observed temperatures and salinities. Since the volume scattering function may hold the key to determination of particulate distributions, such a correlation could prove useful to oceanographers.

The volume scattering function, denoted by  $\sigma(\theta)$ , is defined by:

$$\sigma(\theta) = \frac{J(\theta)}{I_0 v} ,$$

where  $J(\theta)$  is the intensity of scattered light in the direction  $\theta$ ,  $I_0$  is the irradiance input and  $v$  the scattering volume which is determined by the intersection of the beams of incident and scattered light.

Tables of  $\sigma(\theta)$  for monodisperse spherical particles such as those of Ashley and Cobb (1958) and Gumprecht et al (1952) are available, and the combination of curves of  $\sigma(\theta)$  taken from these tables for various numbers of particles of differing sizes and indexes of refraction shows that the sharp maxima and minima found in the polar scattering of monodisperse systems are washed out (Deirmendjian, 1964). Theoretical curves for such polydisperse systems are like the relatively smooth function found for sea water. These curves

also indicate that the rise in the small angle region of this function becomes steeper as the particle sizes increases, and that the magnitude of the scattering increases with increased scattering surface.

With care it may be possible to make deductions about the trend of particle sizes and numbers from the shape and magnitude of the volume scattering function. Previous investigators have made an effort to compare the theoretical curves for certain types of monodisperse systems with measured curves for the natural environment (Sasaki et al, 1960, Jerlov, 1961); however, it must be born in mind that there is no reason that a measured curve for a natural sample should match the theoretical curve for any particular system of monodisperse spherical particles.

In this study the slope of  $\sigma(\theta)$  in the small angle range and the magnitude of the scattering were applied in a qualitative way to characterize various water types.

#### APPARATUS AND EXPERIMENTAL PROCEDURES

A Brice-Phoenix Light Scattering Photometer was employed in this work (Brice et al, 1950). With this device it is possible to determine the volume scattering function between  $30^\circ$  and  $135^\circ$ .

This scatterometer was first used at sea on the R/V Crawford between Woods Hole and St. Georges, Bermuda. Measurements of the scattering function were made at least twice

each watch, concurrent bathythermograph lowerings were made, and salinity samples were taken. In addition, four hydrographic casts were made using teflon coated Nansen bottles.

The surface samples for scattering and salinity were drawn through an uncontaminated sea water sampling system into a clean cell containing a teflon covered stirring bar; the cell was placed in the scatterometer, and stirring was begun. The photomultiplier signal was recorded for the transmitted beam and for angles between  $30^\circ$  and  $135^\circ$  at  $5^\circ$  intervals beginning at  $30^\circ$ , then the transmitted beam was observed again as a check on instrumental drift, which, when present, was corrected for in the data reduction.

Samples obtained from depth were similarly processed except that, to reduce differentiation of the sample, the water was drawn into polyethylene flasks as soon as the Nansen bottles came aboard. To counteract the effect of any settling that might have occurred during the storage time the flasks were agitated before the sample was decanted.

The same apparatus was employed on the R/V Chain during the study of a thermal front in the Sargasso Sea south of Bermuda. On this cruise twenty hydrographic stations and hourly bathythermograph lowerings were made. Surface salinity samples were collected concurrently.

The observed data were reduced by computer to yield the volume scattering function between  $30^\circ$  and  $135^\circ$  which was



extrapolated to cover the range from  $0^\circ$  to  $180^\circ$ . The extrapolation in the small angle range was made by a least squares fit to the equation,

$$\log \sigma(\theta) = A + B\theta + C\theta^2 \quad ,$$

for the points between  $30^\circ$  and  $50^\circ$ . From  $\sigma(\theta)$  the total scattering coefficient  $s$  was calculated by

$$s = 2\pi \int_0^\pi \sigma(\theta) \sin\theta d\theta.$$

The values of  $s$  are strongly dependent on the extrapolated values of  $\sigma(\theta)$  between  $0^\circ$  and  $30^\circ$ . Because of the steepness of this function the extrapolation is, at best, tenuous and possibly very bad; therefore the portion of this coefficient contributed by the measured points,  $s(30-130)$ , was also computed by changing the limits on the integral to  $30^\circ$  and  $130^\circ$ . This quantity was used as the measure of the scattering surface.

## RESULTS AND CONCLUSIONS

### "General Features of the Volume Scattering Function"

One method of characterizing the rise in the volume scattering function at small angles, which is an indicator of relative particle size, is the slope of the extrapolated portion of the curve plotted on natural logarithmic coordinates, the  $\ln$ - $\ln$  slope. The larger negative slopes indicate a larger predominant particle size. An indicator of

the same feature of the curve, the ratio,  $\sigma(30^\circ)/\sigma(45^\circ)$ , is a measured quantity and, therefore, is preferred to the  $\ln\text{-}\ln$  slope near  $0^\circ$ , but it has the disadvantage of being sensitive to fluctuations caused by small errors. The extrapolated curve is based on five points rather than only on the two that the ratio depends. The portion of the scattering coefficient lying between  $30^\circ$  and  $130^\circ$ ,  $s(30\text{-}130)$ , is a measure of the particulate content.

Figure 1 gives an example of the volume scattering function in coastal water. The main features in the curves for coastal water are the semilogarithmic behavior at small angles, the absence of local maxima, and the high values obtained. The slopes were not as steep in coastal waters as offshore, indicating a smaller predominant particle size inshore. Proceeding offshore, near the 100 fathom curve off Woods Hole, a sharp break was encountered in the absolute value of the volume scattering function; it became more curved in the small angle range, and a broad minimum appeared at the largest angles as clearer water was entered. Also shown in Figure 1 is an example of the volume scattering function in clear ocean water, where a series of maxima and minima occurred at angles greater than  $90^\circ$ . The appearance of these fluctuations indicated a tendency toward a monodisperse system of scatterers.

Figure 1 shows the back scattering in clear sea water

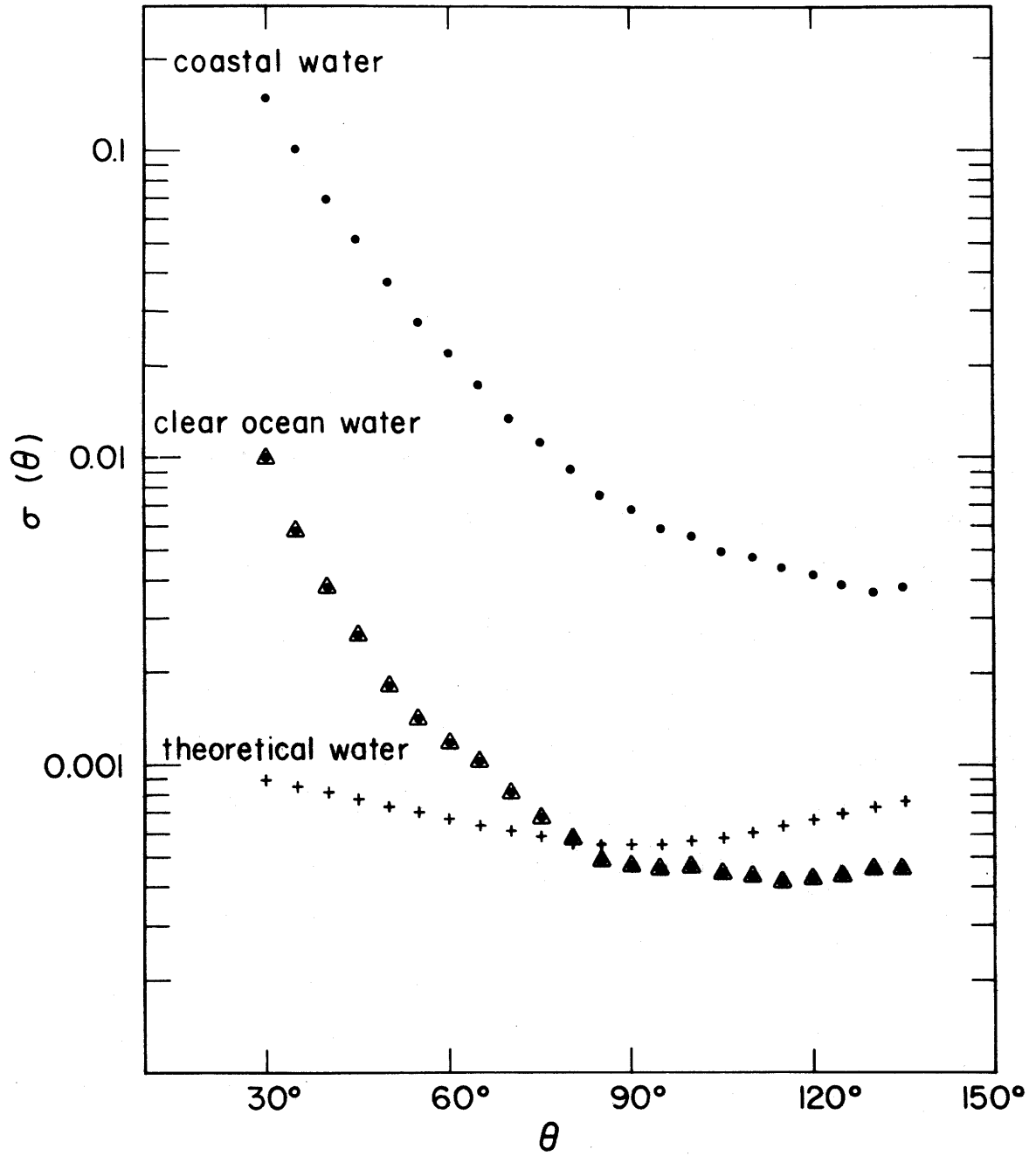


Fig. 1. A sample of the volume scattering function for coastal water, for clear ocean water, and the theoretical curve for pure water.

to be lower than the theoretical values for pure water calculated by the method of Dawson and Hulburt (1941). The discrepancy found in these measurements was not as great as that indicated by Tyler (1961) for water off the California coast, conversely, Jerlov (1961) shows the curve for theoretical water slightly below his measured values throughout the back scattering region.

#### "Surface Samples"

All of the surface samples from the cruise on the R/V Crawford were grouped into five categories which were defined as follows:

coastal water	-shore to 100 fm curve,
Bermuda water	-shore to 100 fm curve,
slope water	-100 fm curve to the western edge of the Gulf Stream,
Sargasso water	-eastern edge of the Gulf Stream to the 100 fm curve at Bermuda,
Gulf Stream water	-between slope water and Sargasso water.

The Gulf Stream was defined as the region where the bathythermograph section showed isotherms sloped sharply downward to the east, since it was undesirable to include any samples from the Sargasso water in the small Gulf Stream group.

The mean values and standard deviations of the ratio,  $\sigma(30^\circ)/\sigma(45^\circ)$ , and the partial scattering coefficient,

Table 1

	$\sigma(30^\circ)/\sigma(45^\circ)$	$s(30-130)$
Coastal water	$3.33 \pm 0.22$	
Slope water	$3.32 \pm 0.14$	$0.0222 \pm 0.0053$
Gulf Stream water	$3.53 \pm 0.28$	$0.0195 \pm 0.0088$
Sargasso water	$3.61 \pm 0.26$	$0.0172 \pm 0.0044$
Bermuda water	$2.91 \pm 0.06$	

s(30-130), for each of these groups appears in Table 1.

Applying t tests to these means, with a 95% confidence level, the slope water can be differentiated from Sargasso water both on the basis of s(30-130) and  $\sigma(30^\circ)/\sigma(45^\circ)$ . Coastal waters run more than a factor of three higher than open ocean water in s(30-130) but coastal water cannot be separated from the slope waters by  $\sigma(30^\circ)/\sigma(45^\circ)$ . Bermuda water has a much lower ratio than any of the others, indicating that the predominant scatterers are smaller. The picture may be summed up as a trend toward fewer and larger scatterers as one proceeds from the coast into the Sargasso region.

The s(30-130) values in port at Bermuda were over 0.1; whereas, just offshore they were in the 0.06 range. This is similar to the behavior of this parameter in coastal water.

#### "Hydrographic Station Samples"

Samples from twenty-four hydrographic stations were processed in the course of this work, but there were no well-developed trends or consistent features found in these stations. Two 200 meter stations showed that great variability can occur between bottles at normal sampling intervals. This emphasizes the necessity for "in situ" instrumentation that will continually record these variations.

One station showed a sharp increase in scattering at

the 400 meter level, the top of the main thermocline. This increase was confirmed by two bottles, and was the highest level of scattering observed in the open sea.

#### "Thermal Front Survey"

In the neighborhood of a thermal front, similar to those discussed by Voorhis and Hersey (1964), the sorting of the results of the surface samples into arbitrary temperature intervals showed that the ratio,  $\sigma(30^\circ)/\sigma(45^\circ)$  in the  $22.8^\circ$  water, 3.080 0.103, was different from the average of all other samples, 3.323 0.123, while the magnitude of the scattering showed no differences. There was no difference on either side of the front in the ratio or in the magnitude of the scattering. At the  $22.8^\circ$  isotherm a strongly developed line of weed, which is taken to be a sign of surface convergence, was noted once; coincidentally the lowest value of the ratio was observed.

#### "Determination of the Scattering Coefficient

##### by Measurement at One Angle"

To test the hypothesis that the scattering coefficient can be determined from the measurement of  $\sigma(\theta)$  at one angle, the ratios,  $s/\sigma(\theta)$  and  $s(30-130)/\sigma(\theta)$  were computed. The average of these ratios for  $30^\circ$  and  $45^\circ$  and their standard deviations yielded the results given in Table 2. These values show that  $s(30-130)$  can be calculated with a standard

TABLE 2

	$s(30-130)/\sigma(30^\circ)$	$s(30-130)/\sigma(45^\circ)$	$s/\sigma(30^\circ)$	$s/\sigma(45^\circ)$
Shelf water	1.134±0.053	3.739±0.111	4.801±0.450	16.38±2.86
Slope water	1.207±0.097	4.044±0.202	5.417±0.712	18.05±2.83
Gulf Stream water	1.171±0.070	4.119±0.209	6.064±1.663	21.96±7.75
Sargasso water	1.174±0.064	4.220±0.159	6.358±1.141	22.97±5.53
Bermuda water	1.323±0.022	3.845±0.033	4.399±0.240	12.79±0.81
Average (excluding Bermuda water)	1.173±0.069	4.118±0.227	5.976±1.265	21.33±6.10



deviation of less than 6% from the measurement of  $\sigma(45^\circ)$ , but they also show that a bias is introduced by the water type.

No true estimate of the precision in obtaining  $s$  from  $\sigma(\theta)$  at one angle can be made from these ratios, since the extrapolation required to obtain  $\sigma(\theta)$  at angles less than  $30^\circ$  may yield results grossly in error.

#### PRECISION AND ACCURACY

The absolute value of the measured volume scattering function is estimated to be correct within 10%. This is based on the accuracy of the calibration factors that are used in the reduction of the observed data to the volume scattering function.

In determining the precision of the measured values, samples taken by pump and processed immediately must be given separate consideration from those taken by bottle in hydrographic stations that must wait perhaps three hours to be processed.

The standard error of  $\ln \sigma(\theta)$  for the pumped surface samples was found to be 0.034. For the samples that were taken by Nansen bottles the standard errors were: for the  $\ln$ - $\ln$  slope between  $0^\circ$  and  $5^\circ$ , 0.018; for  $\ln s(30-130)$ , 0.27; for  $\ln \sigma(30^\circ)$ , 0.31; and for  $\ln \sigma(90^\circ)$ , 0.24.

Some of these standard errors are very large, yet there is no consistent pattern of change as a function of time in

the samples. This implies that the physical and biological processes were not the same in each sample and that particulate distributions can not be accurately determined by other than "in situ" methods. It has been shown, however, that certain water types can be differentiated by their scattering characteristics.

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MEASUREMENTS OF THE FORWARD SCATTERING OF A  
LASER BEAM IN SEA WATER

by

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Curves of the volume scattering function for sea water show that the intensity of scattered light increases quasi-exponentially as the angle of observation diminishes (Duntley, 1963; Kozlyaninov, 1957). One method of obtaining the portion of the extinction coefficient due to scattering is the integration of the volume scattering function,  $\sigma(\theta)$ , in the form:

$$s = 2\pi \int_0^\pi \sigma(\theta) \sin\theta d\theta,$$

where  $s$  is the scattering coefficient, and  $\theta$  is the angle of observation.

Table 1 gives the percent of  $s$  lying between  $0^\circ$  and  $\theta^\circ$ ; it was constructed by numerically integrating the expression for the scattering coefficient using data which are a composite of those of various investigators as tabulated by Jerlov (1963). This table demonstrates that the measurement of low angle scattering is critical in the determination of  $s$  and that  $s$  can be found with a fair degree of precision by measuring only the low angle scattering.

An experiment designed to measure the relative low angle scattering over a variety of surface waters was car-

Table 1

<u><math>\theta^\circ</math></u>	<u><math>\%s(0^\circ - \theta^\circ)</math></u>
5°	25%
10	55
15	67
20	75
30	85
50	93
90	98
130	99

ried out aboard the R/V Chain between Woods Hole and Port Lewis, Mauritius.

A gas laser was employed as the light source in the scattering apparatus. Since lasers provide an easily regulated, intense, collimated, monochromatic pencil of light, they are uniquely adaptable to scattering work. The mode used was at  $6328 \text{ \AA}$ .

One end of a cylindrical, lucite cuvette was fastened firmly to the laser housing so that the beam was directed along the axis of the cuvette. A barrier-layer photocell, of diameter equal to the diameter of the cuvette, was attached to the end opposite the laser housing. The spot where the beam would have struck the sensitive surface was blanked out. At the open end of the laser, where a fixed fraction of the primary energy is emitted, a silicon photocell monitored the laser intensity.

The apparatus is shown in Figure 1. The sea water intake was 3 meters below the waterline, but the ship's plumbing required the pump to be 2 meters above the waterline. To suppress bubble formation the sample was pushed through the cuvette at a gauge pressure of 0.1 atm. which was maintained by adjustment of the overflow and outlet rates.

As particles passed from the inlet to the outlet port, the lower limit of the acceptance angle for scattered light

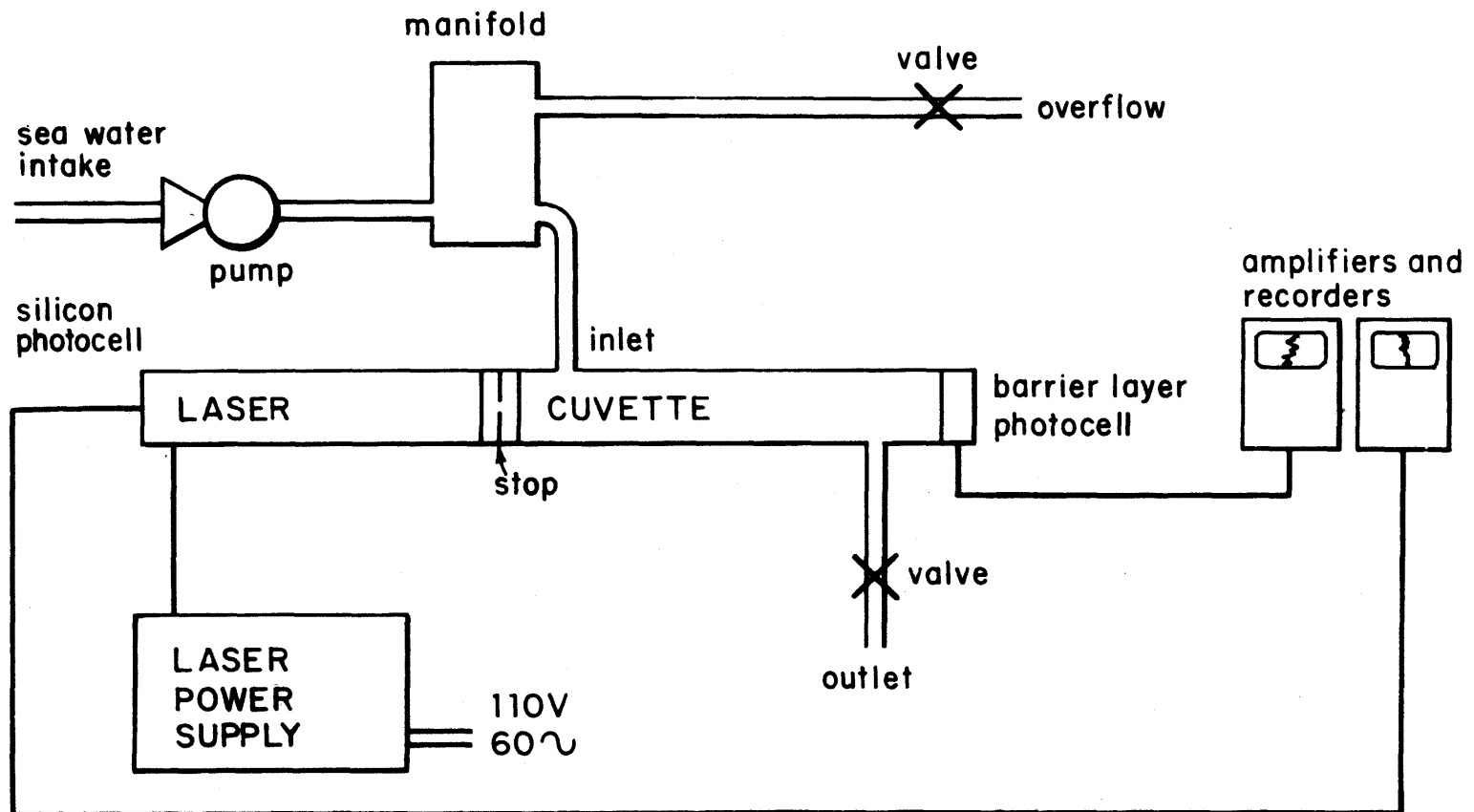


Fig. 1. Apparatus for forward scattering studies.

varied from  $0.5^\circ$  to  $5^\circ$  while the upper limit varied from  $20^\circ$  to nearly  $90^\circ$ . Table 1 shows, however, that this change affected the total energy received by less than 20%. This change would have been noticeable only when studying features that were passed through in less than the three minute flushing time of the cuvette. These features will be exaggerated so that increases will appear to be of greater extent and lesser magnitude, while decreases may be obscured by scatterers still present in the system.

Figure 2 shows the ship's course during the experiment.

The scattering and surface temperature curves for the Atlantic traverse are given in Figure 3. The scattering results have been normalized to the lowest value found in the mid-Atlantic section where the intensity of scattered light was low and nearly constant. The widest variations in the western portions of the track were associated with changes of sea water temperature, and the influence of in-shore processes is evident in the steep rises near Madiera and the African coast.

In the Strait of Gibraltar peaks of scattering were observed that seem to be related to the three major bottom rises. These were up to threefold increases over the neighboring valleys.



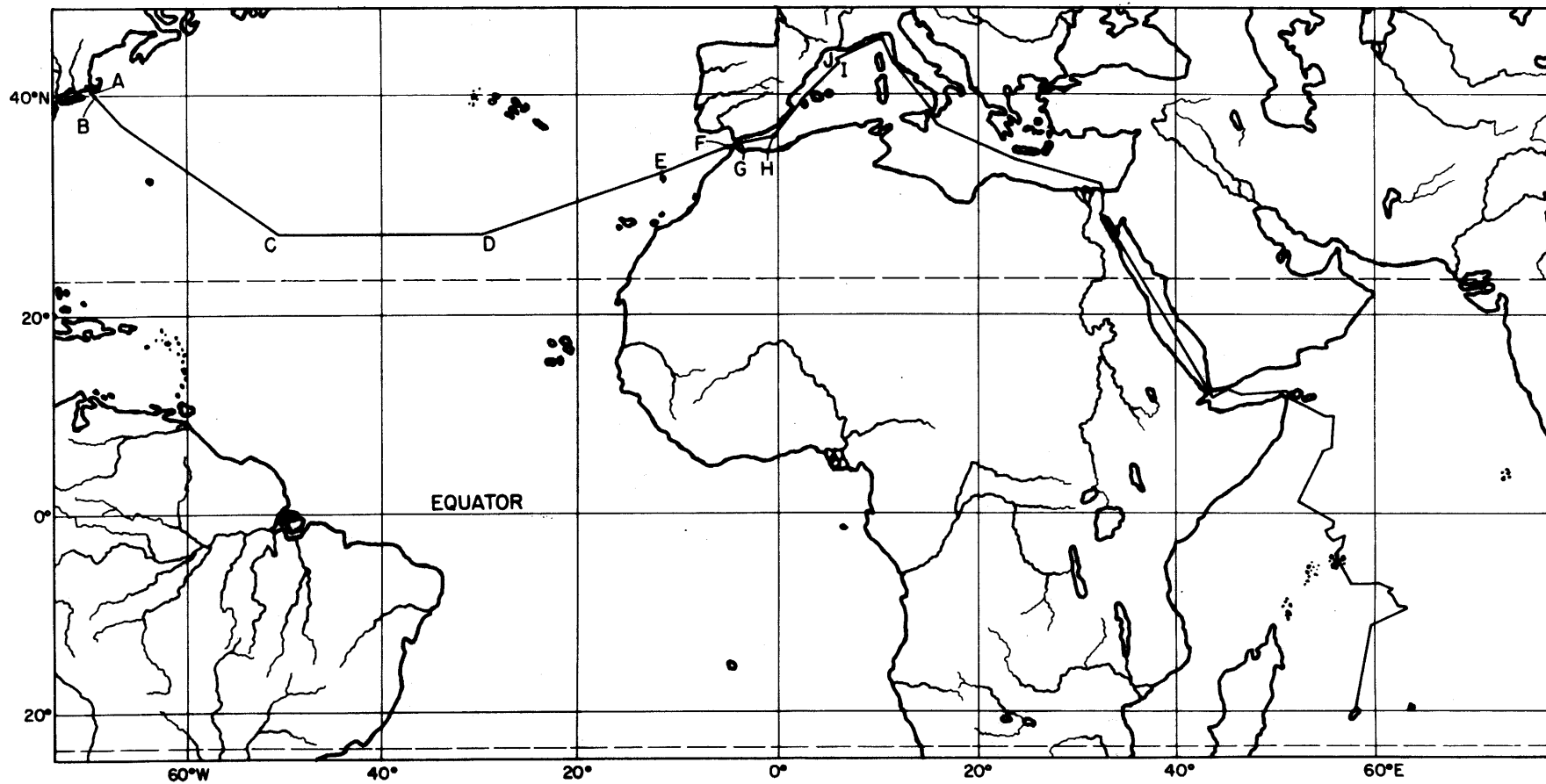


Fig. 2. The ship's track: Woods Hole to Port Lewis, Mauritius.

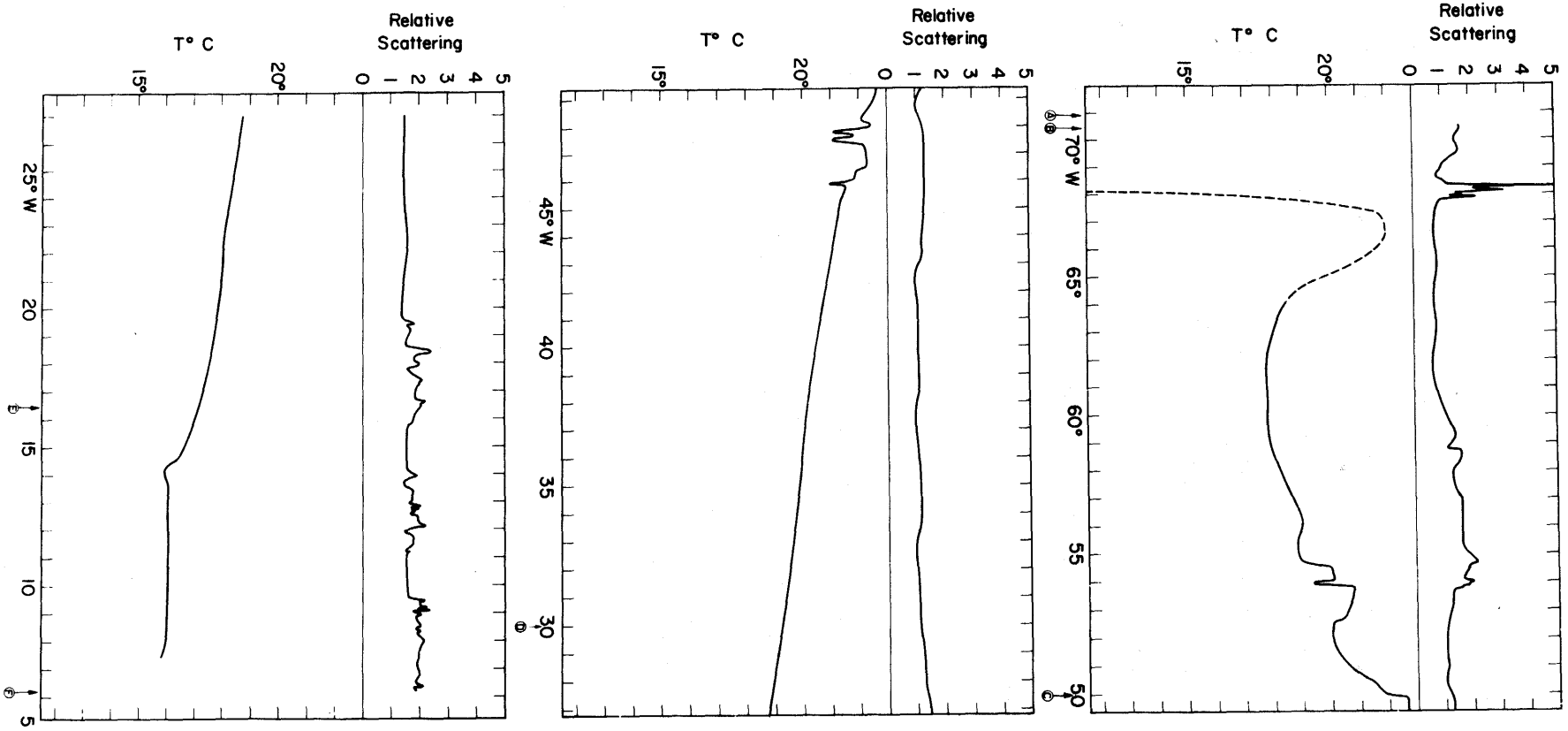


Fig. 3. The forward scattering and surface temperature for the North Atlantic traverse.

The western Mediterranean traverse, Figure 4, shows scattering two to three times the mid-Atlantic values. There is great variability associated with the proximity of land. In the eastern Mediterranean the scattering became more constant as the distance from land increased.

The lowest scattering recorded, six to nine-tenths of the mid-Atlantic values, was in the Indian Ocean beginning near the equator and extending to  $20^{\circ}$  S., which was as far as measurements were made.

In summary, the scattering coefficient can be obtained by measurements of the low angle scattering. Wide fluctuations occur near land. In the open sea there is little variation except in the presence of rapid surface temperature gradients; however, the base value is different for different bodies of water.

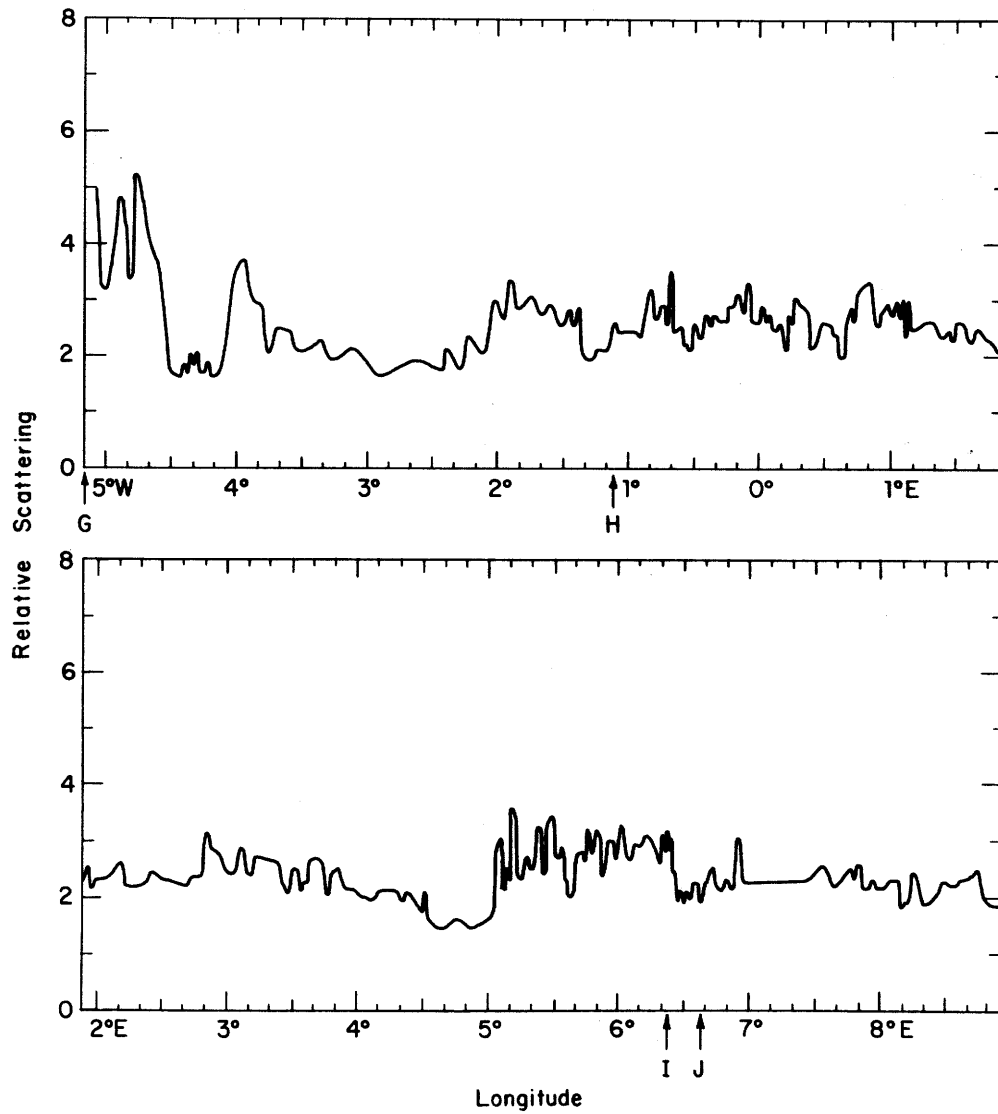


Fig. 4. The forward scattering in the western Mediterranean.

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PART TWO

## CHAPTER ONE

## INTRODUCTION

## 1.1 Preliminary Remarks

This work is an effort to define the variability of the volume scattering function for sea water of several different types. Measurements of scattering may hold the key to the determination of particulate distributions and as such might be useful to oceanographers in many phases of their work.

The volume scattering function,  $\sigma(\theta)$ , is defined by the equation:

$$\sigma(\theta) = \frac{J(\theta)}{Hv}$$

where  $J(\theta)$  is the intensity of scattered light in the direction  $\theta$ ,  $H$  is the irradiance input and  $v$  the scattering volume which is determined by the intersection of the beams of incident and scattered light.

Figure 1-1 shows three theoretical curves of the volume scattering function taken from the tables for monodisperse spherical particles of Ashley and Cobb (1958) and Gumprecht et al (1952). Two of these curves are for single particles of the same size differing in index of refraction and the third is for ten particles of a smaller size. The sum of these three curves is shown in Figure 1-2 together with the theoretical curve for one thousand scatterers of a smaller size and the sum of the four monodisperse systems. Sizes

are given in terms of  $\alpha$  which is defined as  $\pi d/\lambda$ , where  $d$  is the diameter of the particle and  $\lambda$  the wavelength of the radiation. The index of refraction difference,  $\Delta n$ , is the index for the particles minus that for the solvent.

It is obvious that the combination of these monodisperse systems results in the toning down of maxima and minima. The extension of this logic to more disperse systems yields curves in which only major features are evident. Any appearance of local maxima and minima is, therefore, an indication of a trend to monodispersity. These curves also indicate that the rise in the small angle region of this function becomes steeper as the particle size increases. A comparison of curve D to curve E, which latter represents considerably smaller particles, illustrates this effect. In a qualitative sense this criterion may be applied to the volume scattering function for sea water; however, there is no reason that the theoretical curve for any monodisperse system should match that for the natural environment.

In the course of this study two experiments were made which yielded information on the shape of the volume scattering function and its magnitude for sea water. In the first, measurements of  $\sigma(\theta)$  were made with monochromatic light on four hundred samples from surface and subsurface locations between Woods Hole and an area in the Sargasso Sea south of Bermuda. In this region, where sharply contrasting



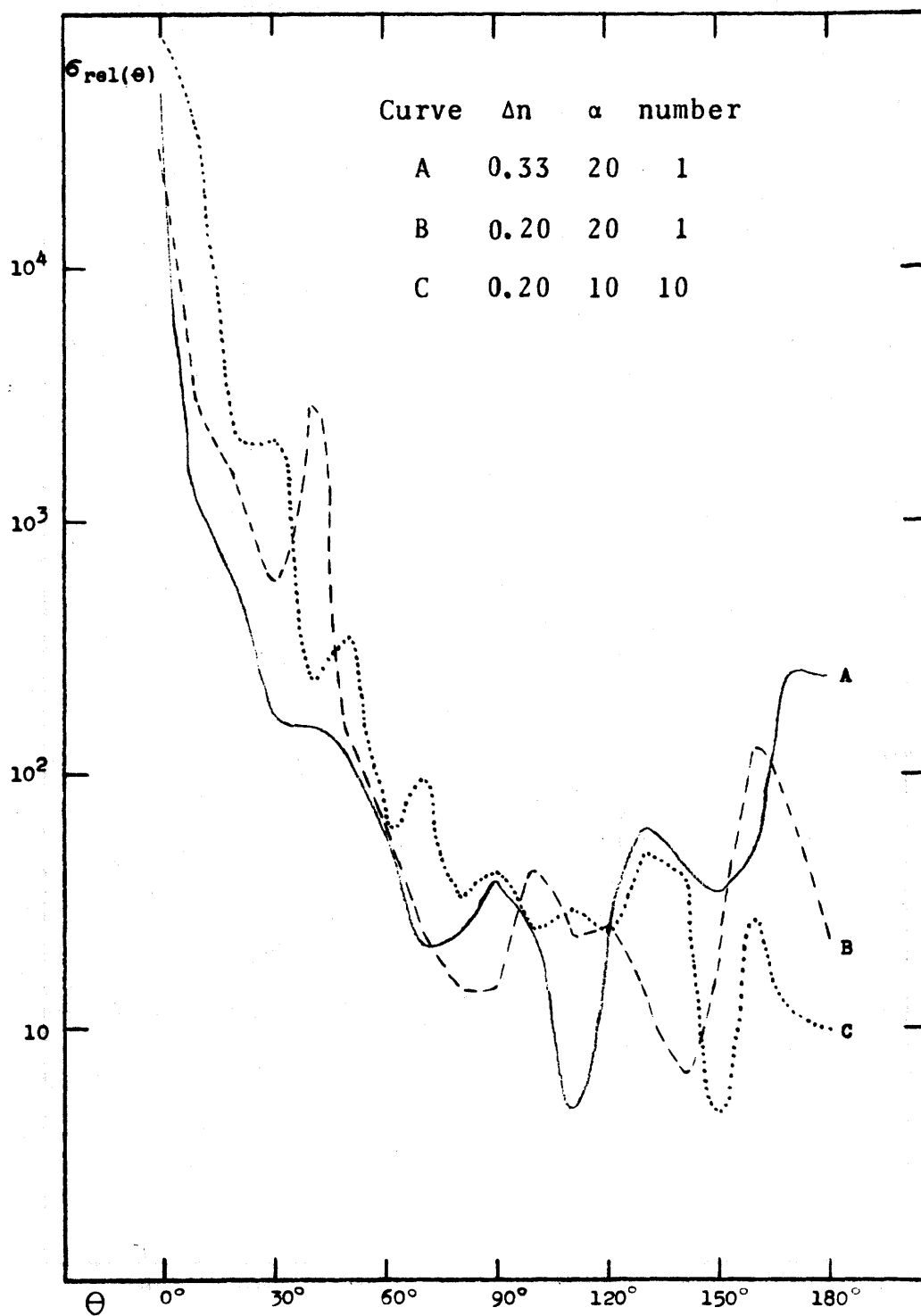


Fig. 1-1. Theoretical curves of the volume scattering function for three systems of monodisperse scatterers.

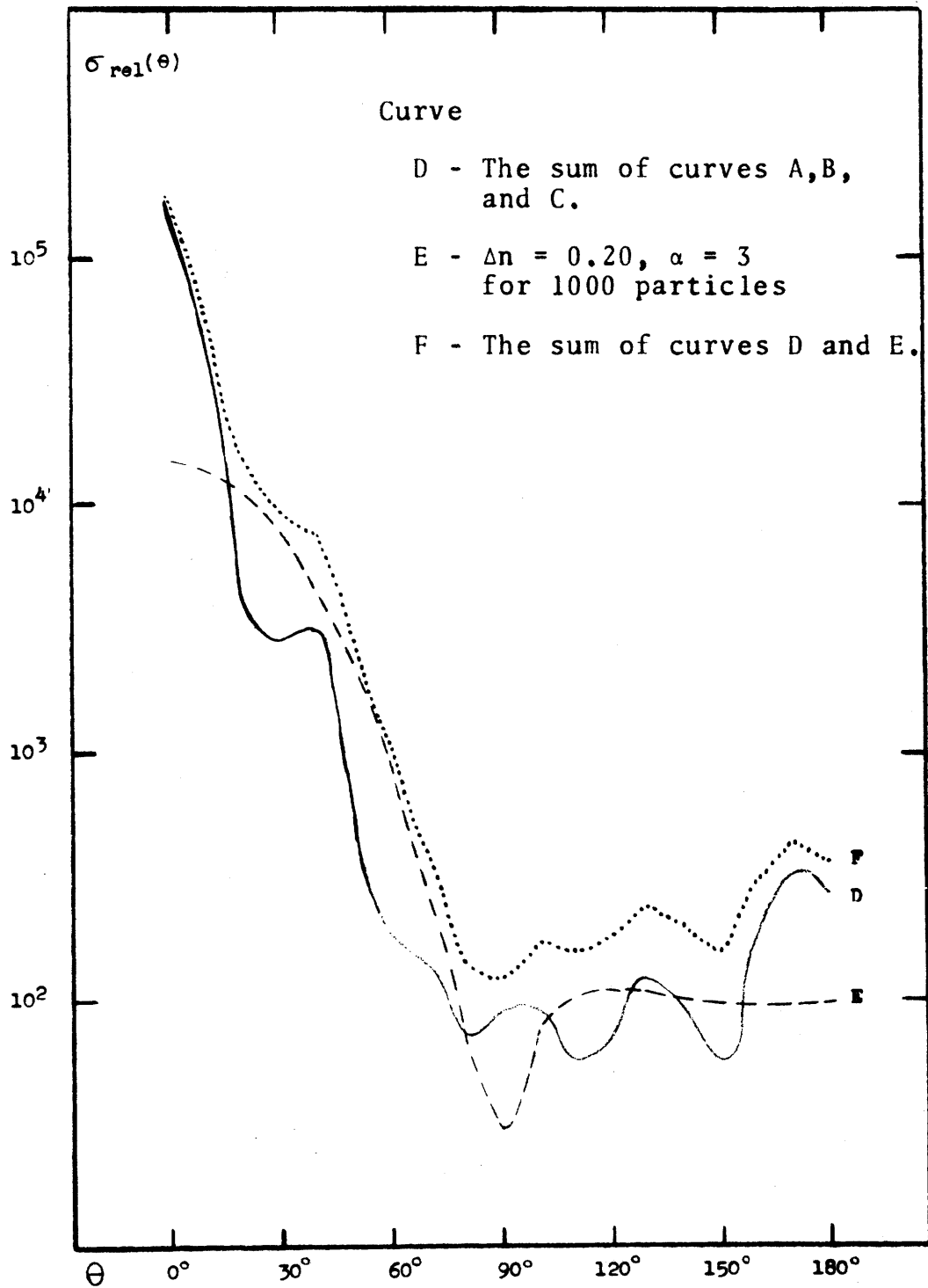


Fig. 1-2. Theoretical curves of the volume scattering function for two systems of polydisperse scatterers and one system of monodisperse scatterers.

water types are found, the variations in the volume scattering function were correlated with concurrently observed temperatures and salinities. In the second experiment, a laser was employed in the study of the relative magnitude of the forward scattering by sea water over a variety of surface water types.

## 1.2 History

The first measurements of the volume scattering function in sea water were made by Ramanathan (1923). His values indicated that the predominant scatterers are large compared with the wavelength of visible light and the the back scattering in sea water approaches that in pure water. Jerlov (1961) came to the same conclusion from more extensive measurements. Ramanathan was inspired to do his work by a controversy over the cause of the coloration of sea water in which Raman (1922) contended the color of the sea was due to the molecular scattering of the water rather than to reflection of the blue color of the sky as Rayleigh had suggested. It is interesting to note in this connection that another geophysical phenomenon, the color of the sky, was the question that first brought the minds of Rayleigh (Strutt, 1871 a, b) and Tyndall (1869) to bear on the phenomenon of light scattering.

The work of Ramanathan was the first and also the last measurement of the volume scattering function in sea water

for over twenty years. The next measurements were reported by Hulburt (1945). In the interim work was centered on a study of the angular distribution of submarine daylight as outlined by Atkins and Poole (1940).

At the time of Hulburt's observations his interest was focused on the wavelength selectivity of the scattering and it appears that his measurement of the volume scattering function was made as a by-product. One of the important errors in the analysis of scattering data may have arisen from this source. Hulburt attempted to integrate the volume scattering function to obtain the scattering portion of the attenuation coefficient, and, in extrapolating his measurements, he made it appear that the volume scattering function decreases at small angles. Measurements by Kozlyaninov (1957) and Duntley (1963) have shown that this is not true. In Chapter Three of the present discussion it is shown that any integrations made on the basis of inaccurate extrapolations will be grossly in error.

Atkins and Poole (1953) presented the first extensive study of the volume scattering function. They collected samples and processed them ashore. The results are similar to those obtained by later investigators using both "in situ" and shipboard techniques. These authors pointed out the possibility that the greater part of the scattering lies at angles less than  $20^\circ$  and were the first to ascribe this

to refraction by transparent particles.

Recent measurements of the volume scattering function have been published by Kozlyaninov (1957), Sasaki et al (1960), Pickard and Giovando (1960), Jerlov (1961), Tyler (1961a), Hinzpeter (1962) and Duntley (1963). The measurements of Sasaki, Pickard and Giovando, and Hinzpeter were made on samples extracted from their environment, while the others worked "in situ". Jerlov (1963) showed that none of these measurements differ in gross features; however, it is shown in this work that the volume scattering function evidences variations that have a physical meaning.

Sasaki (1960) and Jerlov (1961) compared the shapes of the volume scattering functions that they obtained to theoretical curves for various monodisperse systems and drew conclusions about the size of particles in the sample. Jerlov (1961) stated that his measurements of the volume scattering function showed no palpable differences. He made no further attempt to identify the characteristics of a parcel of water by this scattering property. Sasaki (1960) also compared his curves with theoretical curves, but he indicated that he believed real differences exist. It was on this basis that the following work was carried out, in which it is shown that the scattering properties of a parcel of water do characterize it to some extent.

## CHAPTER TWO

## PREPARATORY EXPERIMENTS

## 2.1 Introduction

Early in this work two instruments were constructed to measure, "in situ", the volume scattering function at three fixed angles. A third instrument was constructed to obtain information on the synoptic variation of the total scattering coefficient. None of these experiments was wholly successful; however, the second fixed angle scattering meter produced results that put the study on its final course, a very general look at the shape and magnitude of the volume scattering function in sea water.

## 2.2 Fixed Angle Scattering Meters

The first instrument measured the volume scattering function at  $20^\circ$ ,  $45^\circ$ , and  $135^\circ$  in turbid water; however, it did not have enough sensitivity to measure back scattering in clear sea water. Its shape made it amenable to use as a towed device. This instrument continuously recorded scattered light from a collimated beam; in a two minute cycle it provided information on the scattered light at the three angles as well as sampling the beam.

The case consisted of two concentric steel pipes of one-half inch wall thickness, of which the outer had an inside diameter of nine inches and the inner an outside diameter of five inches. The electronics and working parts were placed

in the two inch annulus between the pipes which was sealed at each end by removable plates. The sample flowed along the axis of the pipes. A two inch wide semicircular slice perpendicular to the axis of the pipes was removed from a section equidistant from each end, and the gaps left in the annular chamber were sealed by welding one-half inch steel plate in them. The windows, made from one-quarter inch thick lucite, were placed circumferentially on the inner pipe opposite this slice, eliminating internal reflections in the scattering volume.

Two slits collimated the incident beam to a divergence of less than  $1^\circ$  in air. A calibration signal was obtained from the scattering of the incident beam in a lucite block, before the beam entered the water. There were three detection ports each of which had behind it a two-slit collimator, with a  $5461 \text{ \AA}$  interference filter between the slits.

All of the signals were led to the same photomultiplier tube by fiber optics. At the tube a rotating disk, with one hole in it, selected the fiber bundle to be observed. This disk was driven by a small electric motor through a geneva motion. The geneva motion also rotated a shutter which intercepted the light beam one-third of the time. The ambient light was recorded while the beam was cut off.

The light source was a 100 watt mercury arc tube, which was driven by a stabilized voltage transformer and filtered

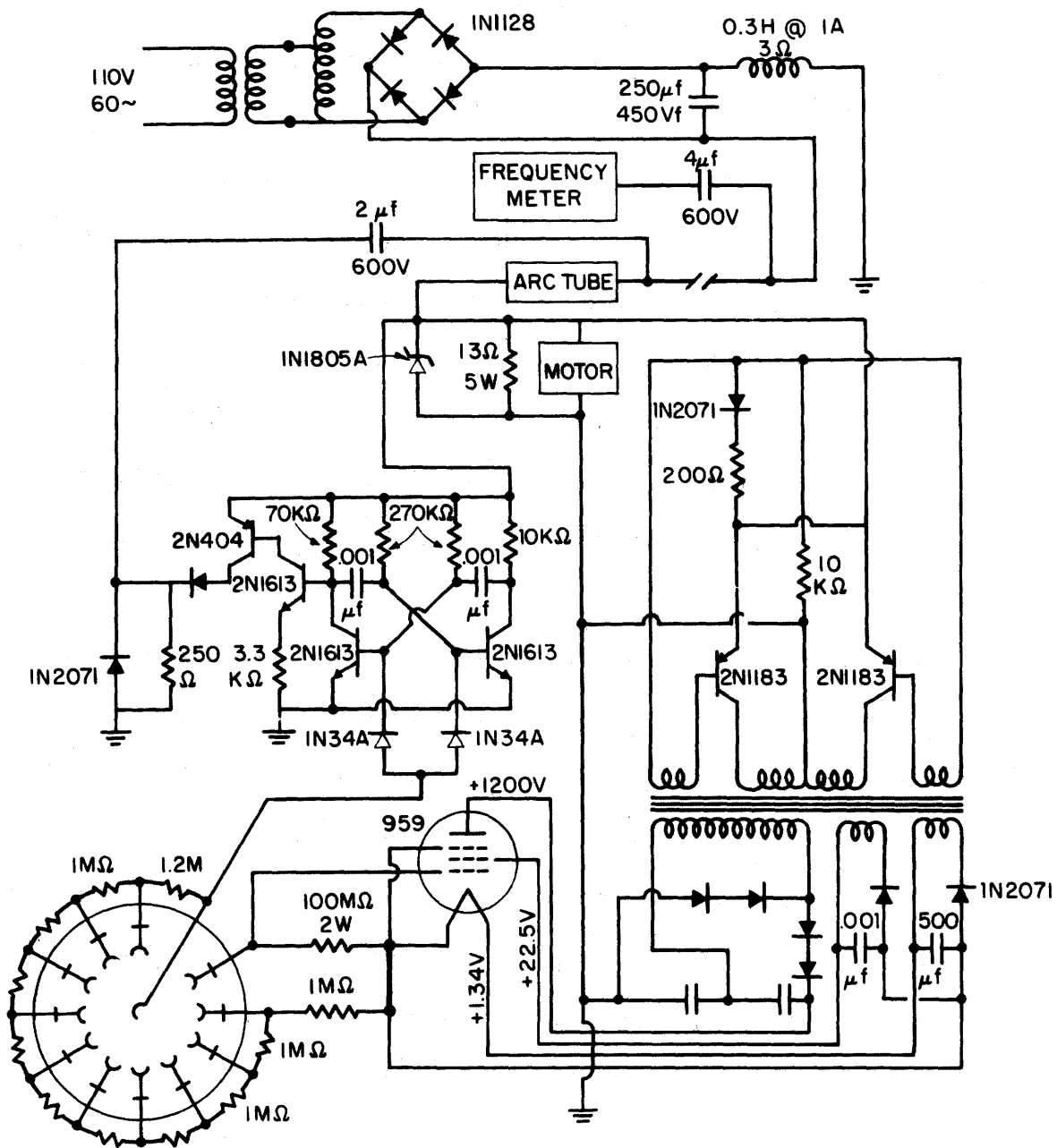
rectifier circuit on deck. This lamp was in series with a 6 volt zener diode resulting in a drop of 130 volts across the lamp's 170 ohms. The ballast transformer provided even current delivery to the mercury arc and consequently relatively even light output.

The photomultiplier tube was employed in a circuit similar to that used by Breslau (1958) which yields a logarithmic response to light intensity. The circuitry of this instrument is shown in Figure 2-1.

The output of the photomultiplier tube controlled the frequency of a multivibrator. This signal was amplified, passed through a blocking capacitor, and transmitted on the same cable that carried the D. C. power. A 0.3 henry inductor was included in the power supply to prevent shorting of the signal. The multivibrator and amplifier were operated in parallel with the zener diode.

A D. C. to D. C. converter provided the various voltage levels required by the circuitry. This supply utilized a one kilocycle toroid oscillator with three secondary windings to supply the heater voltage, 1.25 volts, the screen grid voltage, 22.5 volts, and 600 volts, which was doubled in the rectification process to obtain 1200 volts for the photomultiplier circuit. Since very little current was drawn by the photomultiplier tube, the current used by the converter was only a small fraction of that which passed through the zener





Photomultiplier RCA 6199

Fig. 2-1. Circuit diagram of the first fixed angle scattering meter.

diode. Being in parallel with the zener diode, it did not influence the lamp operation.

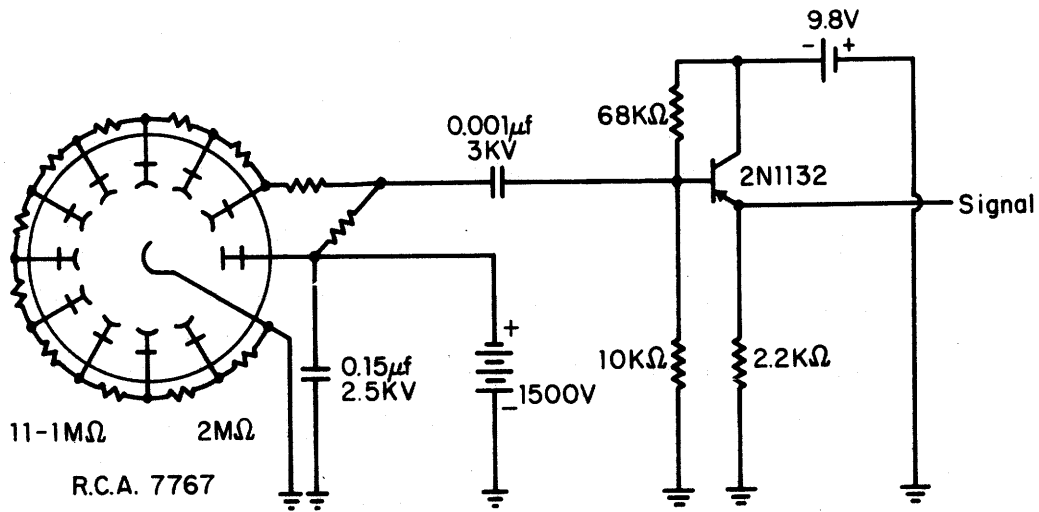
Because this device did not have enough sensitivity to measure back scattering in clear sea water, another instrument was constructed.

In the second design, the light source was a xenon flash tube that was pulsed twice each second with a flash duration of five microseconds. The beam was collimated to  $3^\circ$  in water. This source was housed in a two inch aluminum cylinder, which had a lucite cap at one end and at the other end an aluminum cap through which the electrical connections were made. The device was powered by batteries carried in a separate case.

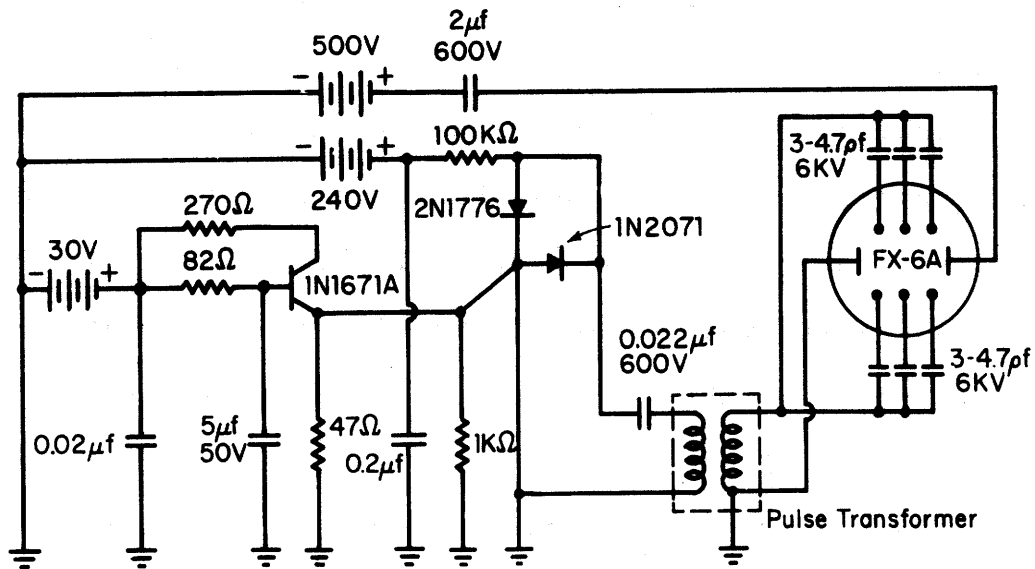
The detectors were similarly housed. Each one consisted of a two-slit collimator, an interference filter, a photomultiplier tube, and an amplifier. The circuitry of the detectors and the light source is shown in Figure 2-2.

The output of the detectors was a pulse of five microseconds duration, which was fed through a coaxial cable to the surface where readout was made on oscillographs. Multiple flashes were recorded, and their mean peak height taken in order to eliminate flash intensity variations. A manually cycled stepping switch, with one blank position for coding, determined which detector was being monitored.

The detectors and the light source were fastened to a



A detector



The strobe light source

Fig. 2-2. Circuit diagrams of the second fixed angle scattering meter.

semicircular aluminum plate which supported the detectors at angles of  $20^\circ$ ,  $45^\circ$  and  $135^\circ$  with the incident beam.

A detector was calibrated by placing the light source opposite it and interposing neutral density filters. In this way curves of light intensity versus pulse height were obtained for each detector. This procedure was carried out before and after lowerings to ensure that the relative sensitivity values between detectors had not changed.

The results of lowerings made from R/V Crawford and R/V Chain are summarized in Table 2-1. The ratio of  $\sigma(20^\circ)$  to  $\sigma(45^\circ)$  showed significant covariations. One would expect this ratio to characterize a polydisperse system of Mie scatterers where specific maxima and minima are washed out, but size distributions may vary.

Table 2-2 is a condensation of the results of other investigators taken from published works. These ratios are merely a guide to the magnitude of the variations, since in some cases the values are the result of extrapolations or interpolations of the published data. The large variations in the  $\sigma(20^\circ)/\sigma(45^\circ)$  column is again remarkable.

These results prompted the study of the scattering function over a wider range of angles, which is detailed in Chapter Four. They also gave an early indication of the variation of the scattering function with water type.

### 2.3 Integrating Scatterometer

The third instrument constructed during the preparatory

TABLE 2-1

Location	$\sigma(20^\circ)/\sigma(45^\circ)$	$\sigma(45^\circ)/\sigma(135^\circ)$
39°47'N 71°00'W (Shelf edge)	6.6	5.7
38°45'N 70°21'W (Slope)	12.6	7.9
" " repeat	8.1	5.6
39°00'N 66°21'W (Eastern edge of the Gulf Stream)	1.8	22
39°30'N 66°30'W	2.5	6.8
40°00'N 66°00'W	3.5	6.3
40°47'N 68°33.5W (Georges Bank)	5.5	6.3

TABLE 2-2

Investigator	Location	$\sigma(20^\circ)/\sigma(45^\circ)$	$\sigma(45^\circ)/\sigma(135^\circ)$
Pickard & Giovando (1960)	British Columbia inlets	60 80	166 17
Tyler (1961)	San Pedro Bay	8.9	12
	Between San Pedro Bay and Santa Catalina	9.1	6.3
	Near Santa Catalina	11	6.4
	Near San Clemente	9.8	5.8
Jerlov (1953)	"Average ocean water" 465m $\mu$	13	5
Hinzpeter (1963)	Near Langeland 400m $\mu$ high scattering	7.3	2.4
	low "	7.5	5.7
	700m $\mu$ high "	2.3	8.6
	low "	5	8
Sasaki et al (1960)	Japan Trench 600 meters	6.8	7.5
	1500 "	4	4.2
	2650 "	2.9	8.7
	3000 "	15	1.7

experiments was a device similar to that suggested by Beuttel and Brewer (1949) and later adapted for sea water by Jerlov (1961) and Tyler and Howerton (1962). This device consisted of a collimated light source with a cosine collector whose surface was parallel to the beam and placed as close to the beam as possible without intercepting it.

This instrument was placed in the center well of the R/V Chain and operated on one cruise. In the Sargasso Sea a series of measurements was obtained in which during four hours the scattering doubled seven times for a period of one minute each, which could have been the result of lines of convergence that are frequently present in this area. The results were, however, more generally disappointing since it was difficult to hold the source intensity constant. A more rewarding experiment with a similar objective is discussed in the next chapter.

## CHAPTER THREE

## FORWARD SCATTERING MEASUREMENTS

## 3.1 Introduction

Curves of the volume scattering function for sea water show that the intensity of scattered light increases rapidly as the angle of observation diminishes. This increase approximates an exponential function of  $\theta$  in which, from  $30^\circ$  to  $70^\circ$ , the exponent lies near 3. Measurements by Duntley (1963) and Kozlyaninov (1957) indicate that at smaller angles the rise is even steeper, perhaps due to refraction of rays by relatively large particles of biological material that have an index of refraction near that of sea water, (Duntley, 1963; van de Hulst, 1957).

To obtain the portion of the attenuation coefficient due to scattering one may determine the volume scattering function,  $\sigma(\theta)$ , and integrate it according to the form:

$$s = 2\pi \int_0^\pi \sigma(\theta) \sin\theta d\theta,$$

where  $s$  is the total scattering coefficient and  $\theta$  the angle of observation. Figure 3-1a is a typical example of  $\sigma(\theta)$  drawn from the data of several authors as tabulated by Jerlov (1963). The effect of multiplying  $\sigma(\theta)$  by  $\sin\theta$  is shown in Figure 3-1b; it is the area under this curve that



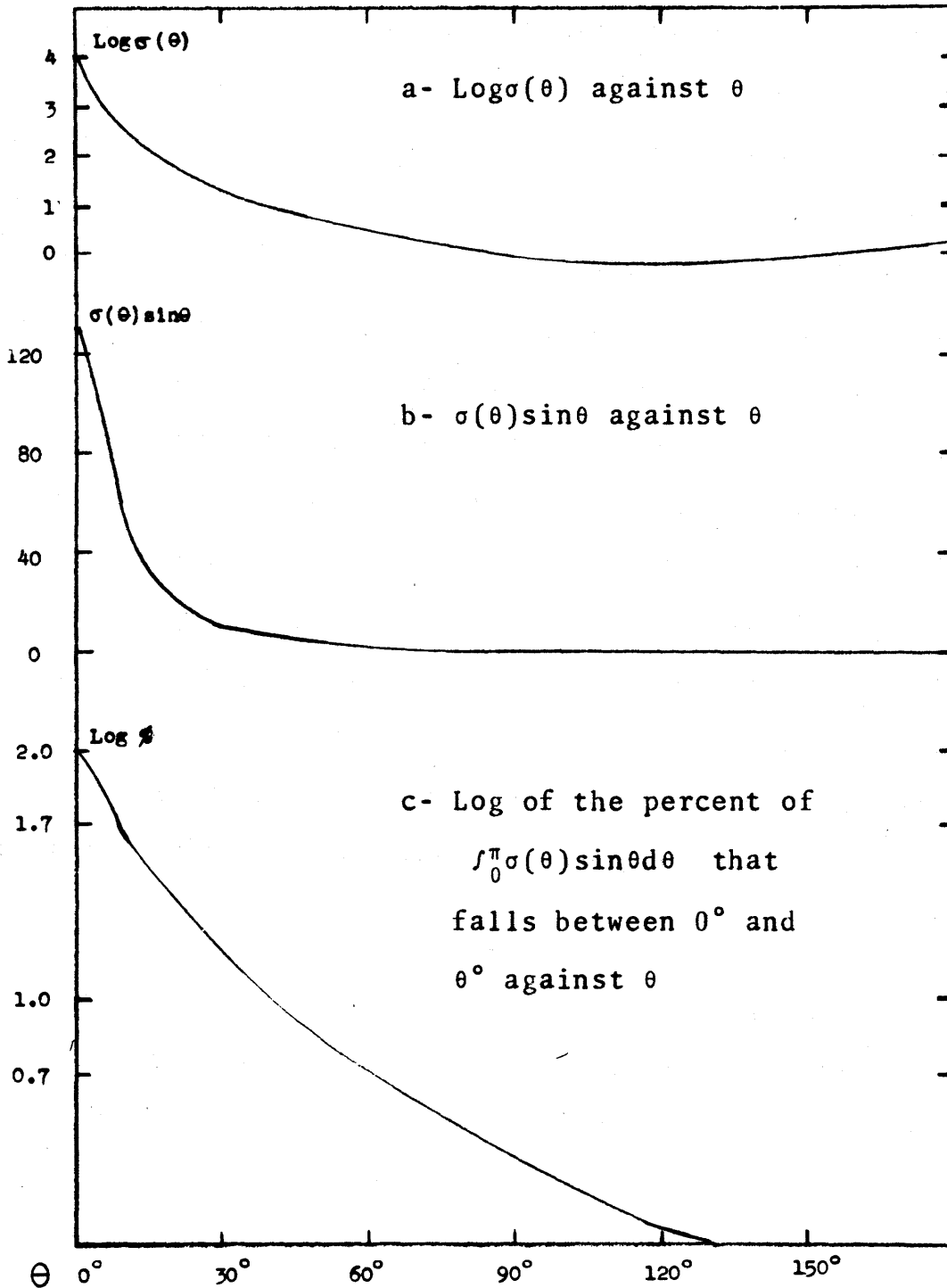


Figure 3-1

is proportional to the scattering coefficient. Figure 3-1c, constructed by graphical integration of  $\sigma(\theta) \sin\theta$ , gives the percentage of the integral that occurs between  $0^\circ$  and any angle. This curve shows that, if the scattering coefficient is determined by mathematical integration, its accuracy is governed by the accuracy with which  $\sigma(\theta)$  can be determined at small angles. If an error of a factor of two is made in  $\sigma(\theta)$  at angles less than  $10^\circ$ , an error of approximately 40% is made in the scattering coefficient. This conclusion is in direct contradiction to statements by Tyler (1961 b) and Duntley (1963) to the effect that the scattering coefficient is insensitive to the magnitude of  $\sigma(\theta)$  at small angles.

The only reported measurement of scattering at small angles in sea water is that of Kozlyaninov (1957) which is an isolated point in a rather large system. For this reason a survey of the relative forward scattering of varied surface waters was undertaken, using a continuously recording instrument.

### 3.2 Apparatus

A device to measure continuously relative scattering in sea water at small angles was taken to sea on the R/V Chain in the spring of 1964 and operated from Woods Hole

to Port Lewis, Mauritius.

A gas laser, Perkin Elmer Model 5200, was employed for the light source. Since lasers provide an easily regulated, intense, collimated, monochromatic pencil of light, they are uniquely adaptable to scattering work. The mode used was at  $6328 \text{ \AA}$ .

One end of a cylindrical, lucite cuvette was fastened firmly to the laser housing so that the beam was directed along the axis of the cuvette. A stop was inserted in the beam at this junction. The cuvette was 25 cm. long, had a diameter of 4.3 cm. with inlet and outlet ports as shown in Figure 3-2. It was wrapped in black tape to eliminate ambient light and to reduce reflections at the air-wall interface.

Two detectors were employed. A Weston "Photronic" barrier layer cell was fastened to the end of the cuvette opposite the laser. The sensitive area of this detector was of the same diameter as the cuvette, and the spot where the laser beam would have struck it was blanked out by a disk 0.7 cm. in diameter. The second detector was a silicon photocell placed at the other end of the laser. It received a fixed fraction of the energy generated and was used to monitor the incident energy. The signals from the two detectors were amplified and recorded simultaneously

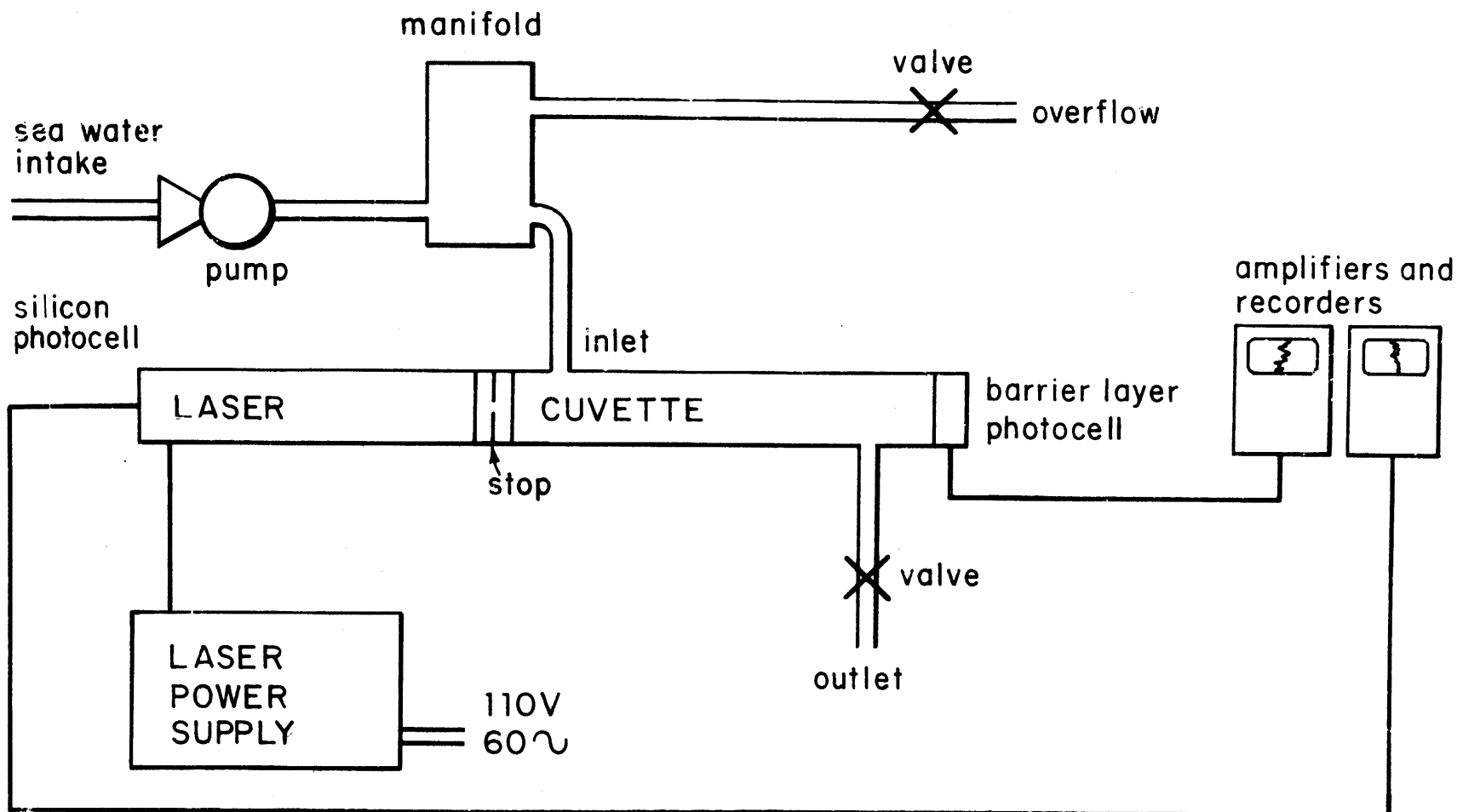


Fig. 3-2. Apparatus for forward scattering studies.

on strip chart recorders.

The sea water sample was obtained through an "uncontaminated" inlet three meters below the waterline, but, due to the ship's plumbing, the teflon gear pump that was used had to be placed two meters above the waterline. The sample was pumped into a manifold first and from the manifold most of it was allowed to overflow while some was diverted into the cuvette. This allowed some rising time for the escape of large bubbles that form in the process of drawing the sample. To suppress the smaller bubbles in the sample a positive pressure of 0.1 atm. was maintained in the cuvette by adjusting the outlet and overflow rates.

The geometry of the system was such that the scattering detected from a particle entering the beam near the inlet port was between  $0.5^\circ$  and  $5^\circ$ . Midway between the inlet and exit ports this acceptance angle was between  $1.5^\circ$  and  $10^\circ$ ; however, this changing of the acceptance angle is shown in Figure 3-1c to affect the total energy received by less than 20%. Such a change will be observable as a rounding of sharp peaks. This change would have been noticeable only when studying features that were passed through in less than the three minute flushing time of the cuvette. Such features will be exaggerated so that increases will appear to be of greater extent and lesser mag-

nitide while decreases may be obscured by scatterers still present in the system.

### 3.3 Operation

The only regular attention this apparatus required other than changing chart paper every ten days was adjusting the scale factor on approaching land, and occasionally flushing bubbles during very rough weather.

Early in this experiment a scratch on the face of the cuvette resulted in a portion of the beam being scattered by the lucite. The system was realigned to remove this scratch from the beam, and results taken before this was done were corrected to account for scattering by it.

The zero readings of the recorders and amplifiers were checked periodically by shutting down the laser. In this way ambient light was accounted for at the same time. The gain of the amplifiers was also checked with a millivolt source; however, after an initial setting, this did not require adjustment.

### 3.4 Results

Figure 3-3 shows the ship's course during this experiment.

The relative scattering and the surface temperatures for the Atlantic traverse are given in Figure 3-4. All

scattering results are normalized to the lowest values found in the mid-Atlantic section of the traverse where the scattering was low and nearly constant. The widest variations in the western portion of the track were associated with thermal changes, while the rise in the offing of Madiera and the rise approaching the African coast seem to be due to inshore processes probably both geological and biological. The most pronounced feature of this traverse was the low, and nearly constant values found over a wide section in mid-Atlantic.

Figure 3-5 shows the scattering in the Strait of Gibraltar and the bottom contour along the ship's track. The peaks of scattering show a relationship to the three major rises of the bottom. In comparing the scattering trace with the bottom contour one must consider both the time required for a sample to pass from the sea water intake to the cuvette and the effect of the bottom contour on either side of the track. The time delay was approximately five minutes which would have moved the scattering trace one minute of longitude westward, and the effect of lateral variation the bottom contour was minimized since the three rises are features of some extent.

The Mediterranean traverse, Figure 3-6, shows scattering two to three times that in the Atlantic. There is

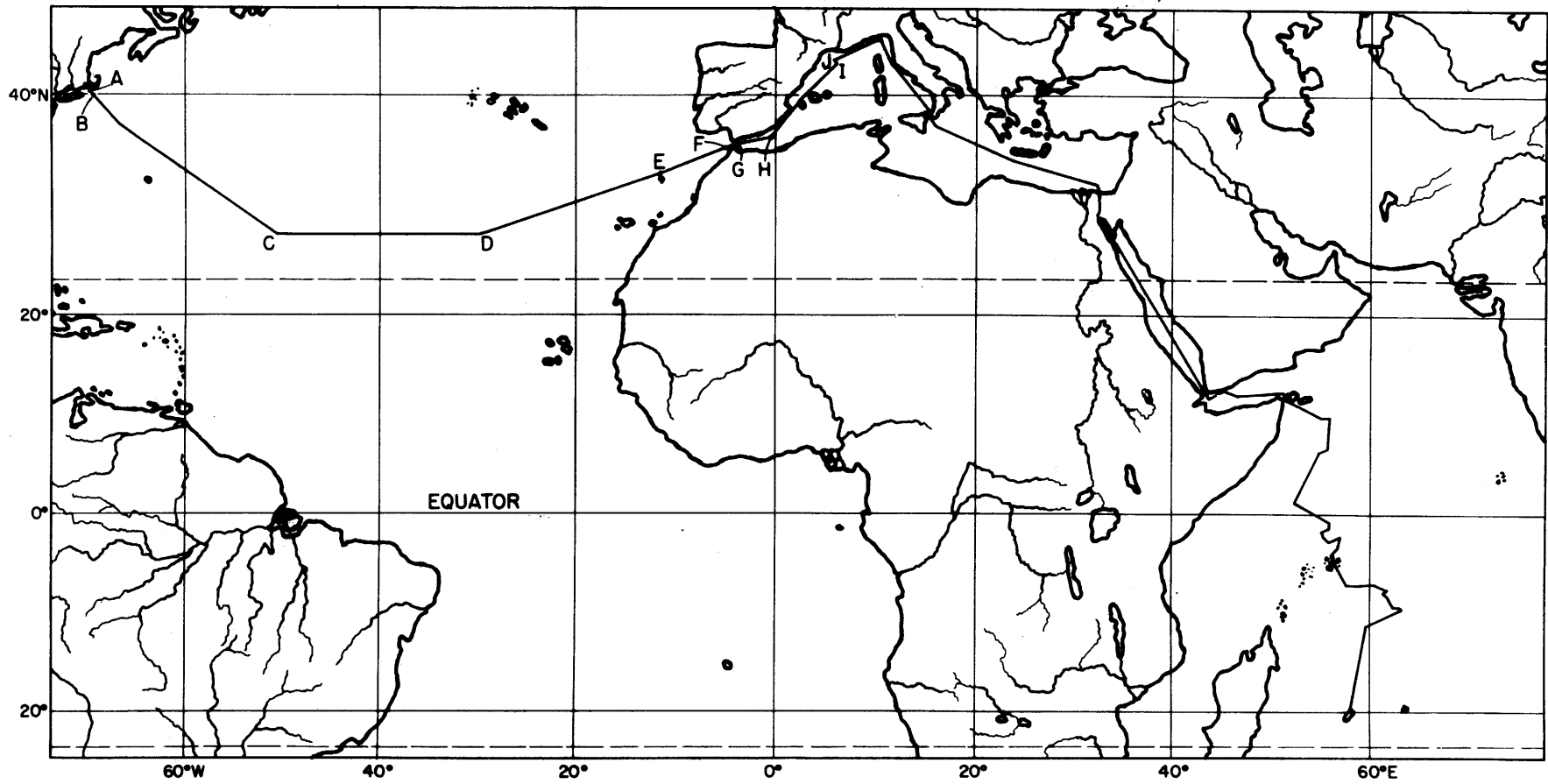


Fig. 3-3. The ship's track: Woods Hole to Port Lewis, Mauritius.



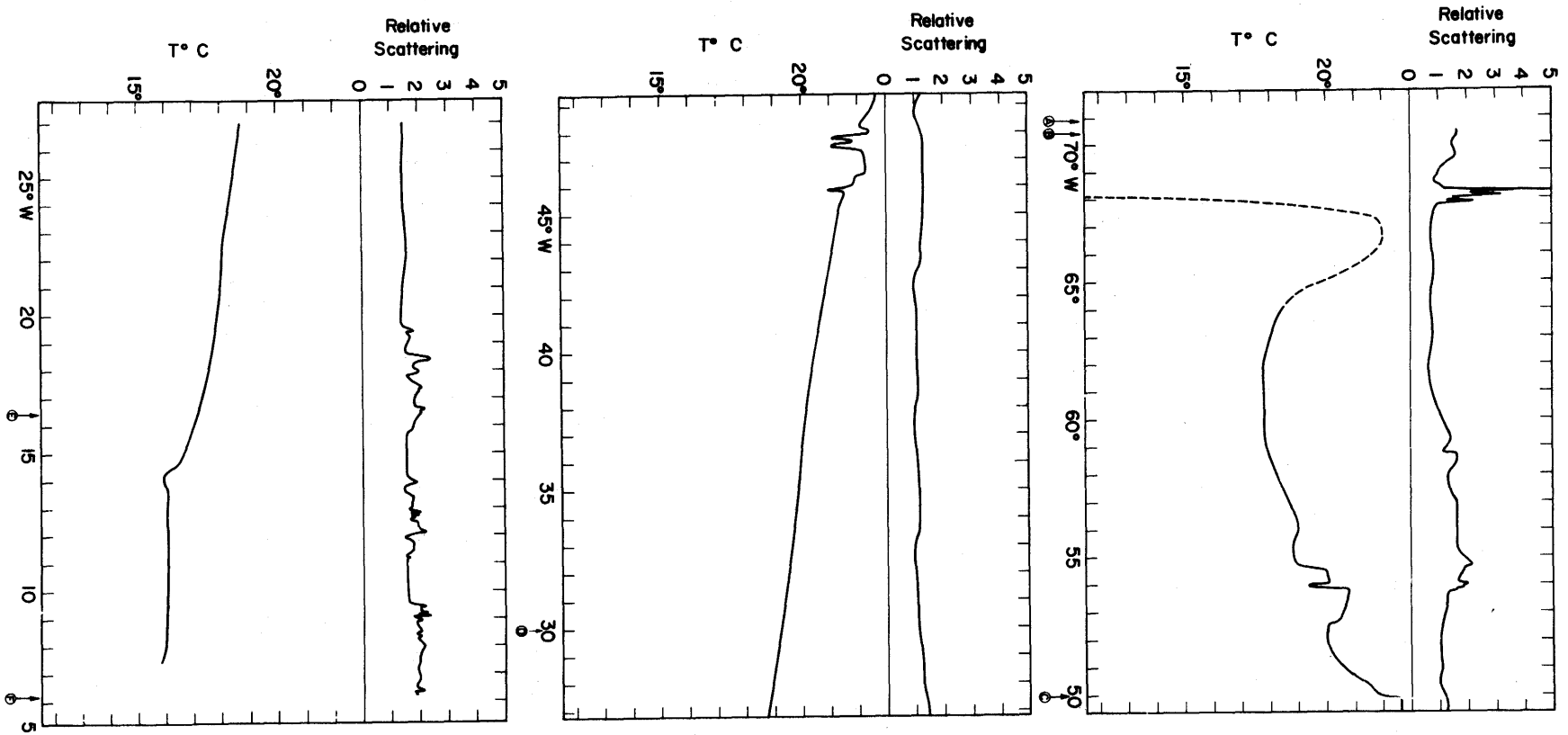


Fig. 3-4. The forward scattering and surface temperature curves for the North Atlantic.

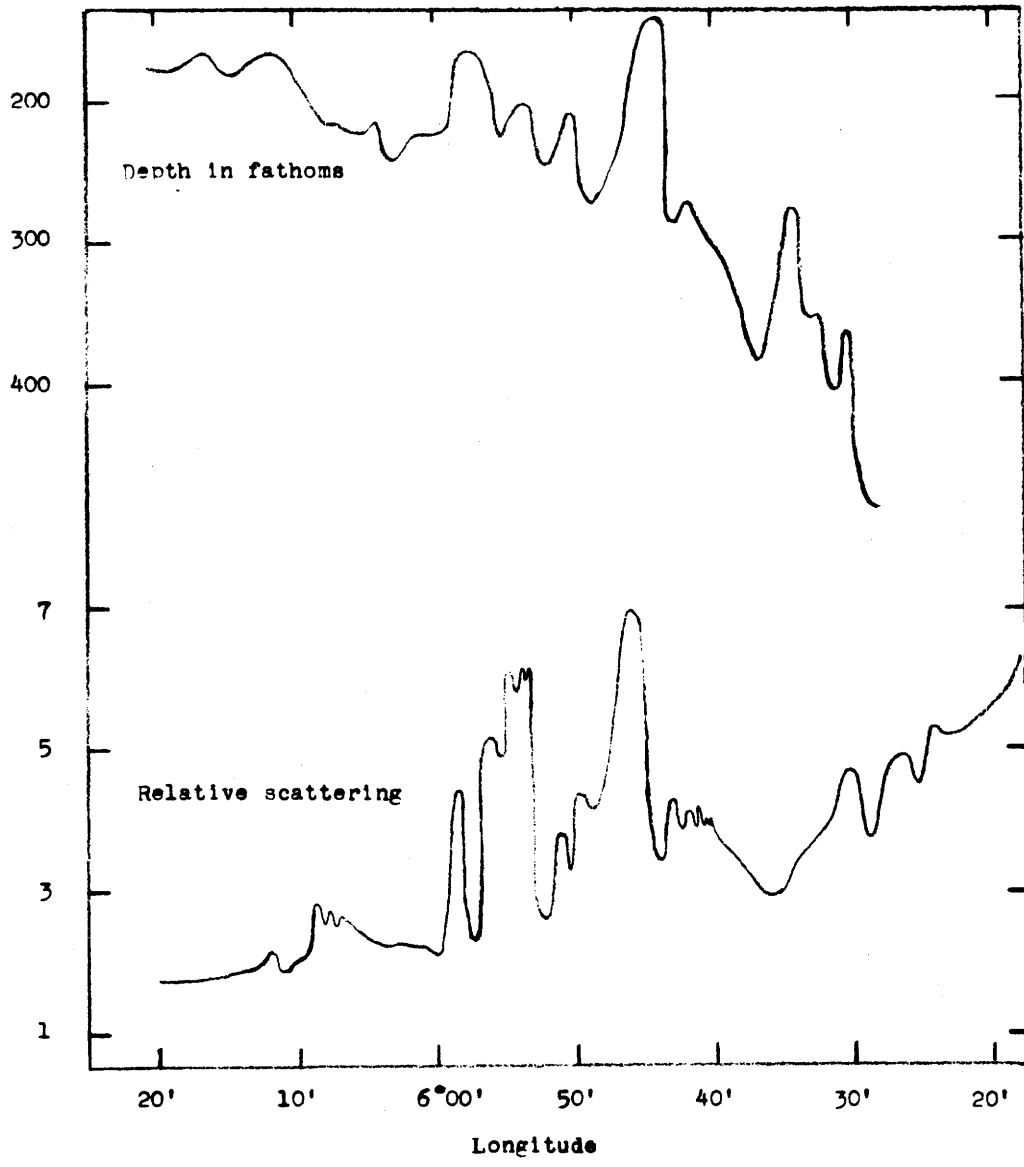


Fig. 3-5. The forward scattering and the bottom contour in the Strait of Gibraltar.

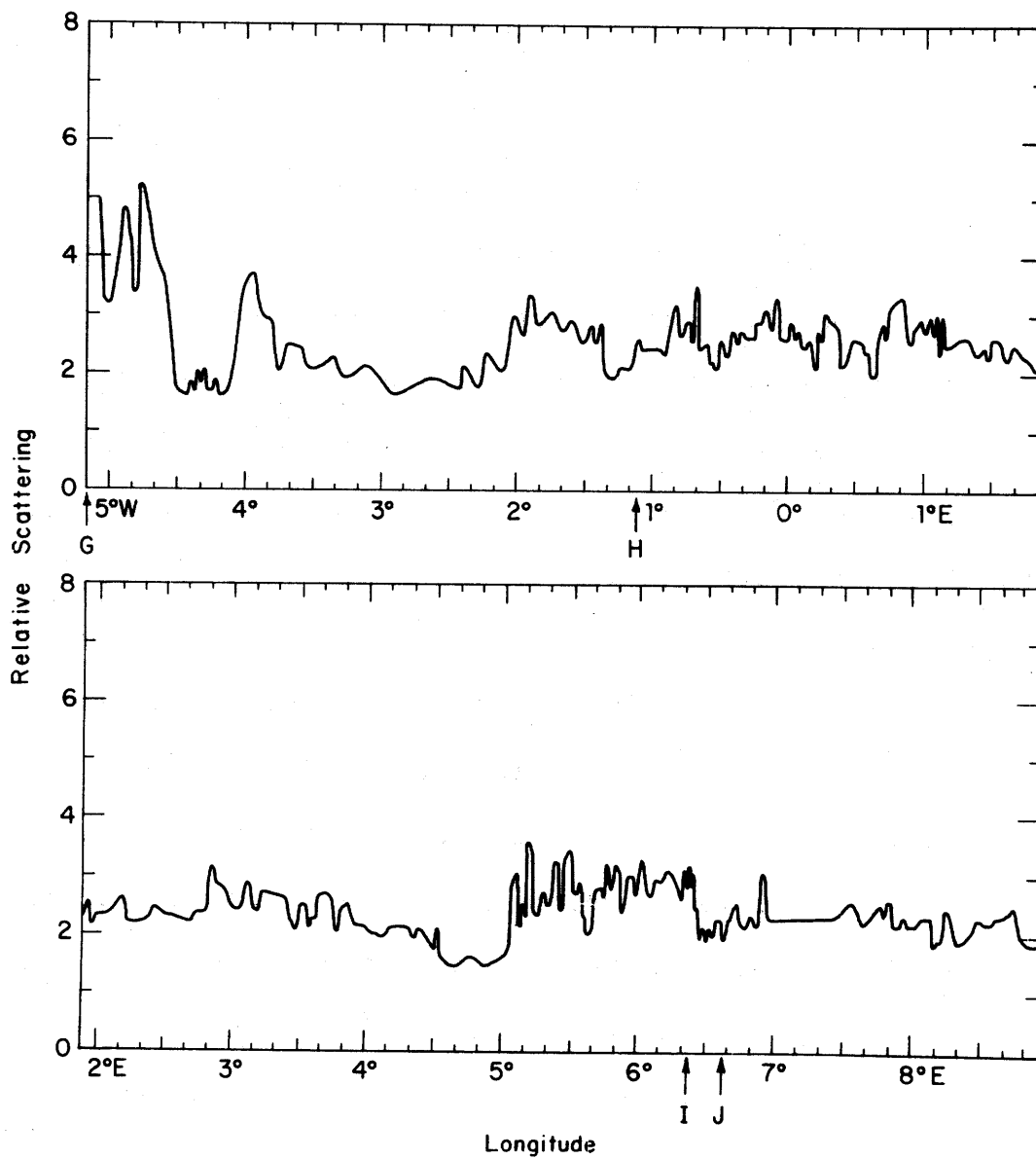


Fig. 3-6. The forward scattering in the western Mediterranean

again great variability in the proximity of land. The lowest scattering in the Mediterranean was observed when the ship was farthest from land, off the Gulf of Lyon, the only other place where relatively low scattering was observed may have represented the influence of Atlantic surface water, since it was downstream from the Strait of Gibraltar.

Figure 3-7 is a photograph of two sections of the record and a sample of the standard track. The upper two traces are from the central North Atlantic portion of the track, the top being the standard, and the lowest trace is from the Mediterranean. These are typical of their respective areas, and they show the influence of inshore processes on the forward scattered light.

From La Spezia the scattering continued to run between two to three times that in mid-Atlantic. In the Straits of Messina two peaks nearly six times the mid-Atlantic values were observed. After Messina the record began to settle down to a steadier value which was between 2.0 and 2.2 times the mid-Atlantic base up to the coast near Port Said with one excursion to 2.8 south of Crete. This behavior reinforces the idea that great variability is caused only by inshore processes.

In the central Gulf of Suez values were from 3.1 to

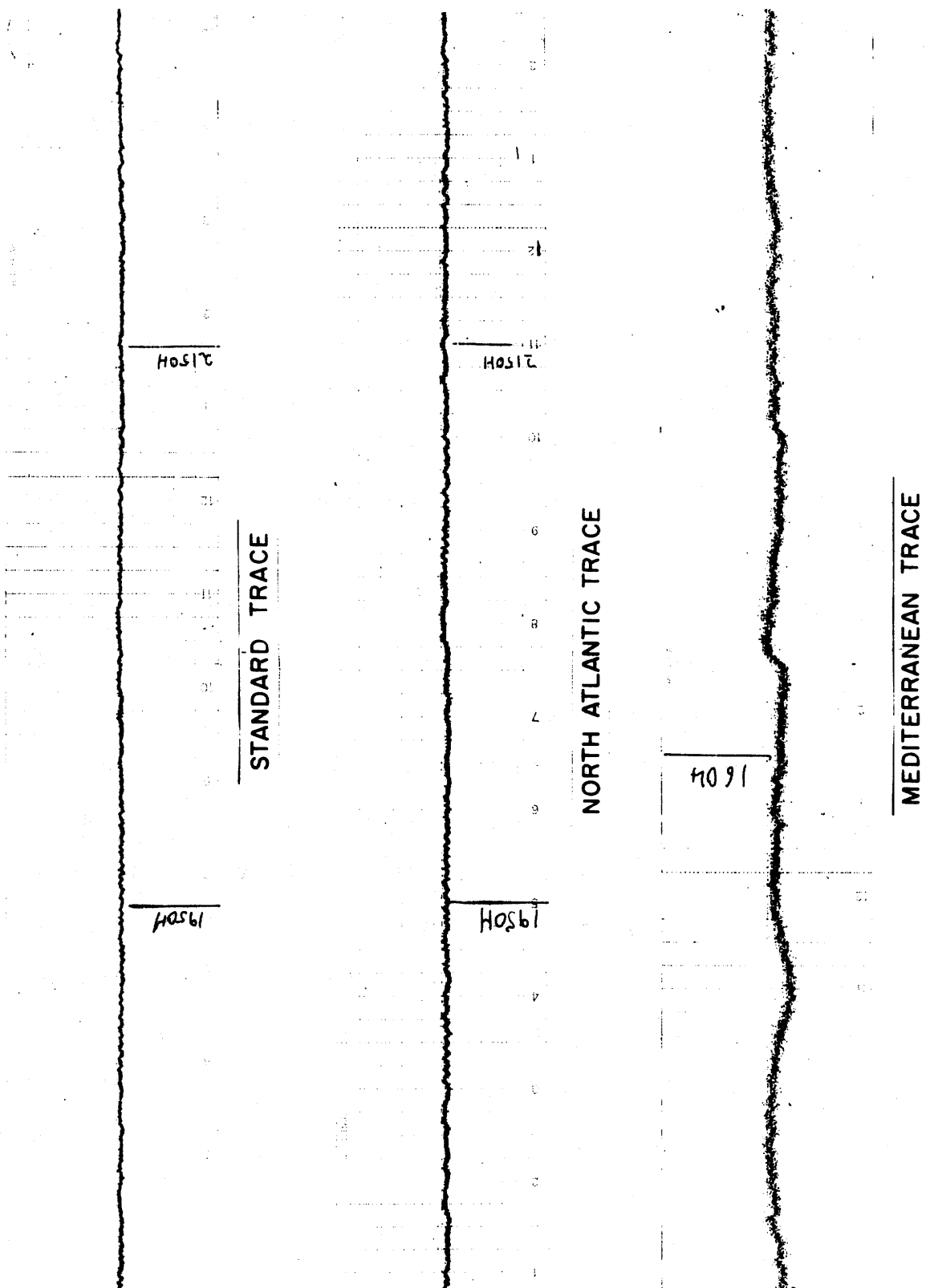


Fig. 3-7. Typical sections of the scattering record.

3.3, and in the Red Sea they dropped to approximately 1.5.

The lowest scattering recorded was in the Indian Ocean beginning near the equator and extending to  $20^{\circ}$  south, which was as far as measurements were made. Values here ranged from six to nine tenths of the mid-Atlantic ones, and no value higher than 1.7 was observed in the Indian Ocean. These results are confirmed by the low values for particulate carbon found in this area (Menzel, 1964). The influence of land in the case of the Seychelles and Mauritius was not observed until one actually entered the harbor.

These results are estimated to be internally consistent within approximately 5%. The limitation is based on the width of the trace which does not allow more accurate readings. There are two cases in which there is more uncertainty than this. The scratch on the cuvette face necessitated such a large correction that values taken west of longitude  $47^{\circ}$  west may be as much as 50% in error. The other case involves the values in the Red Sea and Indian Ocean, where the lack of frequent zero checks makes it possible that there may be as much as a 10% difference in base line between these and the Atlantic values to which they are normalized.

### 3.5 Summary and Conclusions

Close to land the scattering intensity fluctuated ir-

regularly through as much as a factor of two; whereas such variations in the open sea were rare. The widest variation observed in the open sea occurred in the waters of the western boundary of the Gulf Stream.

Sharp short term variations in the scattering picture that were not associated with inshore processes accompanied sharp temperature changes. Lines of weed were observed to coincide with the two thermal jumps that were crossed. In both cases the scattering indicated an increase in particulate matter above the mean value for the surroundings, adding weight to the evidence that a surface convergence of some extent may have been present in this area.

The scattering in the Seychelles-Mauritius area during April is shown to be nearly equivalent to that in the North Atlantic between the Gulf Stream and Bermuda during February and significantly less than the average value in the southern part of the Sargasso region at the end of February.

Comparison with measurements of the volume scattering function, reported in Chapter Four, shows that the magnitude of the forward scattering is more variable than the magnitude of the scattering at angles greater than  $30^\circ$ . This means that forward scattering is a more sensitive indicator of particulate content.

## CHAPTER FOUR

## VOLUME SCATTERING FUNCTION MEASUREMENTS

## 4.1 Introduction

In this chapter we turn from forward scattering to observations of the shape and magnitude of the volume scattering function from which it is possible to make deductions about the trend of particle sizes and numbers. Previous investigators have made an effort to compare the theoretical curves for certain types of monodisperse systems with measured curves for the natural environment (Sasaki et al, 1960, Jerlov, 1961); however, it must be borne in mind that there is no reason that a measured curve for sea water should match the theoretical curve for any monodisperse spherical particle, since the sharp maxima and minima found in the scattering diagrams for such particles are washed out by a variety of sizes, shapes, and indexes of refraction (Deirmendjian, 1964). Theoretical curves for such polydisperse systems are like the relatively smooth function obtained for sea water and the chance for precise quantitative evaluation of sizes or numbers is reduced. One can, however, think of the magnitude of  $\sigma(\theta)$  in terms of the total scattering surface and of the shape of  $\sigma(\theta)$  as being related to the size of the predominant scatterers.

## 4.2 Apparatus and Experimental Procedures

A Brice-Phoenix Light scattering Photometer was used



in this work. With this device it is possible to determine the volume scattering function between  $30^\circ$  and  $135^\circ$ , these limits being imposed by the geometry of the system. The instrument was modified to make its use at sea contingent only on the state of mind of the operator.

This instrument is illustrated in Figure 4.2-1 which is taken from the operation manual for the device (P. P. I. Co., 1963). For use at sea it was left in its packing crate which was cut away to provide the necessary access and mounted on rubber feet to absorb vibrations. The modifications were all in the form of retainers to prevent shifting, due to the ship's motion, of the neutral density filters, the angle setting, or the scattering cell.

The light source was an 85 watt mercury arc lamp that used a frequency-sensitive, voltage-regulating, ballast transformer to provide constant current. This was not an ideal implement for operation with the type of power supplies found on research vessels, since their voltage is well controlled but their frequency drifts irregularly through one cycle. When heavy loads are added, a shift of as much as three cycles may occur, and this is enough to extinguish arc.

The scattering cell was pyrex glass, cylindrical in shape with flat entrance and exit windows normal to the

The following is the nomenclature for Figure 4.2-1.

A -Rotatable arm attached to disc  
AN-Analyzer  
C -Semi-octagonal cell  
C1-Shutter collimating tube  
C2-Primary beam collimating tube  
D -Graduated disc  
D1-Lamp diaphragm  
D2-Removable collimating tube diaphragm  
D3-Cell table diaphragm  
D4-Nosepiece diaphragm  
D5-Cathode diaphragm  
D6-Collimating tube diaphragm  
EC-Electrical compartment  
F1-Monochromatic filter  
F2-Neutral filter  
F3-Location for filters used in correcting for fluorescence  
L -Mercury lamp  
L1-Achromatic lens  
L2-Plano-cylindrical lens  
PH-Covered peep hole  
PT-Photomultiplier tube  
PO-Demountable polarizer  
S -Photographic shutter  
SC-Light-tight scattering compartment  
T -Light trap tube  
W -Working standard

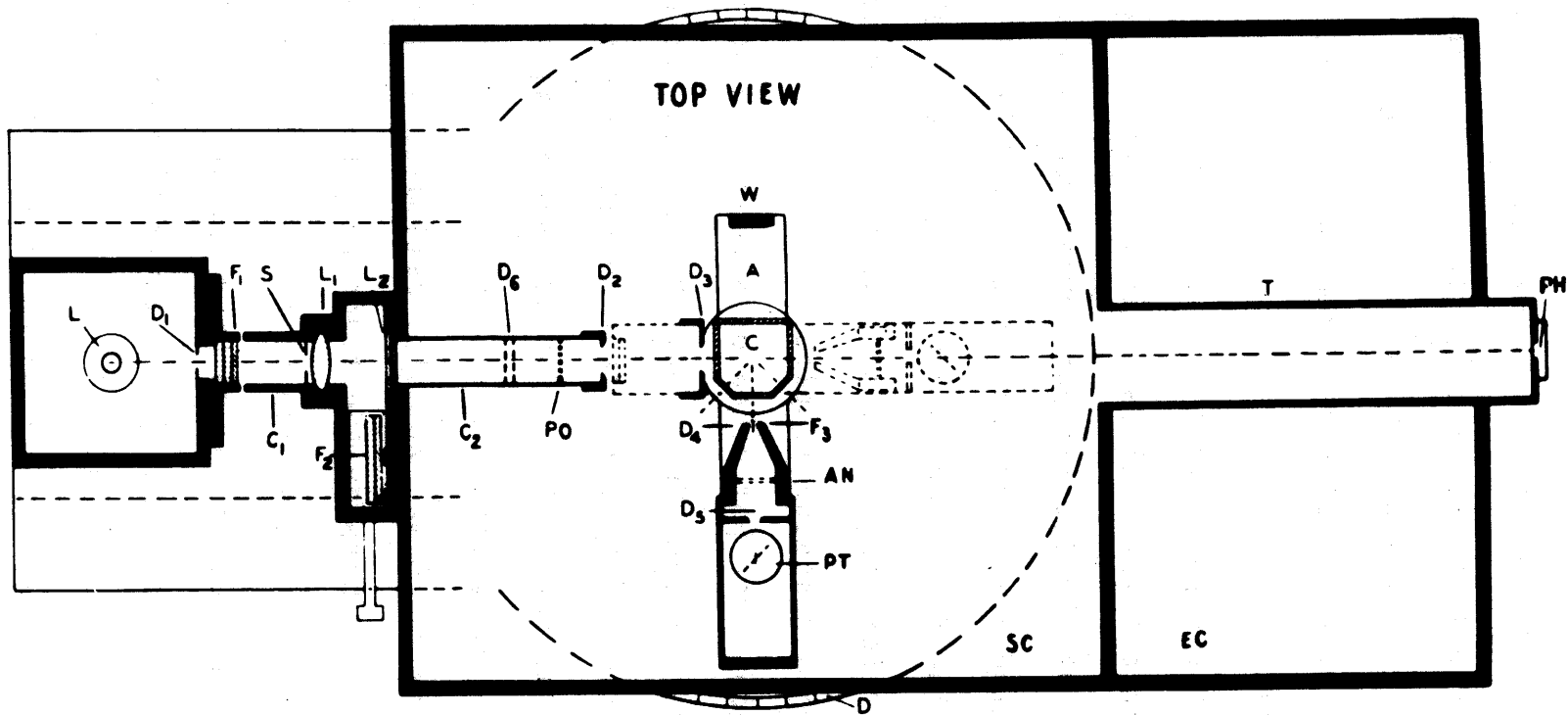


Figure 4.2-1. The Brice-Phoenix Light Scattering Photometer.

primary beam. During operation the cell was situated on a platform in the light-tight compartment. Orientation of the flat surfaces was accomplished by returning the portion of the incident beam reflected from the first glass surface on itself.

At sea the high voltage was kept across the photomultiplier detector at all times to insure maximum stability. When the top of the light-tight compartment was opened a switch actuated a shutter that intercepted light that would otherwise flood the photomultiplier tube, obviating the necessity for changing the voltage on the photomultiplier tube when changing samples.

The readout was performed on a Leeds and Northrup strip chart recorder of the "Speedomax G" vintage. At each angle a recording time of approximately 30 seconds was required to obtain an average value. Particles passing through the scattering volume caused excursions up to 10% on either side of a mean which was visually estimated so that equal areas were formed between the trace and the mean value line on top and bottom. This mean is only valid if the time spent in the scattering volume by a particle of given properties is proportional to the concentration of such particles. To achieve this end and to minimize the recording time necessary to obtain a mean value line the samples were

stirred continuously.

This scatterometer was first used at sea on the R/V Crawford between Woods Hole and St. Georges, Bermuda. Measurements of the scattering function were made at least twice each watch, concurrent bathytheromgraph lowerings were made, and surface salinity samples were taken. In addition, four hydrographic casts were made using teflon coated Nansen bottles.

The surface samples for scattering and salinity were drawn through an "uncontaminated" sea water sampling system. The intake and pump were nearly amidships one meter below the water line, and the samples were conveyed to the laboratory through polyvinylchloride piping and fittings.

The salinity samples were bottled and analyzed ashore while the scattering samples were examined immediately, except during the hydrographic stations, when the time required to process each sample caused delays of as much as two to three hours. The effect of these delays is discussed in the section covering precision and accuracy.

The scattering samples were drawn into a cell that was first rinsed with running sea water; a teflon covered stirring bar was inserted; the cell was placed on the cell table in the light-tight compartment of the scatterometer, and stirring was begun. The photomultiplier signal was

recorded for the transmitted beam and for angles between  $30^\circ$  and  $135^\circ$  at  $5^\circ$  intervals beginning at  $30^\circ$ , then the transmitted beam was observed again as a check on the instrumental drift.

Samples obtained from depth were similarly processed except that, to reduce differentiation in the sample, the water was drawn into polyethylene flasks as soon as the Nansen bottles came aboard. To counteract the effect of any settling that might have occurred during the storage time the flasks were agitated before the sample was decanted.

This apparatus was employed later on the R/V Chain during the study of a thermal front in the Sargasso Sea, south of Bermuda. On this cruise there were twenty hydrographic casts, hourly bathythermograph lowerings were made, and surface salinity samples were collected concurrently.

The surface sampling inlet on the R/V Chain was three meters below the waterline; however, the pump, because of the ship's plumbing, was two meters above the waterline. In all other respects the experimental apparatus and procedures were identical.

#### 4.3 Data Processing Procedures

The observed data, given in Appendix A, consist of

the photomultiplier signal at each angle and the neutral density filters that were in the beam. These data were processed by computer using the FORTRAN program that is given in Appendix B. The operations performed are outlined in the following paragraphs.

The effect of the neutral density filters was removed according to the formula:

$$S_1(\theta) = S(\theta) \cdot T,$$

where  $S(\theta)$  is the observed signal and  $T$  the product of the optical transparency of the filters.  $S_1(\theta)$ , the signal reduced to the basis that all the filters were in the beam, was then normalized to the values for  $S_1(0^\circ)$  by

$$S_2(\theta) = S_1(\theta) \div [S_1'(0^\circ) \cdot \frac{S_1'(0^\circ) - S_1''(0^\circ)}{22} \cdot \{(\theta/5) - 7\}]$$

where  $S_2(\theta)$  is the normalized result, and  $S_1'(0^\circ)$  and  $S_1''(0^\circ)$  are the reduced, transmitted beam signals before and after the angular measurements. This manipulation spreads linearly the effect of any instrumental drift.

Reflections at the air-glass interface of the cell make corrections necessary. At the flat exit window near-

ly 4% of the beam is reflected, and scattered light from this redirected beam appears added to that scattered from the primary beam at the supplementary angle. A second reflection that has exactly the same result occurs at the air-glass interface opposite the point of observation. The theoretical basis for and empirical proof of these effects and the procedure for correcting the errors they introduce are given by Tomimatsu and Palmer (1963). The standard method of correcting for these effects is by the following empirical equation:

$$S_3(\theta) = S_2(\theta) - 0.78 S_2(180-\theta),$$

where  $S_3(\theta)$  is the corrected value. This procedure is begun with the largest value of  $\theta$  and carried through its supplementary value; therefore,  $S_2(\theta)$  at  $30^\circ$ ,  $35^\circ$ , and  $40^\circ$  are left uncorrected. To place them on the same basis as the other values,  $S_3(135^\circ)$  is assumed to increase only due to increased scattering volume and they are adjusted according to:

$$S_3(\theta) = S_2(\theta) - 0.78 S_3(135^\circ) \cdot \sin 45^\circ / \sin \theta.$$

The assumption that  $S_3(\theta)$  is constant at angles greater than  $135^\circ$  is not valid but it does give an order of magnitude estimate of the correction, which is small compared



with the magnitude of  $S_3(\theta)$  in the low angle region.

The scattering volume is proportional to the sine of the angle of observation and to obtain the relative volume scattering function the following equation is used:

$$\sigma_{rel}(\theta) = S_3(\theta) \cdot \sin(\theta).$$

The volume scattering function,  $\sigma(\theta)$ , is given by the equation,

$$\sigma(\theta) = \left[ \frac{TD \sin^2(R_w/R_c)(r/r')}{1.049\pi h(1-R)^2(1-4R^2)} \right] \sigma_{rel}(\theta),$$

the evolution of which may be traced by reference to Brice et al (1950), Sheffer and Hyde (1952), Oth et al (1953) and Tomimatsu and Palmer (1959, 1960, 1963). The calibration factor, enclosed in brackets, is dependent on the geometry and optical constants of the system. The product TD is a constant for the opal glass reference standard used in the determination of other calibration constants, it has the dimension of length, since it is derived from the transmittance of opal glass.  $R_w/R_c$  is a dimensionless factor called the residual refraction correction, which is dependent on the size of the cell and corrects for the inade-

quately compensated apparent shortening of the distance from the receiver to the center of the scattering volume (Brice et al, 1950).  $n$  is the index of refraction of the solvent, and  $h$  is the width of the incident beam.  $1.049$ ,  $(1-R)^2$ , and  $(1-4R^2)$  result from corrections made for reflections at air-glass interfaces.  $R$  is the fraction of light reflected at such an interface. The working standard constant,  $a$ , relates the reference standard to the working standard which is inserted in the direct beam whenever it is observed. This constant is best determined by the experimenter since its value may change a few percent with minor adjustments. The factor,  $r/r'$ , relates the normal beam geometry to a narrow configuration that is necessary when cylindrical cells are used; the investigator determines this ratio for the cell and stops being used.

The measured values were extrapolated so that an estimate of the total scattering coefficient could be obtained. In the forward direction this extrapolation was made by fitting the points between  $30^\circ$  and  $50^\circ$ , utilizing the method of least squares, to an equation of the form:

$$\log \sigma(\theta) = A + B\theta + C\theta^2 \quad .$$

The values in the back direction were similarly determined; however, in this case the equation employed was

$$\log \sigma(\theta) = D + E\theta \quad ,$$

and the points to which the equation was fitted were from  $115^\circ$  through  $135^\circ$ .

The total scattering coefficient was obtained by integration, using Simpson's rule, of  $\sigma(\theta)$  according to the equation:

$$s = 2\pi \int_0^\pi \sigma(\theta) \sin\theta d\theta.$$

The portion of this coefficient under the measured section of the curve,  $s(30-130)$  was computed by changing the limits on the integral to  $30^\circ$  and  $130^\circ$ . To determine whether there is any basis for statements to the effect that the total scattering function may be determined by measurement of  $\sigma(\theta)$  at one angle, calculations of the ratio of these integrated quantities to  $\sigma(\theta)$  were made for each angle.

Finally, to describe the shape of the volume scattering function, the first and second derivatives and the ln-ln slope were computed between each of the points from the following equations:

$$\text{first derivative} = \sigma'(\theta) = [\sigma(\theta) - \sigma(\theta + 5^\circ)] / [5^\circ \pi / 180^\circ],$$

$$\text{second derivative} = \sigma''(\theta) = [\sigma'(\theta) - \sigma'(\theta - 5^\circ)] / [5^\circ \pi / 180^\circ],$$

$$\text{ln-ln slope} = \frac{\ln\sigma(\theta) - \ln\sigma(\theta + 5^\circ)}{\ln[\theta\pi/180^\circ] - \ln[(\theta + 5^\circ)\pi/180^\circ]}.$$

#### 4.4 Accuracy and Precision

The accuracy of the volume scattering function is the basis for the determination of the accuracy of all results. The manufacturer of the instrument employed in these experiments indicates that the effect of uncertainty in the calibration factors supplied by them is approximately 4%; however, it is necessary for the investigator to determine two other factors. Although it was possible to determine each of these factors with great precision; this does not exclude the possibility of a systematic error and one can only estimate the accuracy of the net calibration factor.

In addition to this uncertainty one must examine the precision of the measured values for any given sample. Samples taken by pump and processed immediately must be given separate consideration from those taken by bottle in hydrographic stations that must wait perhaps three hours to be processed.

An attempt to obtain an estimate of the precision of measurements on samples processed immediately was made by drawing two simultaneously and processing each as quickly as possible. The deviations from the mean of the natural logarithm of  $\sigma(\theta)$  for each angle were determined and the standard error found to be  $\pm 0.034$ . Values for the precision of derived quantities based on this estimate are for

$\sigma(30^\circ)/\sigma(45^\circ)$ , 0.15, and for  $\ln s(30-130)$ , 0.1.

The other class of experiments is that in which there is an appreciable lapse of time between the collection and the processing of a sample; under these conditions the precision depends on the procedure and on the processes that were acting to alter the composition of the sample. To determine the effect of storage time twelve samples from various stations were run as soon as they were collected and repeated at intervals during the processing of the other samples from the same station. Figures 4.4-1 through 4.4-3 show the volume scattering function for three of these samples after various storage times had elapsed. These curves demonstrate the nonprogressive nature of the observed changes which lead one to believe that more than one process was involved.

To determine the standard error, each of the twelve samples was considered representative of a discrete population. The deviations from the mean for each sample were found and the standard error was determined according to the formula:

$$s_e^2(x) = \frac{\sum_{i=1}^{12} \{N_i / (N_i - 1)\} \sum_{j=1}^{N_i} \{x_j - \bar{x}_i\}^2}{\sum_{i=1}^{12} N_i - 1}$$

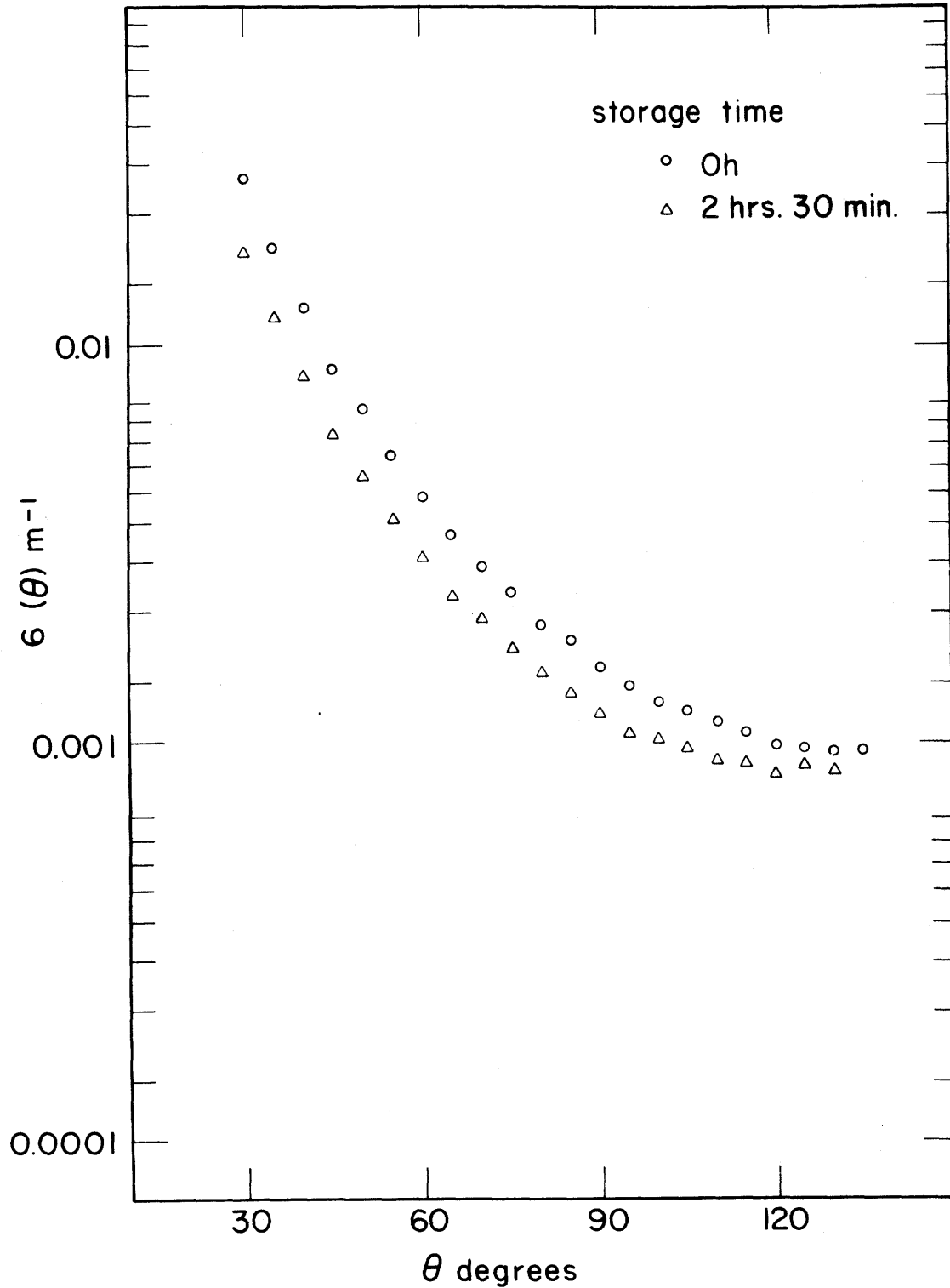


Fig. 4.4-1. The volume scattering function against  $\theta$  for various storage times: R/V Chain station #603, 1000 meters.

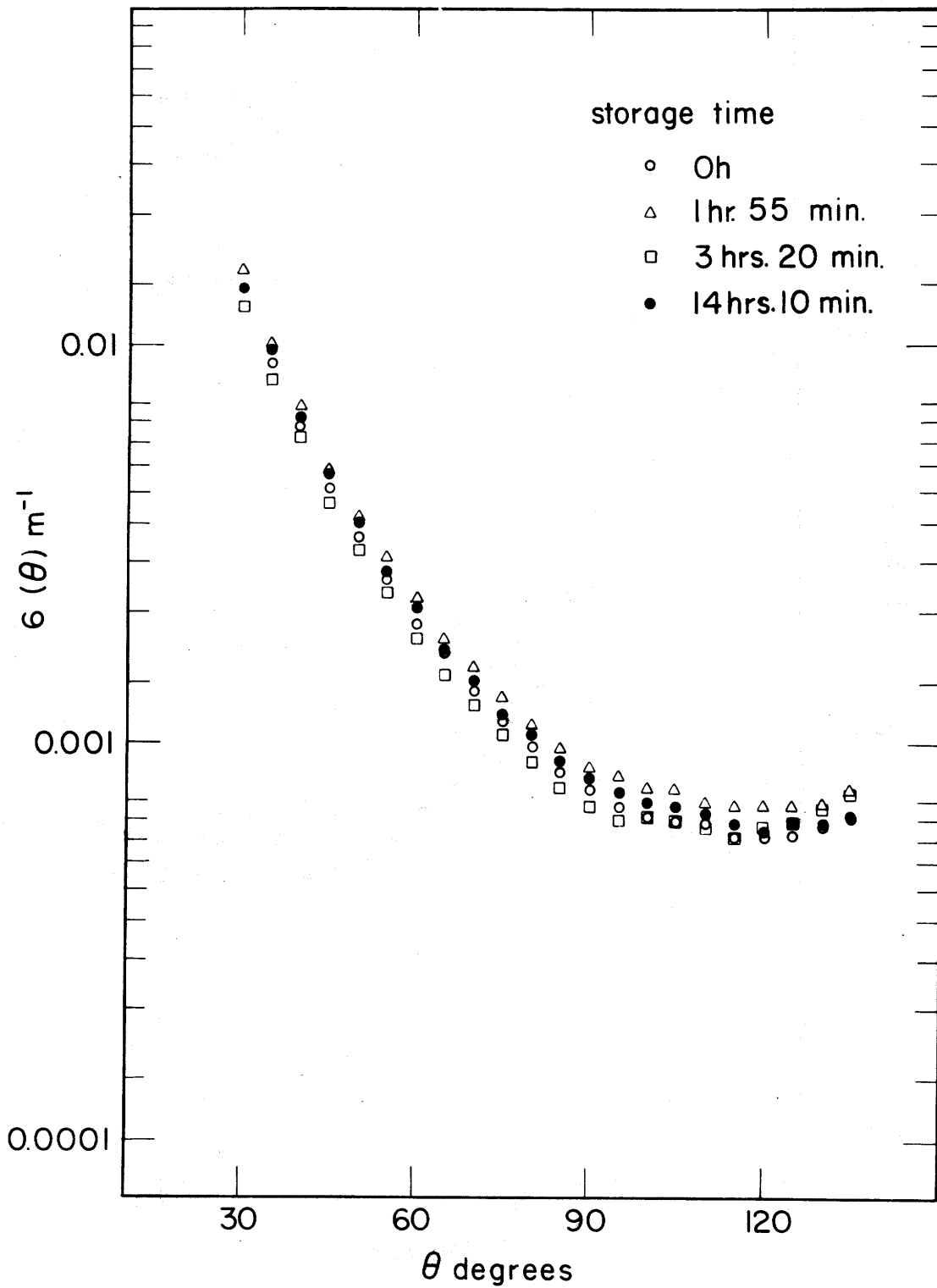


Fig. 4.4-2. The volume scattering function against  $\theta$  for various storage times: R/V Chain station #603, 100 meters.

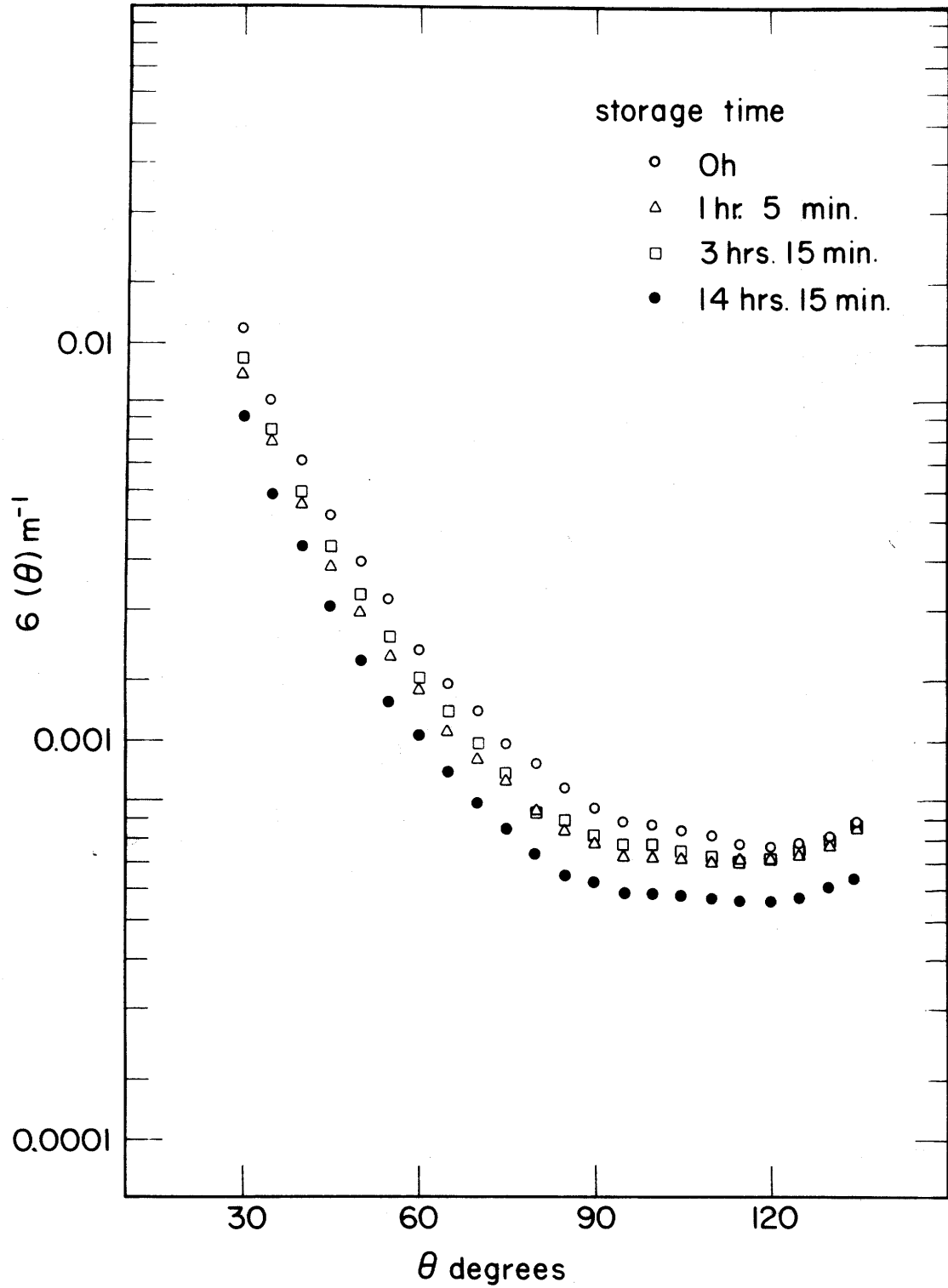


Fig. 4.4-3. The volume scattering function against  $\theta$  for various storage times: R/V Chain station #604, 400 meters.



where  $N_i$  is the number of runs made on any sample  $i$ , the quantity  $(x_j - \bar{x}_i)$  is the deviation of the result of any run from the mean for that sample. To test whether the deviations were normally distributed, they were ranked in ascending order, and assigned values of  $P = \frac{n-1/2}{N}$  in this order where  $N$  was the total number of runs and  $n$  the rank of a particular run.  $P$  was then plotted against the deviations on probability paper. When no appreciable trends away from straight line behavior were present the deviations were normally distributed giving quantitative meaning to the values for the standard error. In order to obtain a straight line on the probability plot for the volume scattering function it was necessary to use the deviations of the logarithm of  $\sigma(\theta)$ . This is because the errors in  $\sigma(\theta)$  are proportional to the magnitude of  $\sigma(\theta)$ . The probability plots are given in Figures 4.4-4 through 4.4-9.

Figure 4.4-4 is the plot of the deviations for the case of immediate processing. The others are for the samples that were stored before processing. All except the ratio,  $\sigma(30^\circ)/\sigma(45^\circ)$ , exhibit straight line behavior. The deviation from normality of these errors, may result from the combination of rather large errors in the individual measurements; therefore, the  $\ln-\ln$  slope of the extrapolated curve has been used to characterize the shape of the meas-

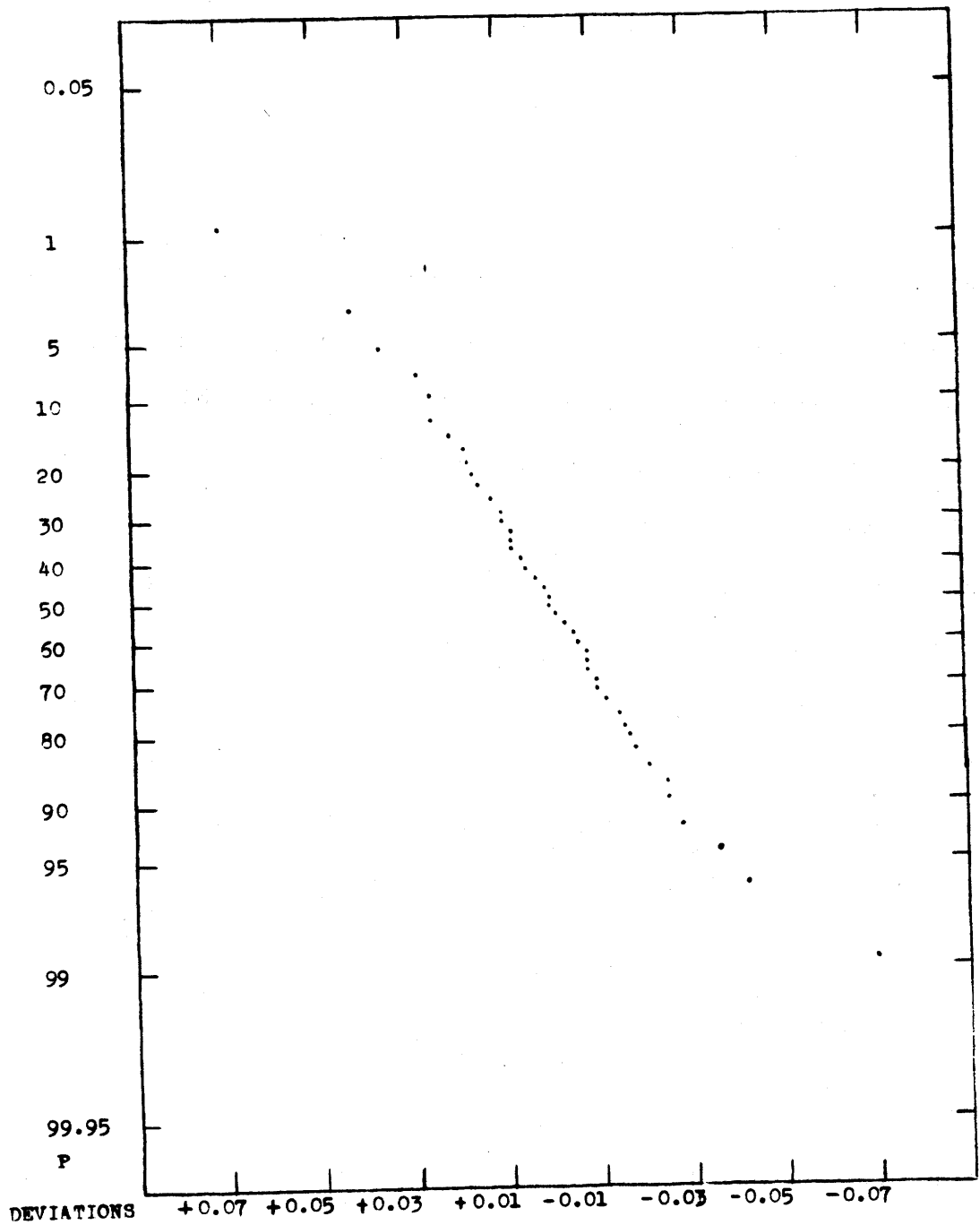


Fig. 4.4-4. The deviations of  $\ln\sigma(\theta)$  against probability.

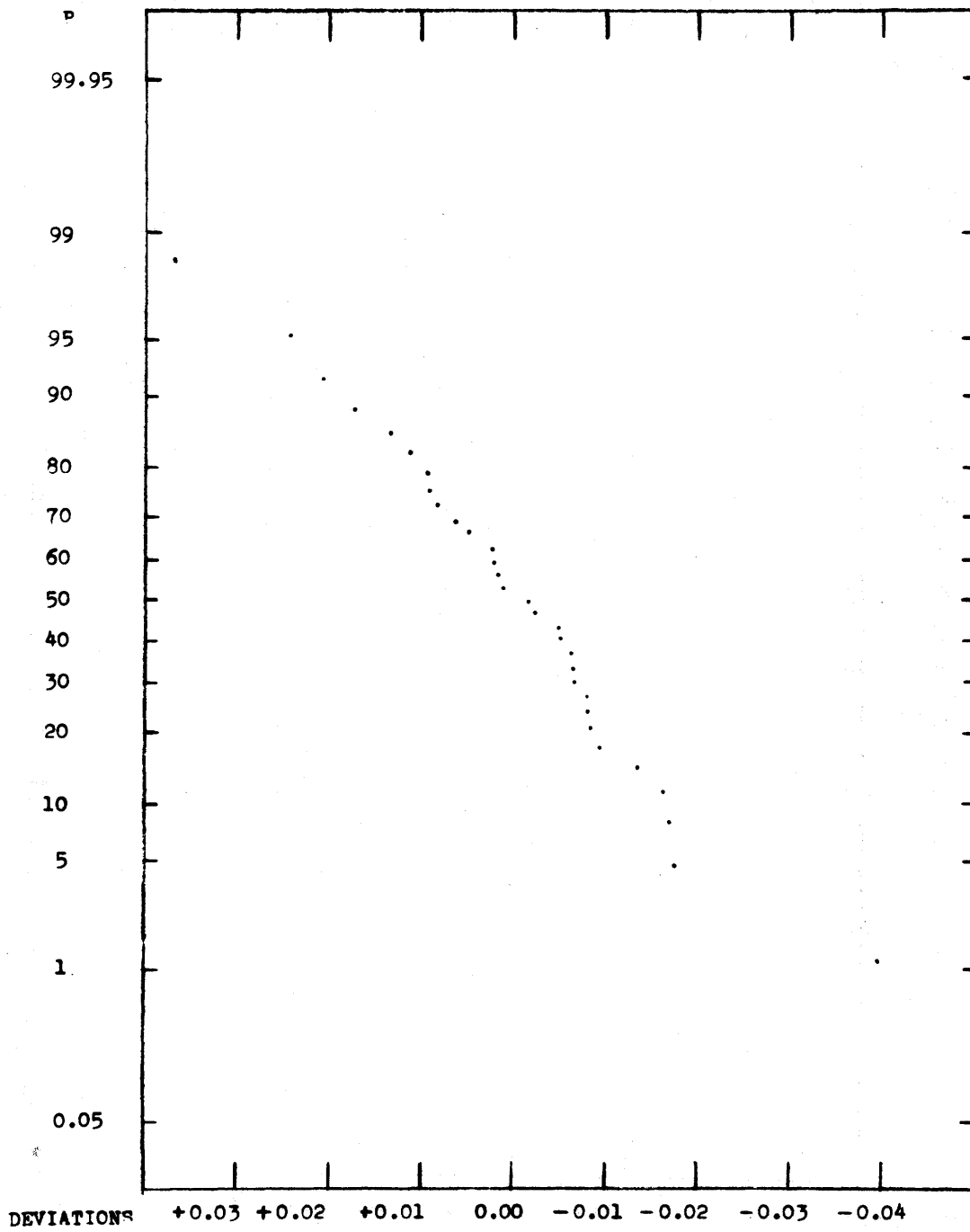


Fig. 4.4-5. The deviations of the ln-ln slope against probability.

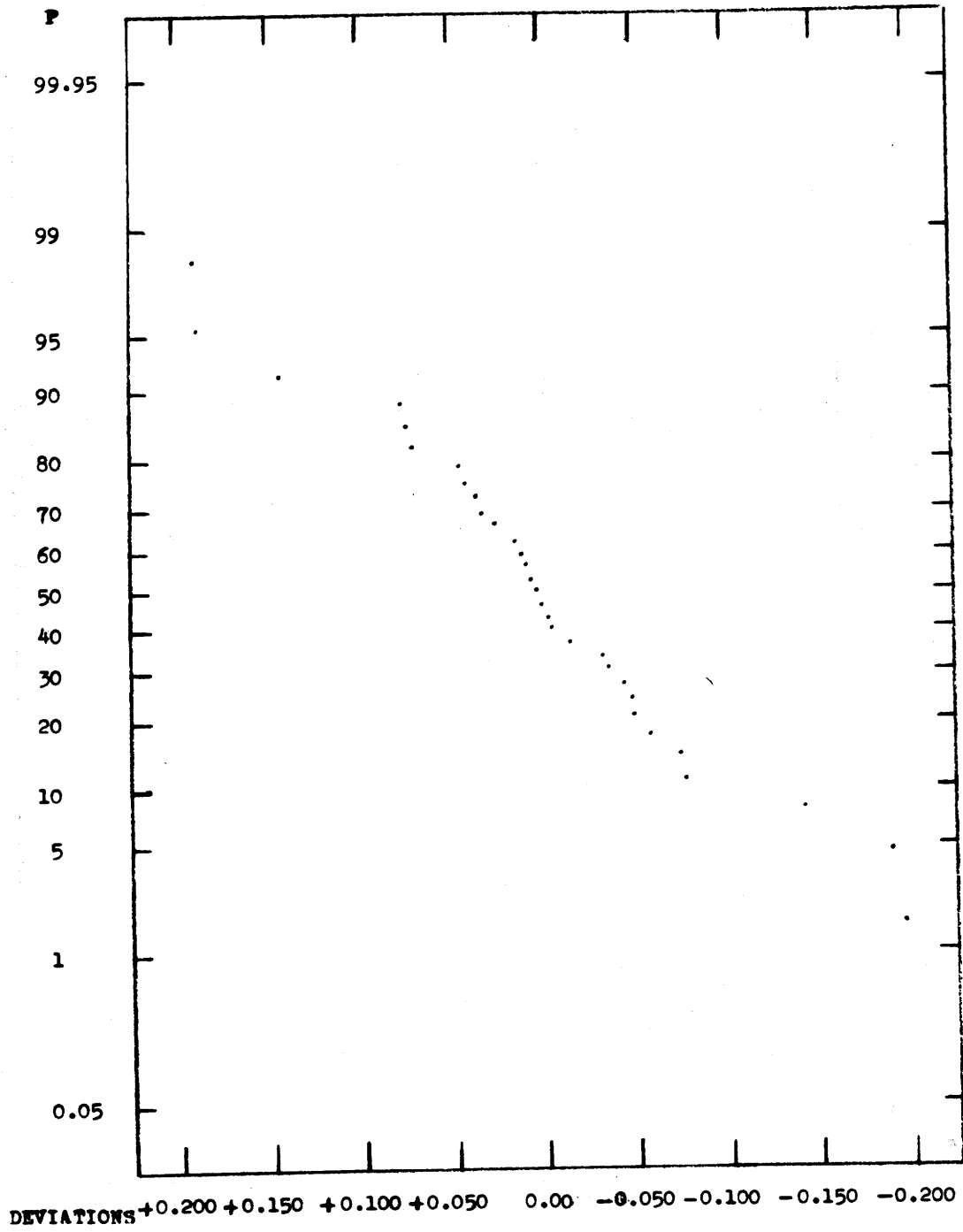


Fig. 4.4-6. The deviations of the  $\log[s(30-130)]$  against probability.

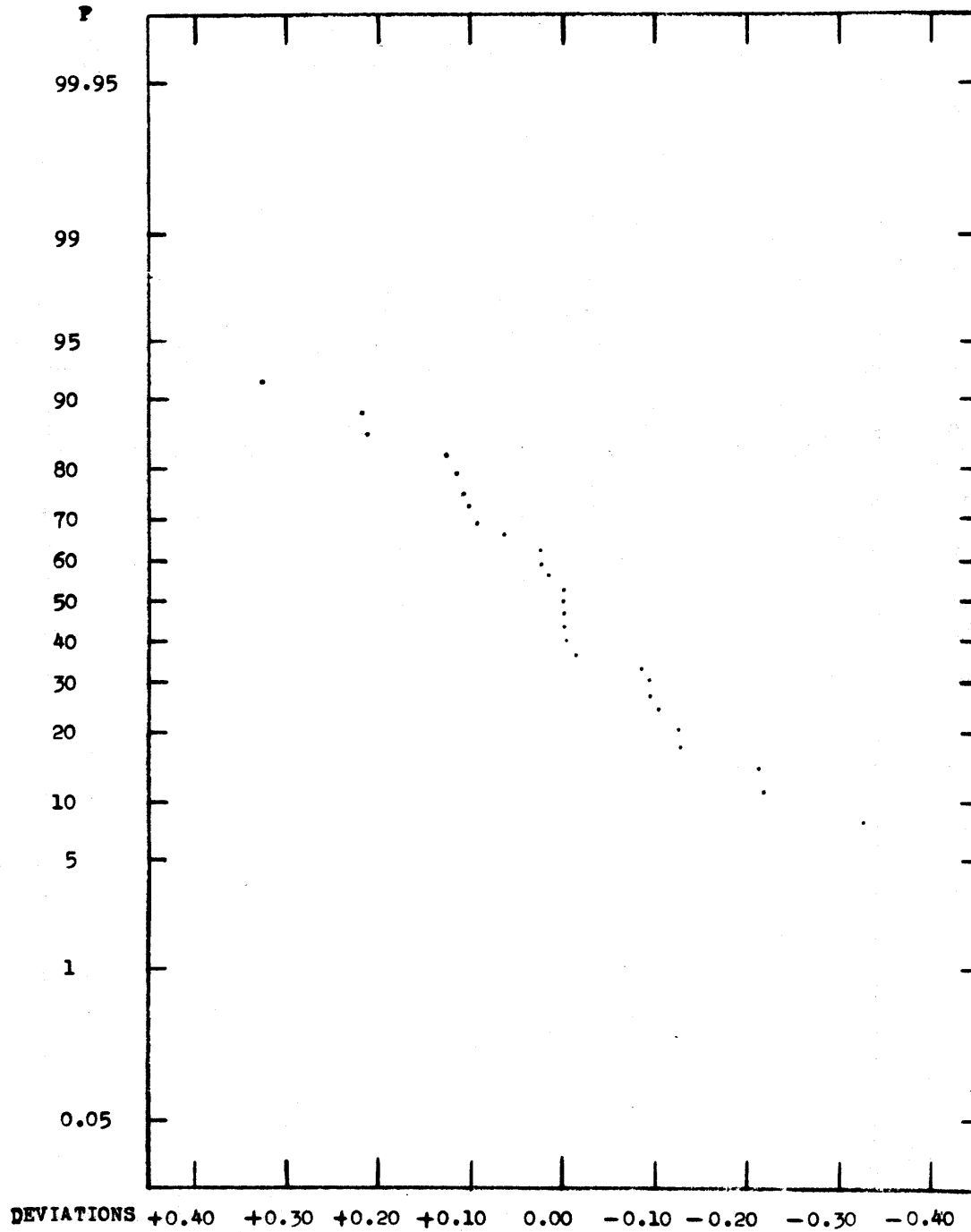


Fig. 4.4-7. The deviations of the  $\ln\sigma(30^\circ)$  against probability.

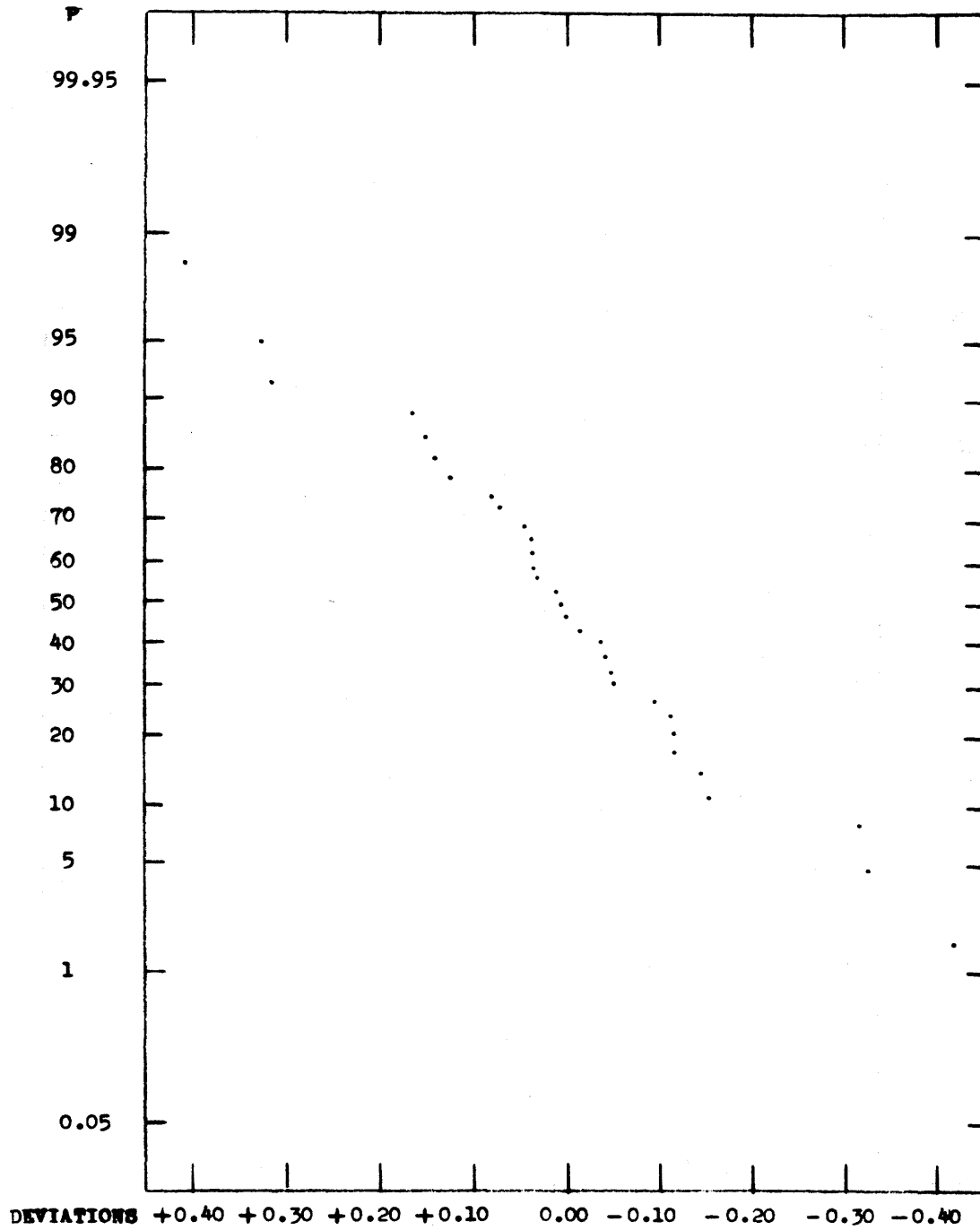


Fig. 4.4-8. The deviations of the  $\ln \sigma(90^\circ)$  against probability.

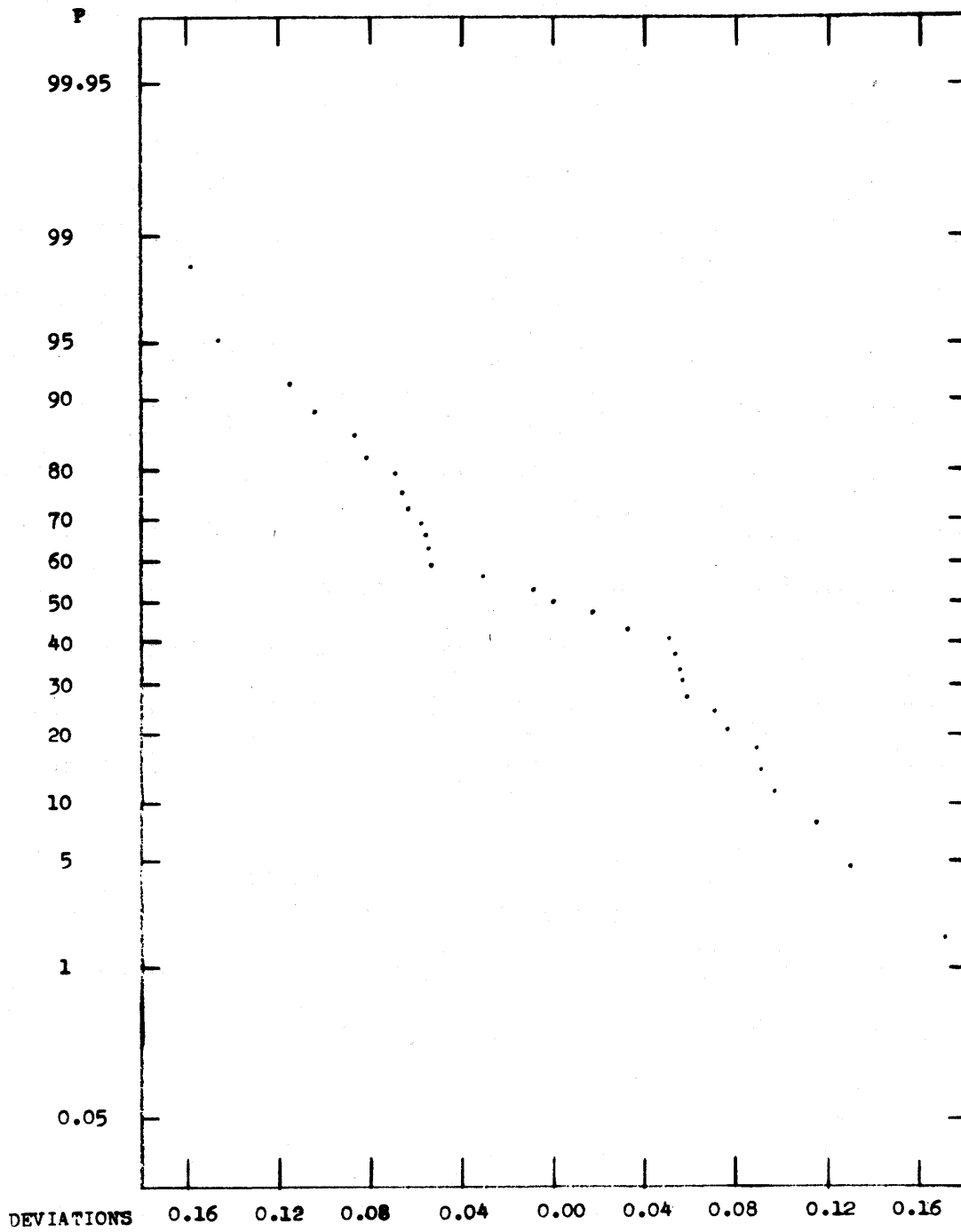


Fig. 4.4-9. The deviations of  $\sigma(30^\circ)/\sigma(45^\circ)$  against probability.

ured curve.

The standard errors calculated in the preceding fashion were: for the ln-ln slope of the extrapolated curve between  $0^\circ$  and  $5^\circ$ , 0.0182; for  $\ln s(30-130)$ , 0.272, for  $\ln \sigma(30^\circ)$ , 0.307; and for  $\ln \sigma(90^\circ)$ , 0.235.

Some of these standard errors are very large, yet one can discern no pattern of change as a function of time in the samples. This implies that the physical processes are not the same in each case, and that a whole field of study is open here which must be attacked before particulate distributions may be determined by other than "in situ" methods. Since it is impossible to assess the effect of withdrawing the sample from its environment without simultaneous "in situ" measurements, this is suggested as a subject for future study, and the possible changes that may have arisen due to the techniques employed here are blissfully ignored.

#### 4.5 Results and Conclusions

##### 4.51 "General Features of the Volume Scattering Function"

One method of characterizing the rise in the volume scattering function at low angles, which is an indicator of relative particle size, is the ln-ln slope. The larger negative slopes indicate a larger predominant particle size. An indicator of the same feature of the curve, the ratio  $\sigma(30^\circ)/\sigma(45^\circ)$ , is a measured quantity; it is preferred to



the ln-ln slope at  $0^\circ$ , but it has the disadvantage of being sensitive to fluctuations caused by small errors. The ln-ln slope at  $0^\circ$  is based on six points rather than only the two on which the ratio depends.

The portion of the scattering coefficient lying between  $30^\circ$  and  $130^\circ$ ,  $s(30-130)$  is a measure of the particulate surface. The total scattering coefficient was also calculated but the meaning of these numbers is in doubt due to their dependence on extrapolated points.

Figure 4.5-1 shows an example of the volume scattering function in coastal water. The main features of such inshore curves are, the semilogarithmic behavior at low angles, the absence of local maxima, and the high values obtained. The slopes were less negative in coastal water than offshore, indicating a smaller predominant particle size. Proceeding offshore, near the 100 fathom curve off Woods Hole, a sharp break was encountered in the absolute value of the volume scattering function. It became more curved in the low angle range, and a broad minimum appeared at the largest angles. Also shown in Figure 4.5-1 is an example of the volume scattering function in clear ocean water, where a series of maxima and minima occurred at angles greater than  $90^\circ$ . The appearance of these fluctuations indicated a tendency toward a monodisperse system of scatterers. The

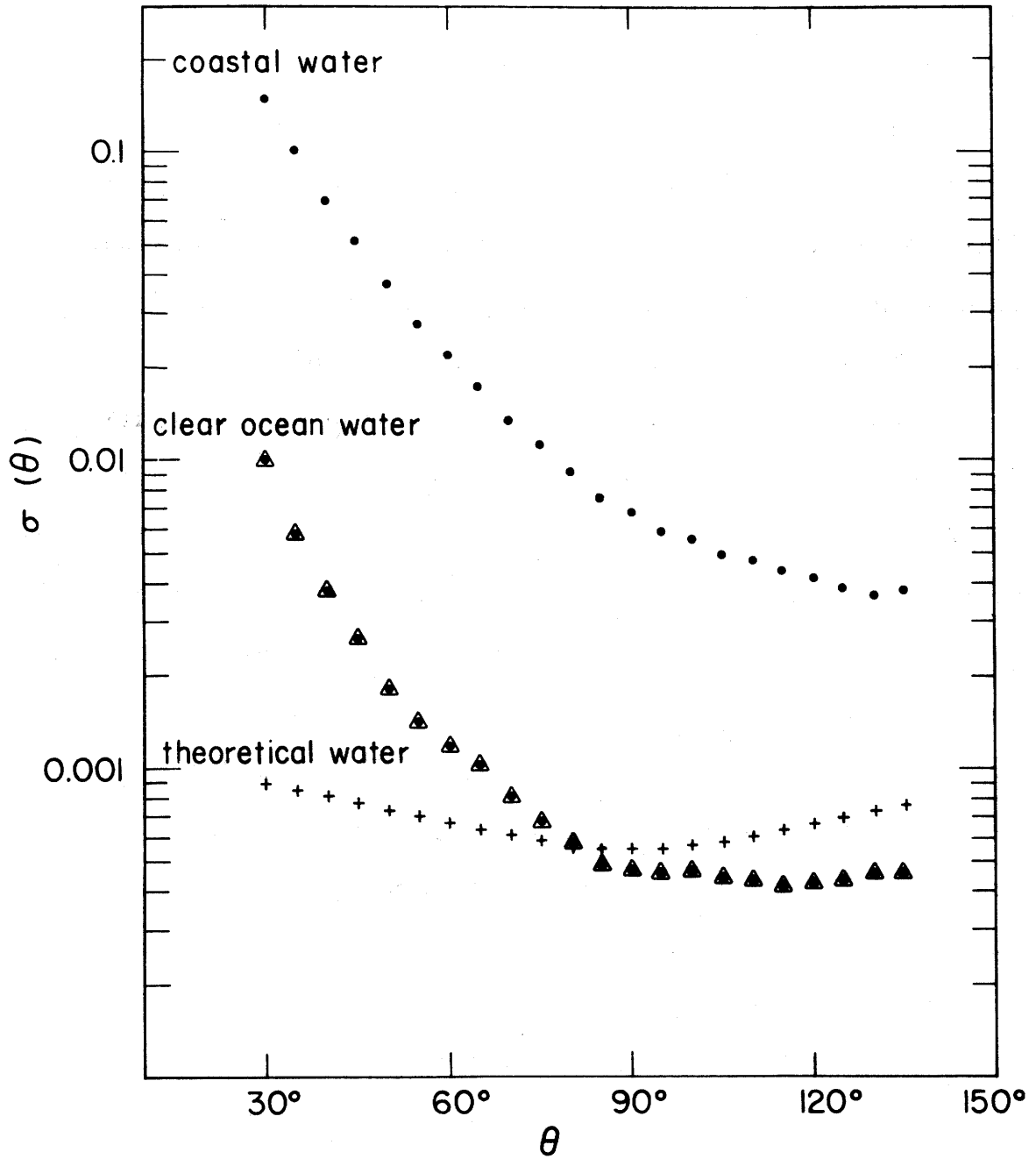


Fig. 4.5-1. A sample of the volume scattering function for coastal water, for clear ocean water, and the theoretical curve for pure water.

Sample numbers: CH42/1 and CH42/144.

significance of the difference between this curve and the theoretical curve is discussed later.

#### 4.52 "Surface Samples"

All of the surface samples from the cruises on the R/V Crawford were grouped into five categories which were defined as follows:

coastal water        -shore to 100 fm curve,  
 Bermuda water       -shore to 100 fm curve,  
 slope water         -100 fm curve to the western edge of the  
    Gulf Stream,  
 Sargasso water     -eastern edge of the Gulf Stream to the  
    100 fm curve at Bermuda,

Gulf Stream water -between slope water and Sargasso water.  
 The Gulf Stream was defined as the region where the bathy-thermograph section showed isotherms sloped sharply downward to the east, since it was undesirable to include any samples from the Sargasso water in the small Gulf Stream group.

The ratio,  $\sigma(30^\circ)/\sigma(45^\circ)$ , when examined by statistical methods, showed that there were real differences among these water types. The mean values and standard deviations of the ratio were computed for each water type and used in t tests. In each case the hypothesis that there was no significant difference was tested, using the 95% confi-

dence level as the criterion of significance.

The mean value of  $\sigma(30^\circ)/\sigma(45^\circ)$  for Bermuda was 2.91, with a standard deviation of 0.06, significantly lower than any of the other types, implying that the predominant scatterers were smallest in this region. The other values were:

coastal water	3.33 $\pm$ .22
slope water	3.32 $\pm$ .14
Gulf Stream water	3.53 $\pm$ .28
Sargasso water	3.61 $\pm$ .26

The probability that the coastal and slope waters were the same is greater than 90% but does not satisfy the 95% criterion. The Sargasso and Gulf Stream waters have lower ratios than either the slope or coastal waters; however, the Sargasso water cannot be differentiated from the Gulf Stream water. A trend toward larger scatterers as one proceeds offshore is shown by these ratios.

The absolute value of the scattering can also be used to differentiate these water types. Figure 4.5-2 shows the portion of the scattering coefficient between  $30^\circ$  and  $130^\circ$  together with the concurrent traces of salinity, temperature and the ratio,  $\sigma(30^\circ)/\sigma(45^\circ)$ . The sample having the highest value of  $s(30-130)$  was taken in Vineyard Sound; the magnitude then reduced in two jumps to a base level for

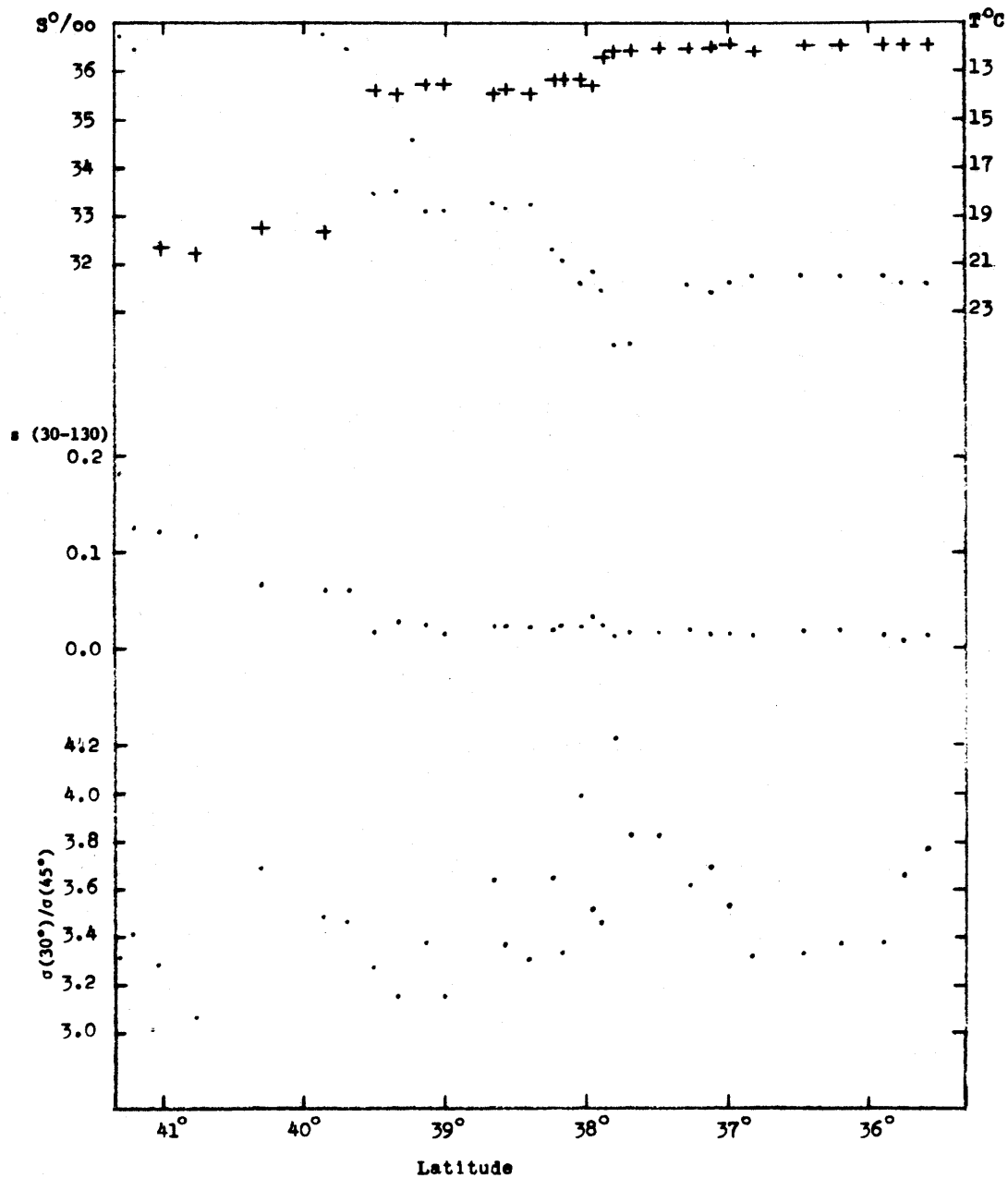


Fig. 4.5-2. Salinity (crosses), temperature,  $s(30-130)$ , and  $\sigma(30^\circ)/\sigma(45^\circ)$  against latitude; data taken on the R/V Crawford in November 1963 along the course from Woods Hole to Bermuda.

clear water. A distinction can be made between the shelf water and the slope water since a factor of three is involved but, the arbitrary division at the 100 fathom curve resulted in the borderline value being placed in the wrong category on both the outbound and return portion of this cruise. The correlation of the break in scattering with the thermohaline front that is well developed in this region during the winter shows that the scattering is controlled by the circulation.

The  $s(30-130)$  values in port at Bermuda were over 0.1 whereas just offshore they were in the 0.06 range. The other water types are given below:

slope water	$0.0222 \pm 0.0053$
Gulf Stream water	$0.0195 \pm 0.0088$
Sargasso water	$0.0172 \pm 0.0044$ .

There is a trend toward a lower average as one moves into the Sargasso region; however, due to the variance the only significant difference is between the slope and the Sargasso water. This indicates that the intermediate value for Gulf Stream water is not unreasonable.

These results were confirmed by later measurements made on the R/V Chain; although, the sequence of values for  $s(30-130)$  as the ship proceeded southward was not monotonically decreasing. The values starting in Vineyard Sound

were 0.19, 0.13, 0.065, 0.11, 0.056, 0.021, 0.020, 0.016, and 0.021, where the Gulf Stream came between the 0.021 and the 0.020 values.

#### 4.53 "Hydrographic Station Samples"

The temperature, salinity,  $\ln s(30-130)$ , and  $\ln-\ln$  slope as a function of depth for all of the hydrographic stations are presented in Figures 4.5-3 through 4.5-26. The standard error of the difference between any two numbers is indicated on these graphs and one can be 95% confident that a difference is real if the limits indicated on one point do not overlap the limits on the other.

The closest thing to a consistent feature was the increase in the  $\ln-\ln$  slope near the base of the main thermocline. The two 200 meter stations, Figures 4.5-15 and 16, show that in the surface layers there is a great deal of detail that is missed with the large sampling interval employed in the usual hydrographic station. This fact emphasizes the necessity for continuous "in situ" recordings with which true profiles both vertically and horizontally can be made.

#### 4.54 "Thermal Front Survey"

A generalized temperature section for the thermal front is shown in Figure 4.5-27; this front was similar to those discussed by Voorhis and Hersey (1964). The sort-

(text continued on p. 129)

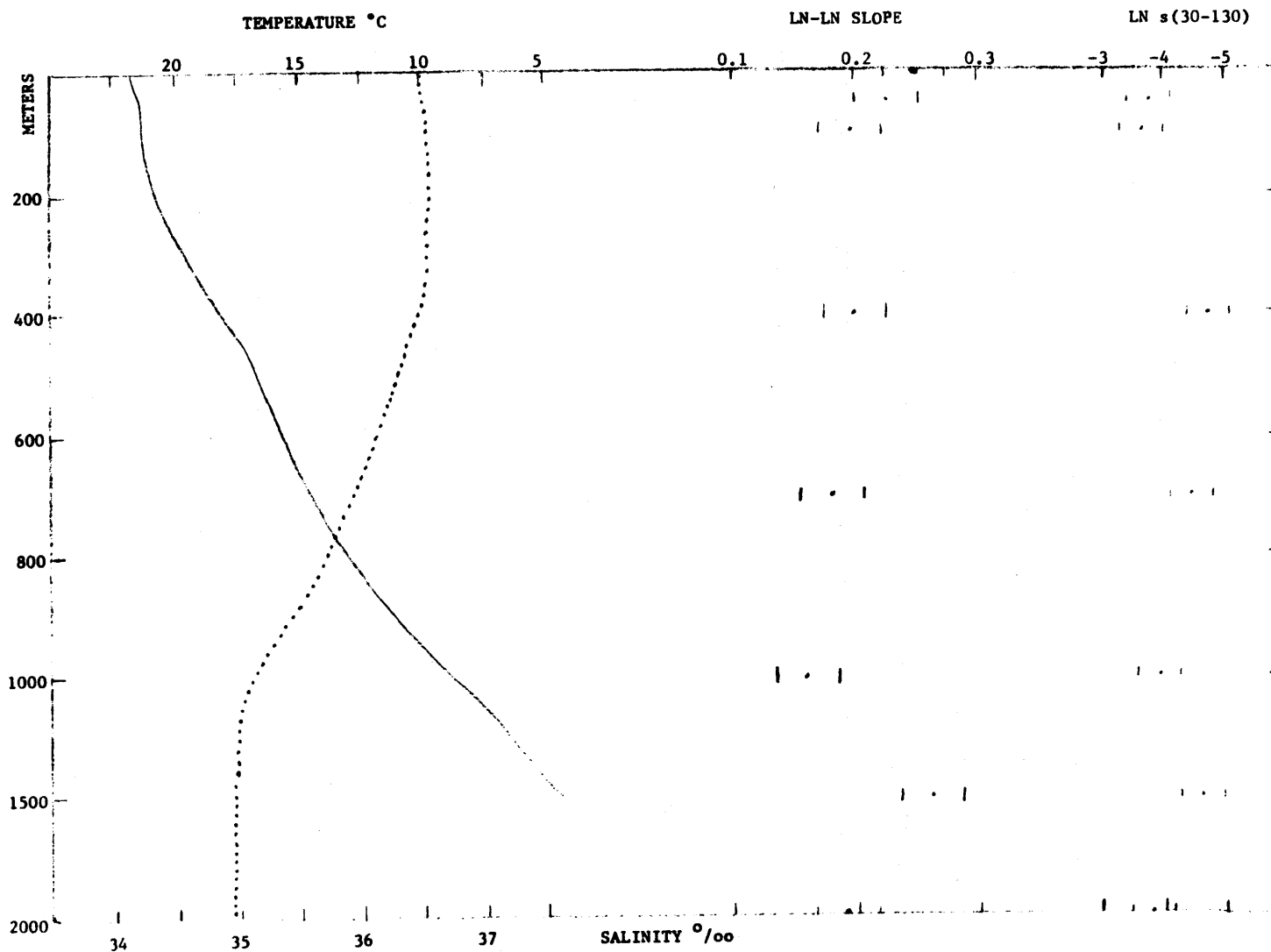


Fig. 4.5-3. On 4 Dec. 1963 at 36°14'N and 67°23'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.



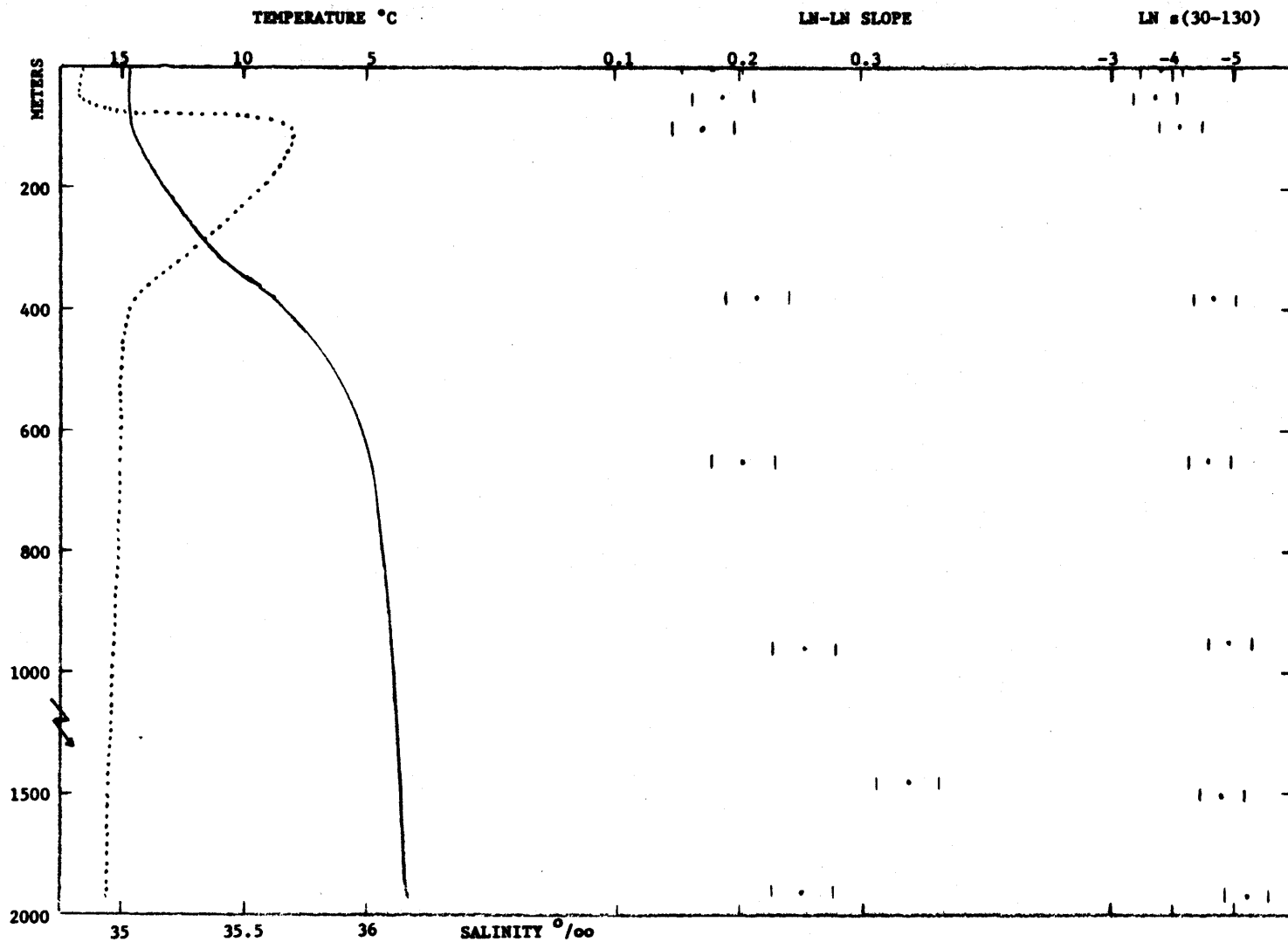


Fig. 4.5-4. On 5 Dec. 1963 at 38°55'N and 69°05'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

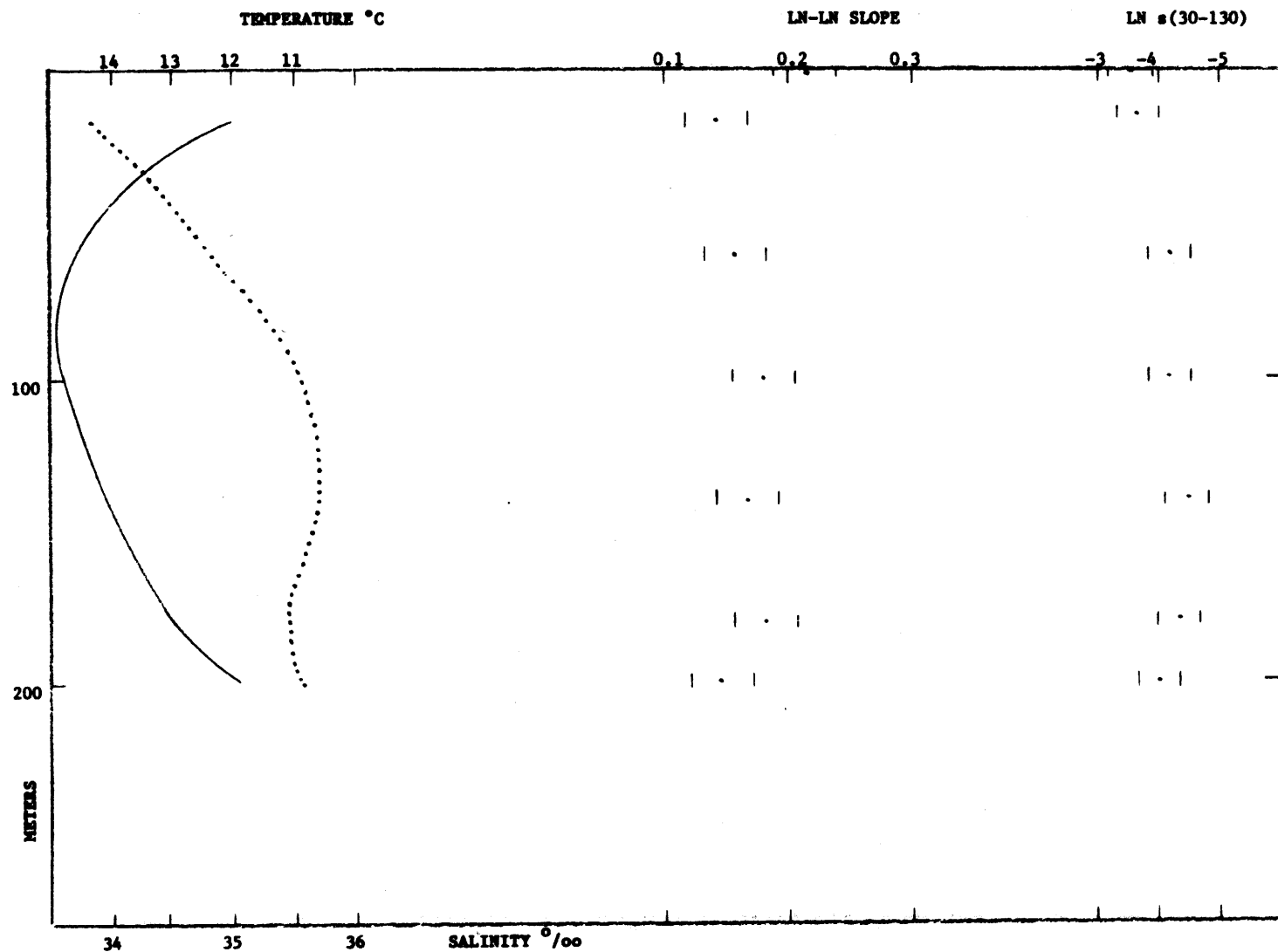


Fig. 4.5-5. On 5 Dec. 1963 at 39°57'N and 69°57'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

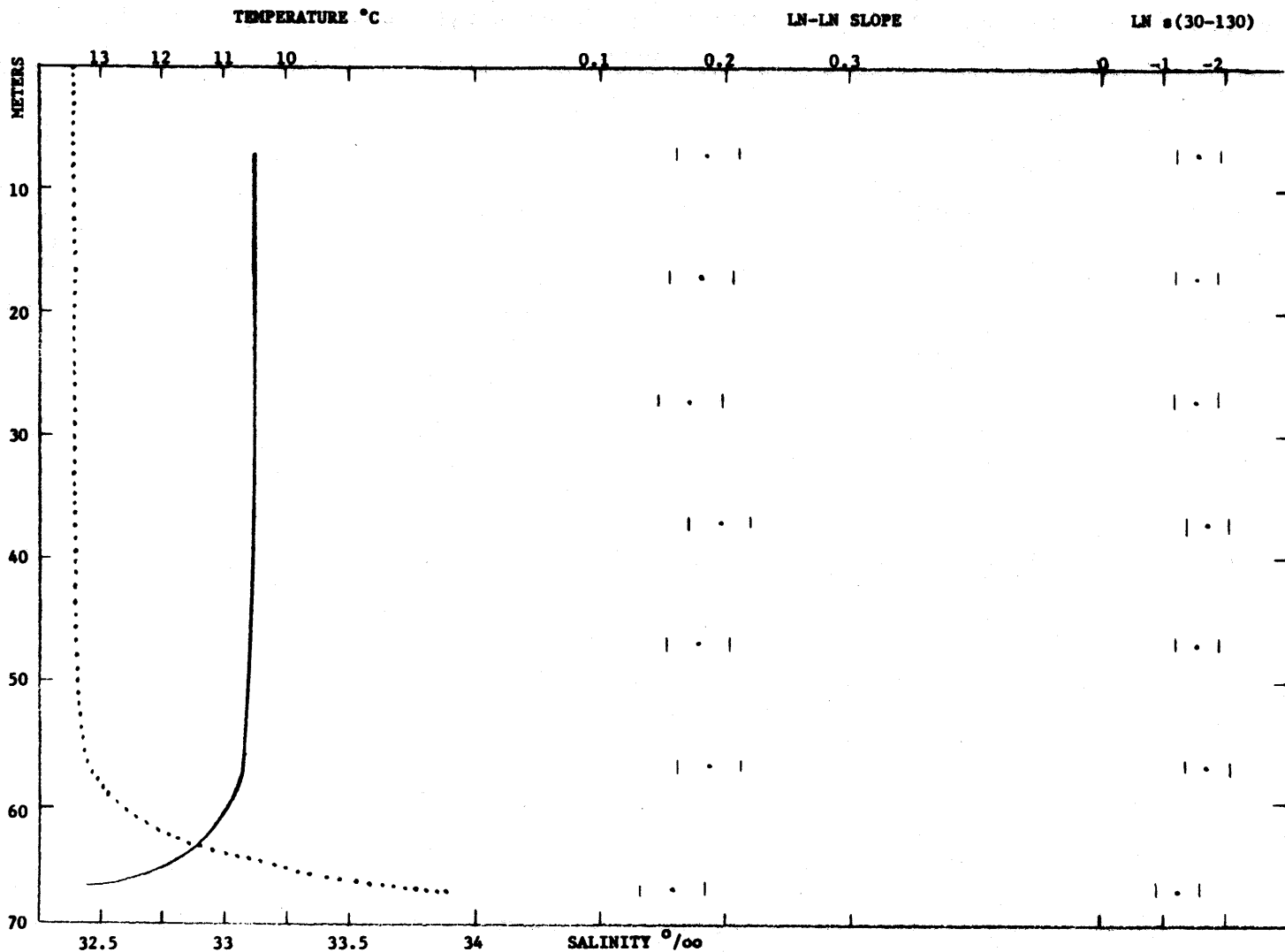


Fig. 4.5-6. On 5 Dec. 1963 at 40°31'N and 70°25'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

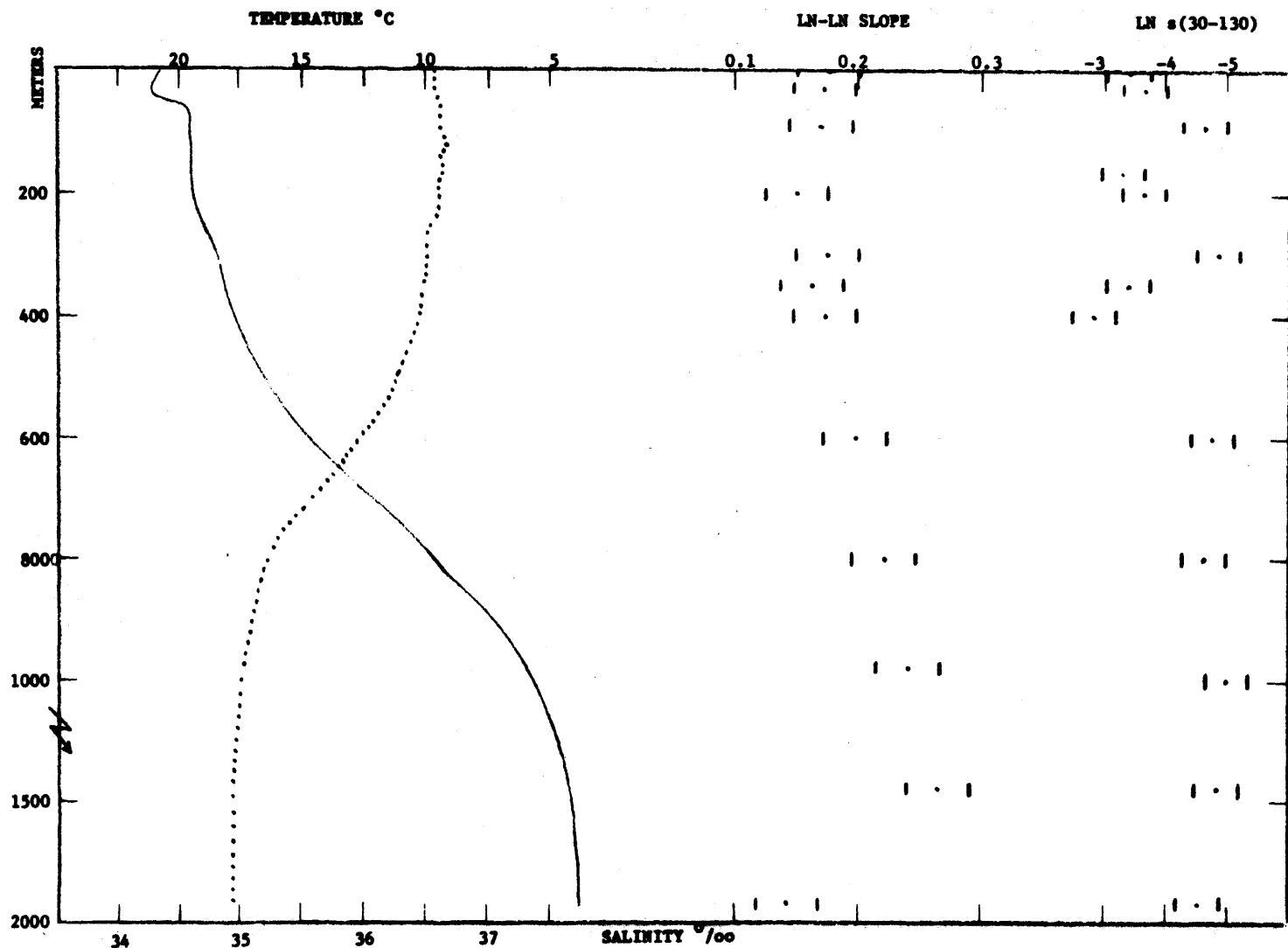


Fig. 4.5-7. On 16 Jan. 1964 at 37°11'N and 70°00'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

(mirrored) ' in-in 'arobe' sup in s(30-130) ob'suar ob'ar

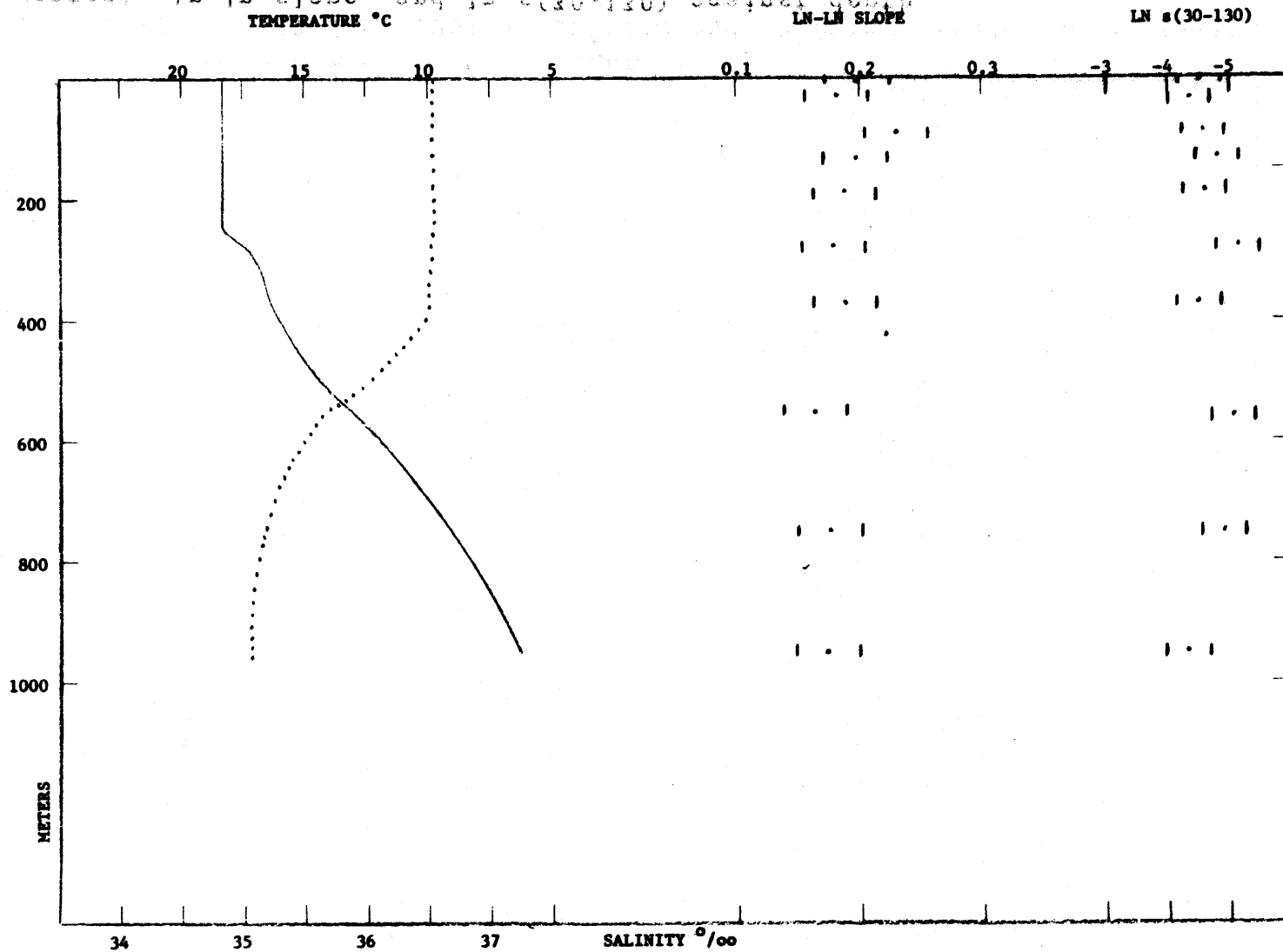


Fig. 4.5-8. On 17 Jan. 1964 at 34°53'N and 70°00'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

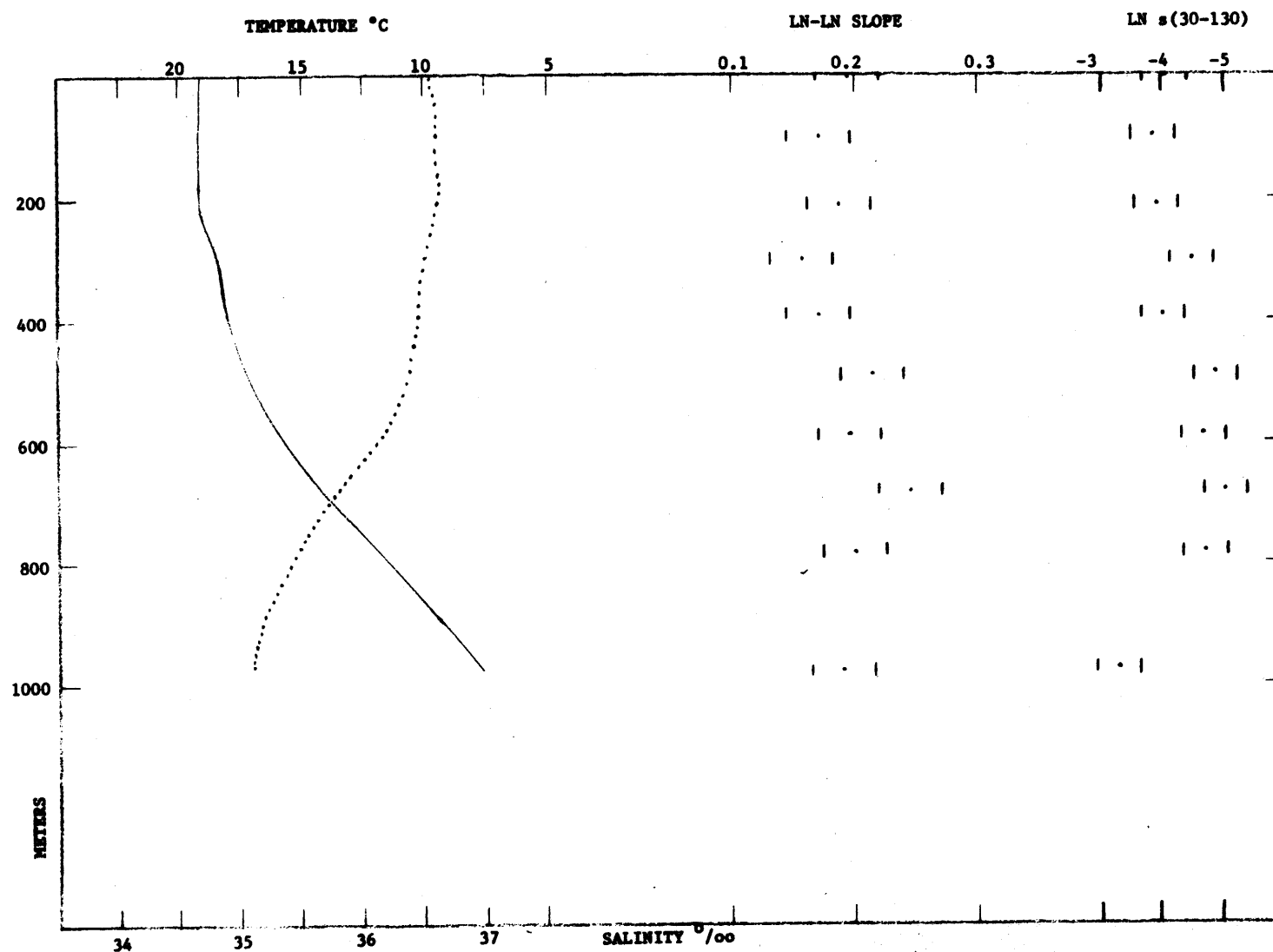


Fig. 4.5-9. On 17 Jan. 1964 at 32°47'N and 70°00'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

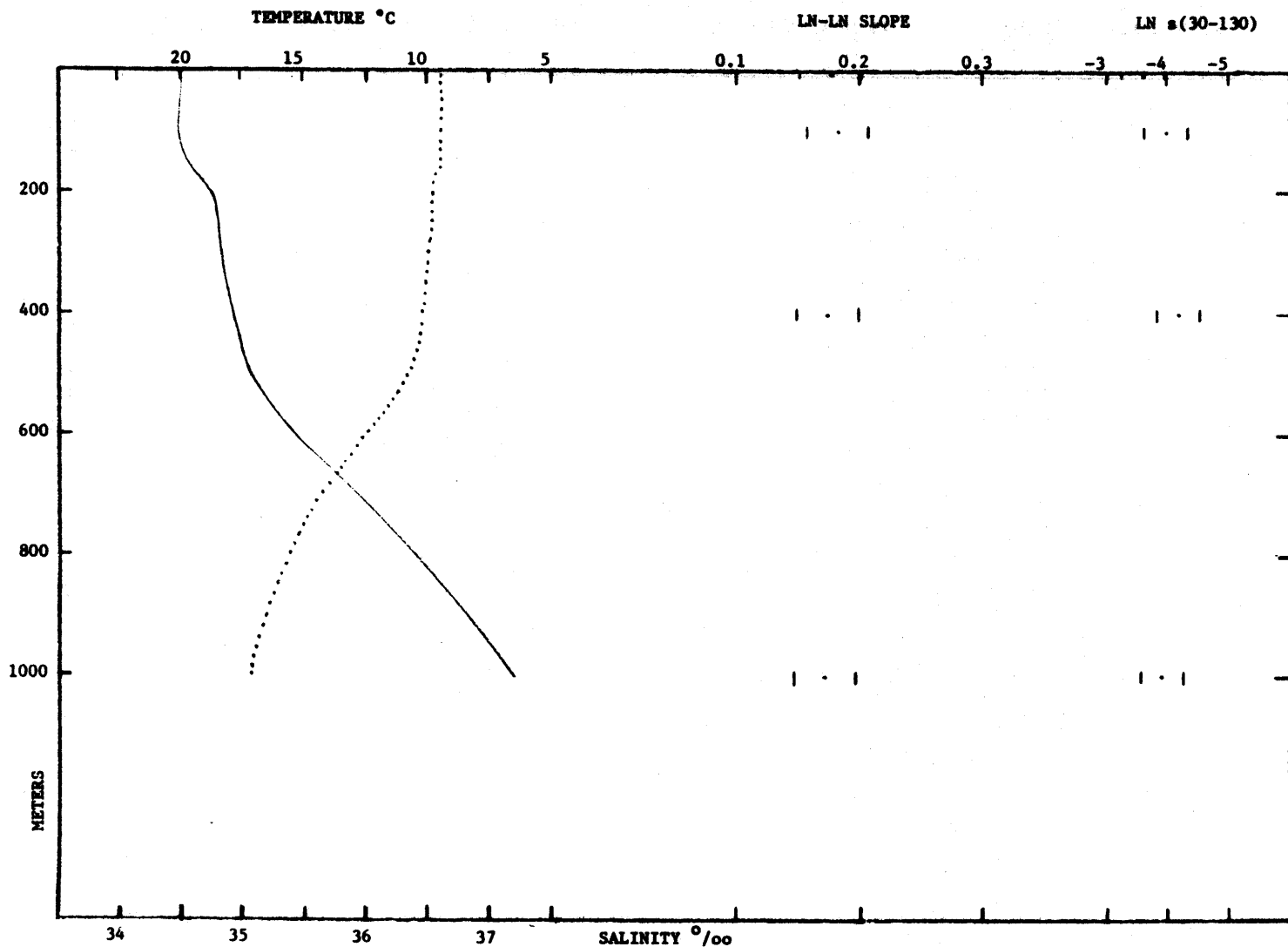


Fig. 4.5-10. On 18 Jan. 1964 at 30°21'N and 69°32'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

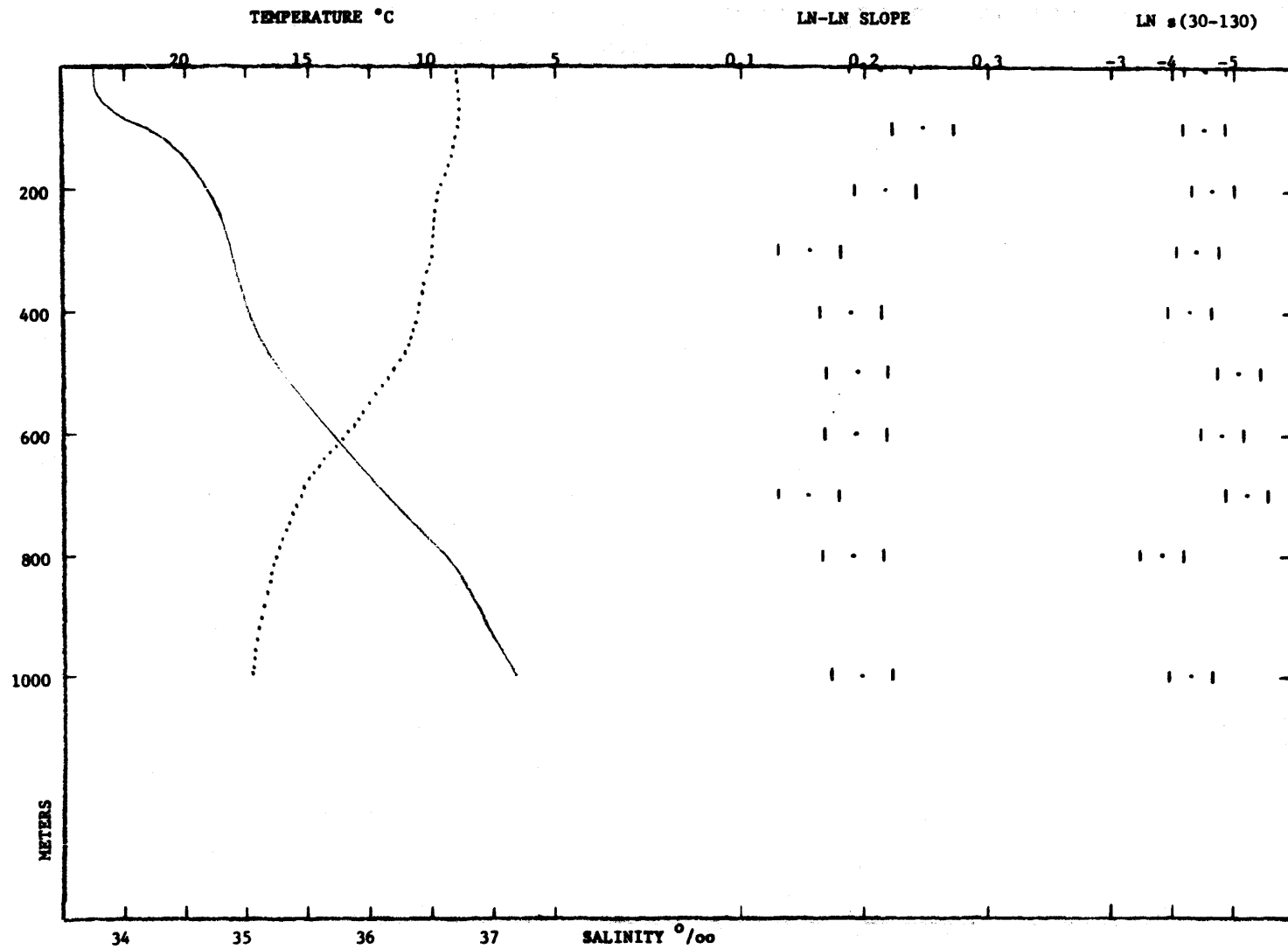


Fig. 4.5-11. On 19 Jan. 1964 at 26°32'N and 69°30'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.



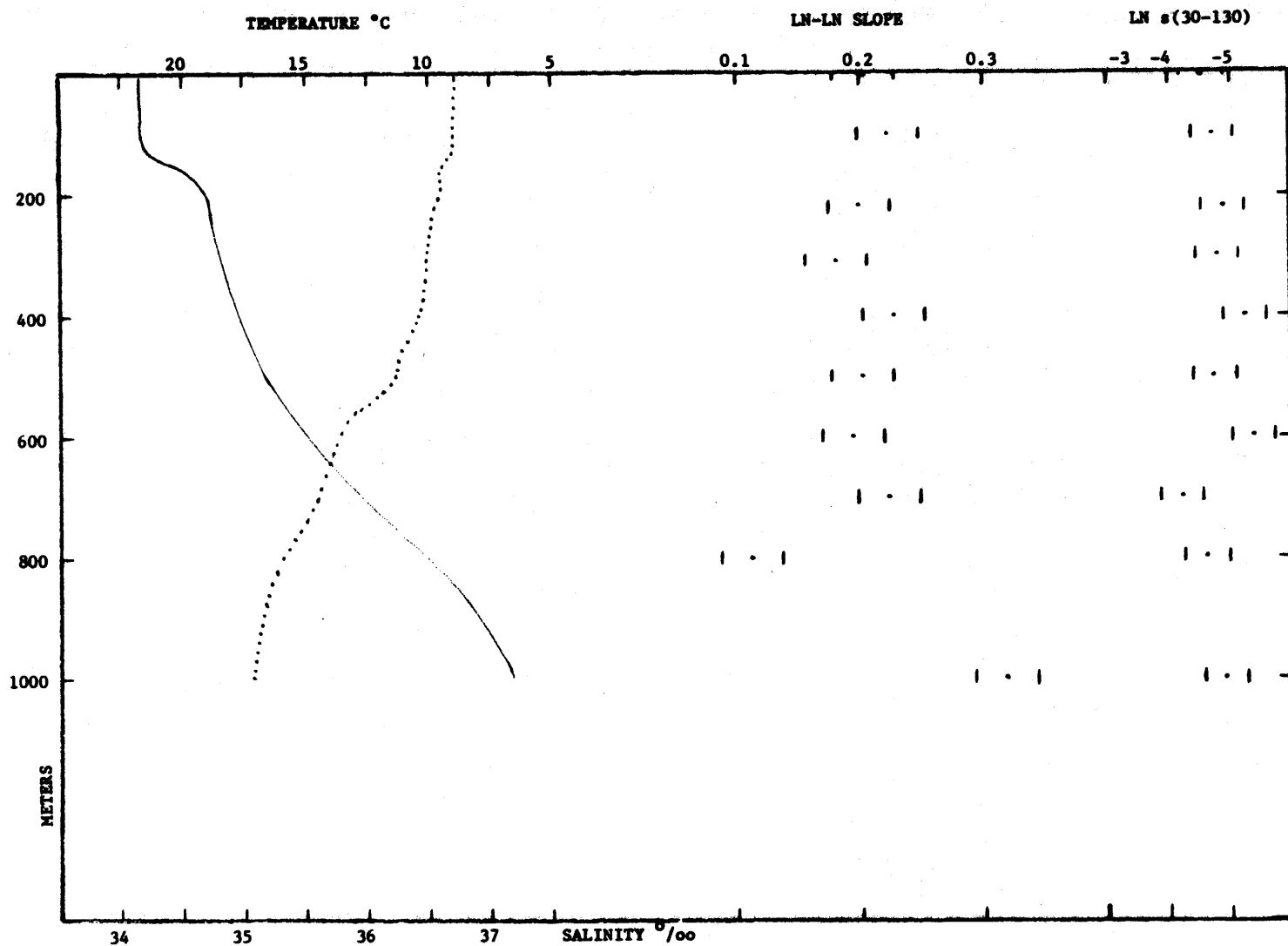


Fig. 4.5-12. On 20 Jan. 1964 at 27°15'N and 69°52'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

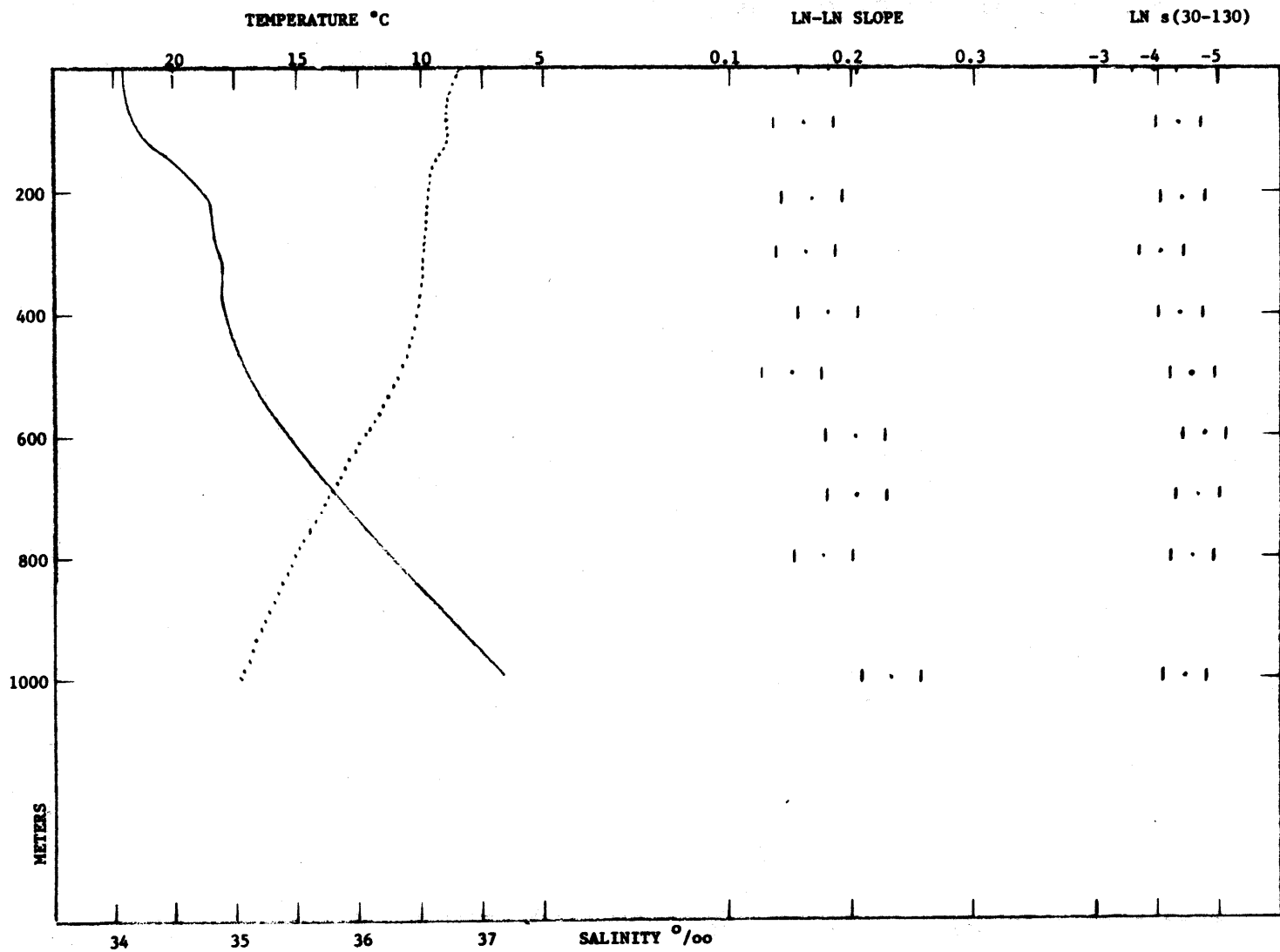


Fig. 4.5-13. On 23 Jan. 1964 at 28°03'N and 71°47'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

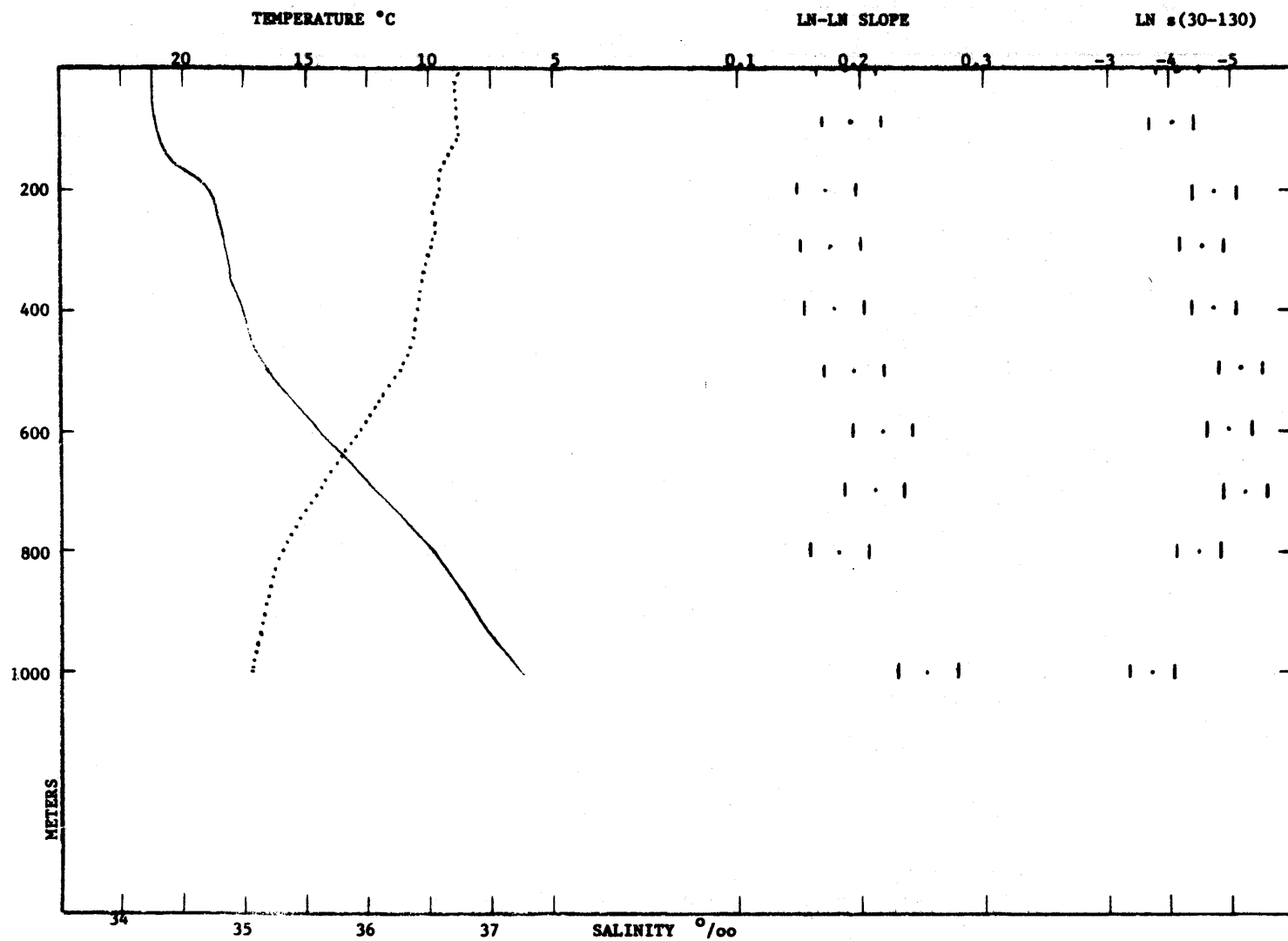


Fig. 4.5-14. On 24 Jan. 1964 at 27°10'N and 69°17'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

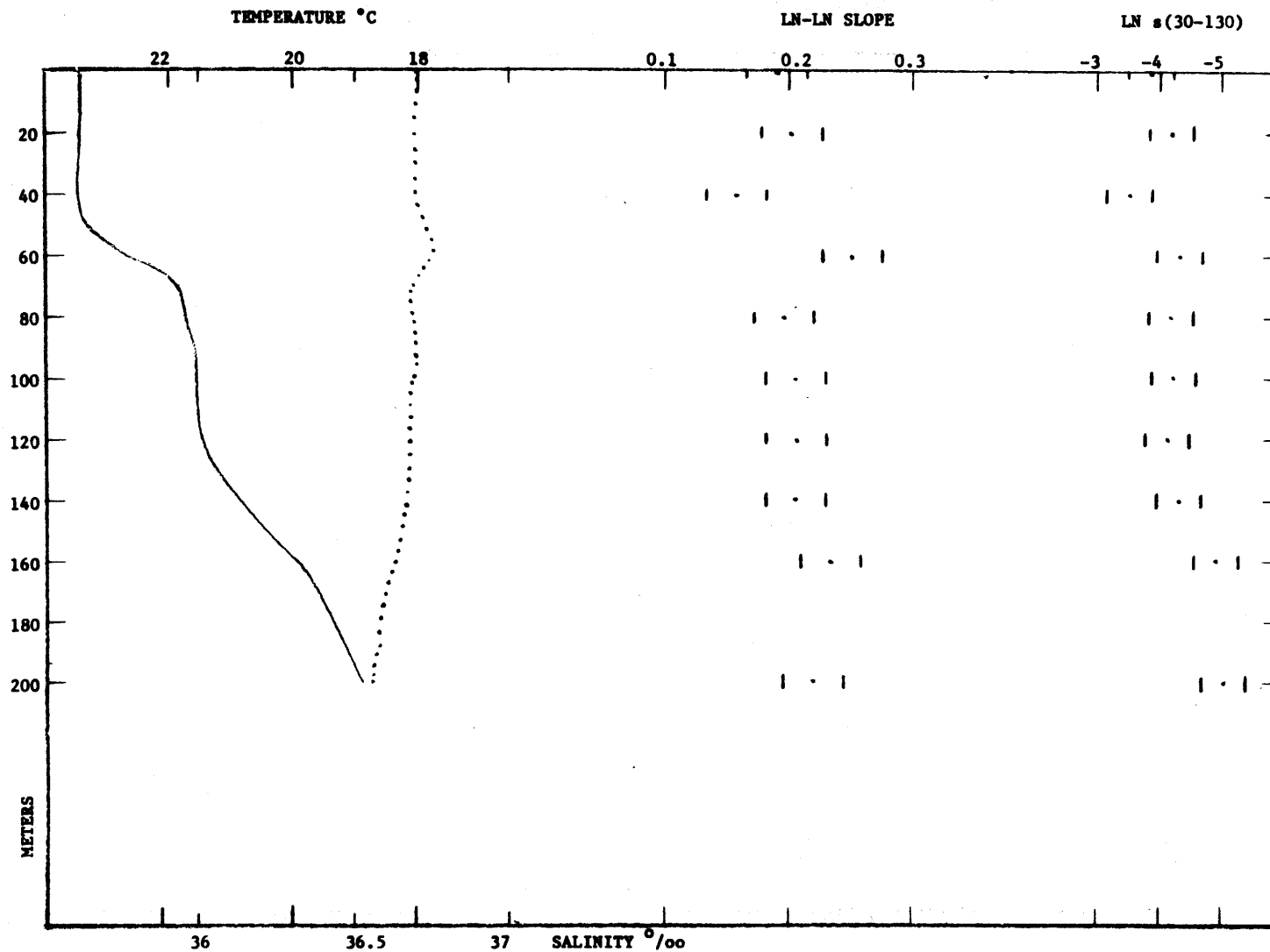


Fig. 4.5-15. On 25 Jan. 1964 at 26°28'N and 67°35'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

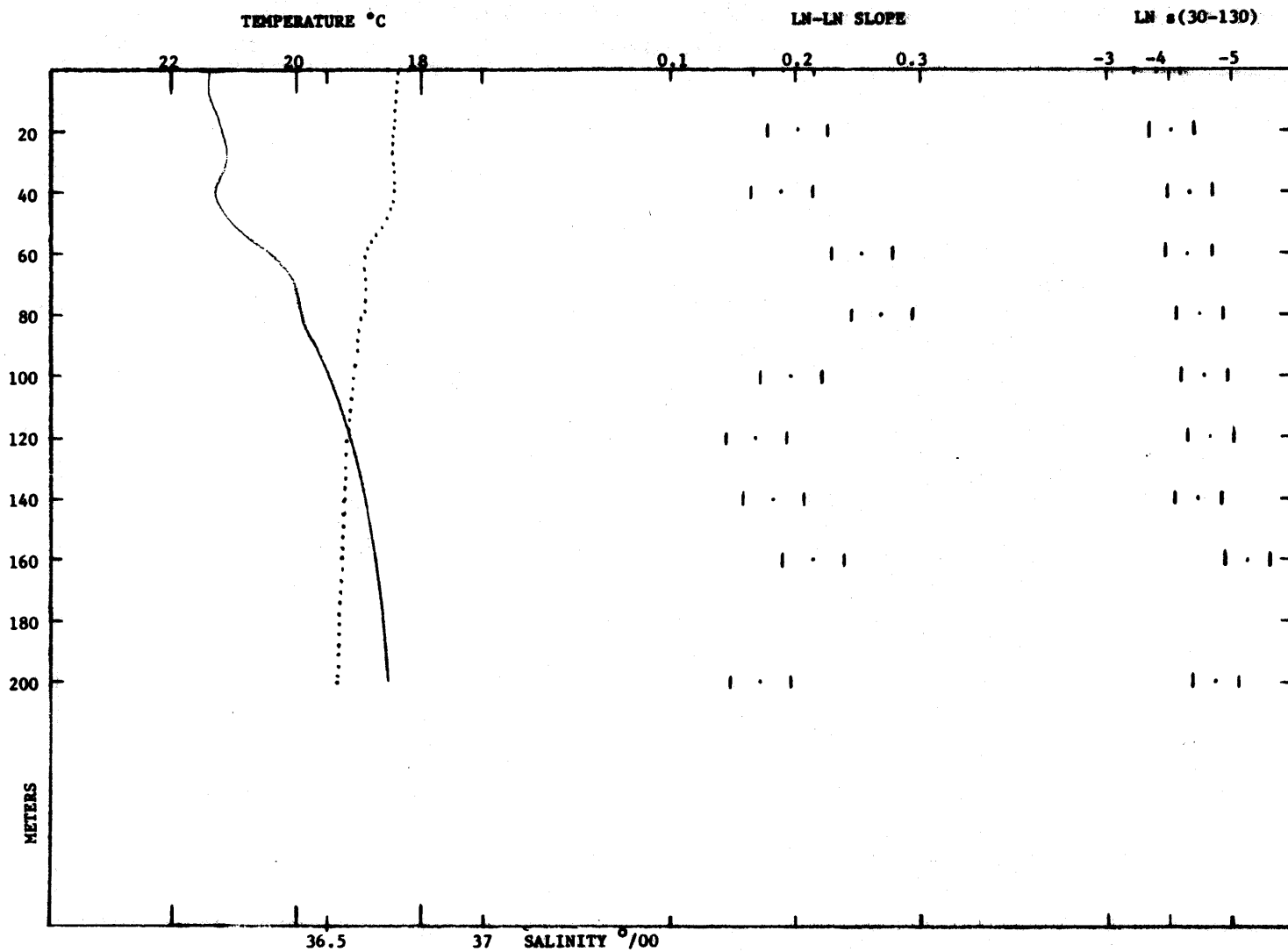


Fig. 4.5-16. On 26 Jan. 1964 at 26°52'N and 67°46'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

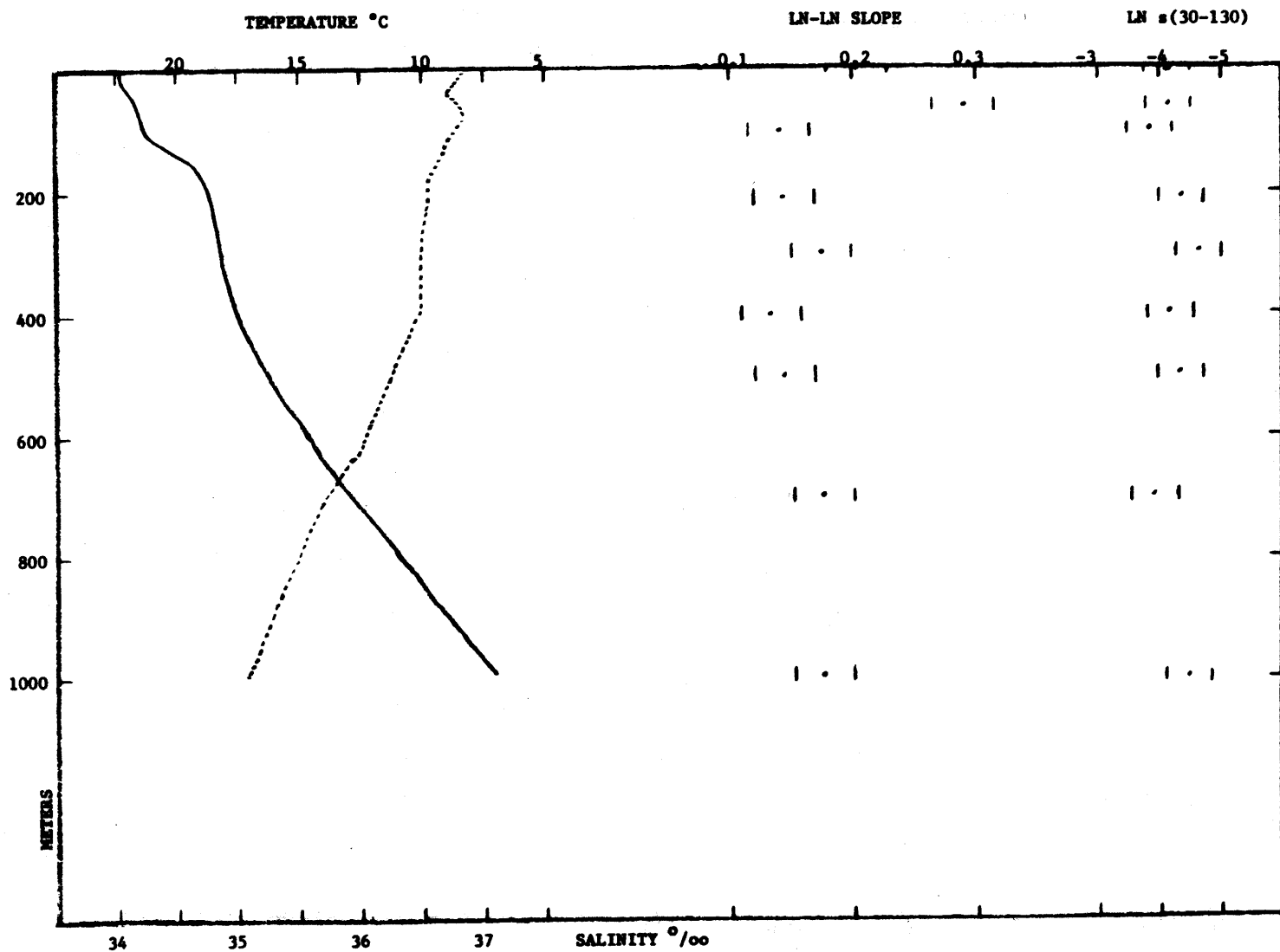


Fig. 4.5-17. On 29 Jan. 1964 at 28°51'N and 63°07'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

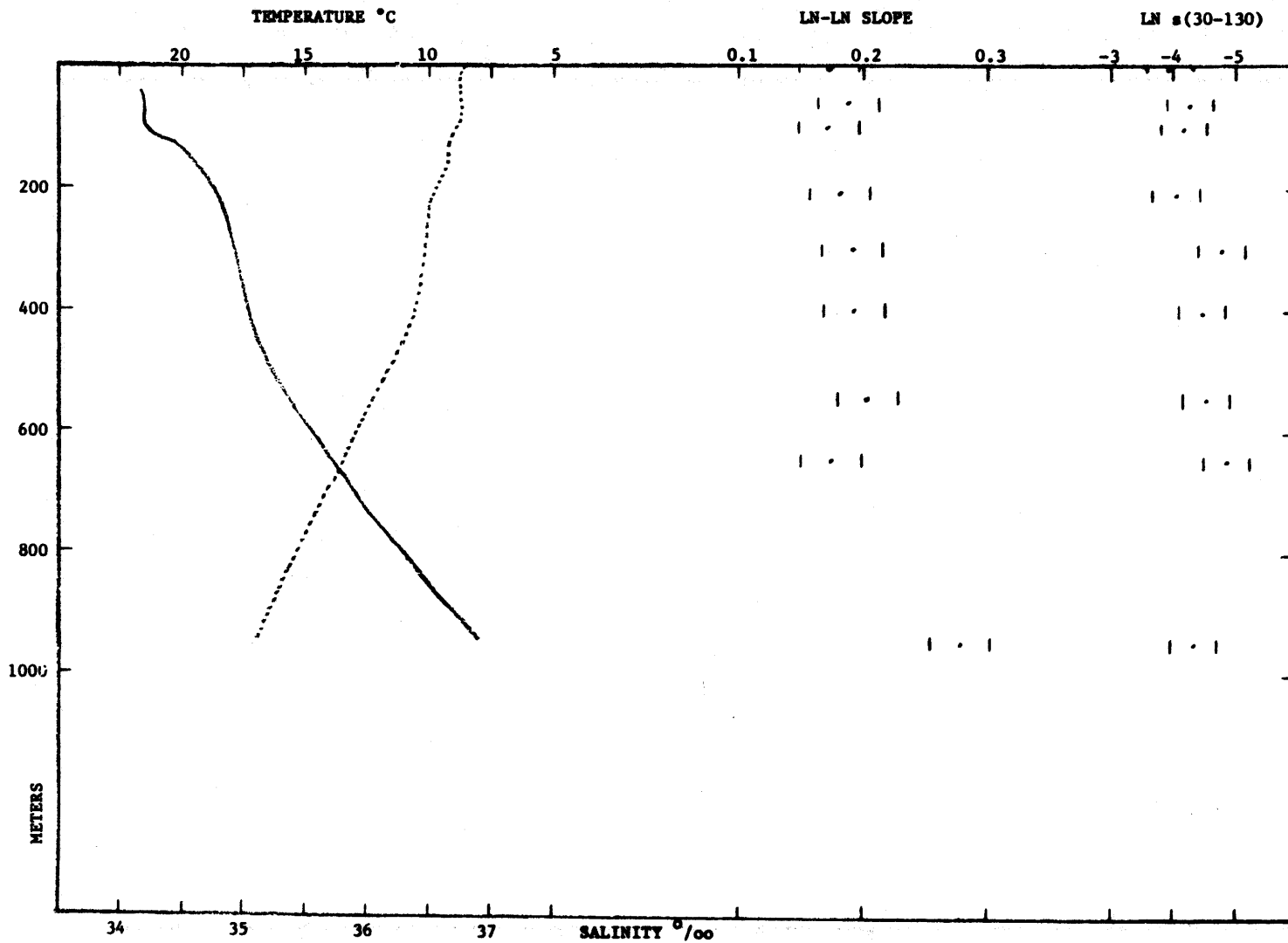


Fig. 4.5-18. On 29 Jan. 1964 at 29°57'N and 64°04'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

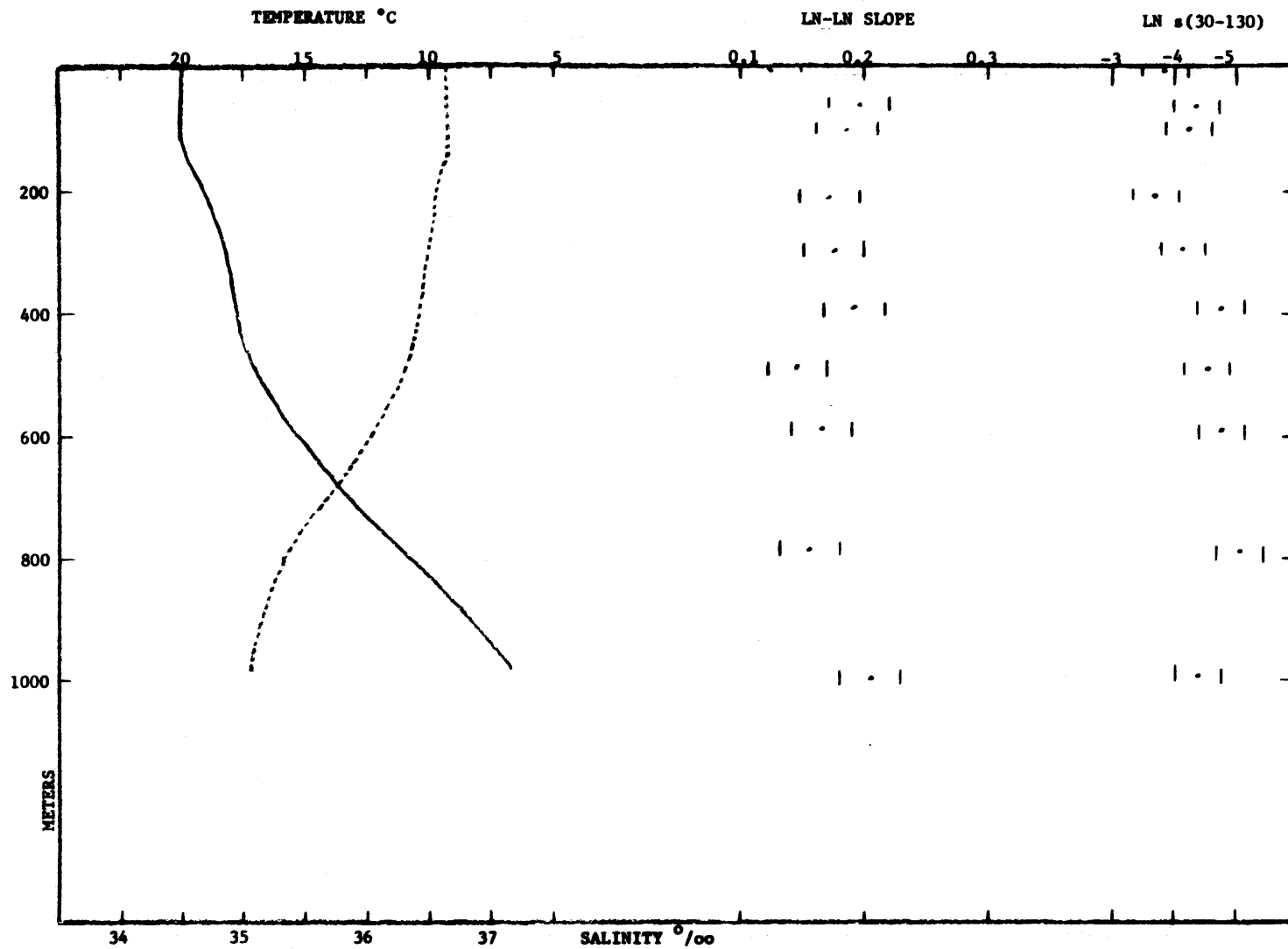


Fig. 4.5-19. On 30 Jan. 1964 at 31°03'N and 64°47'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.



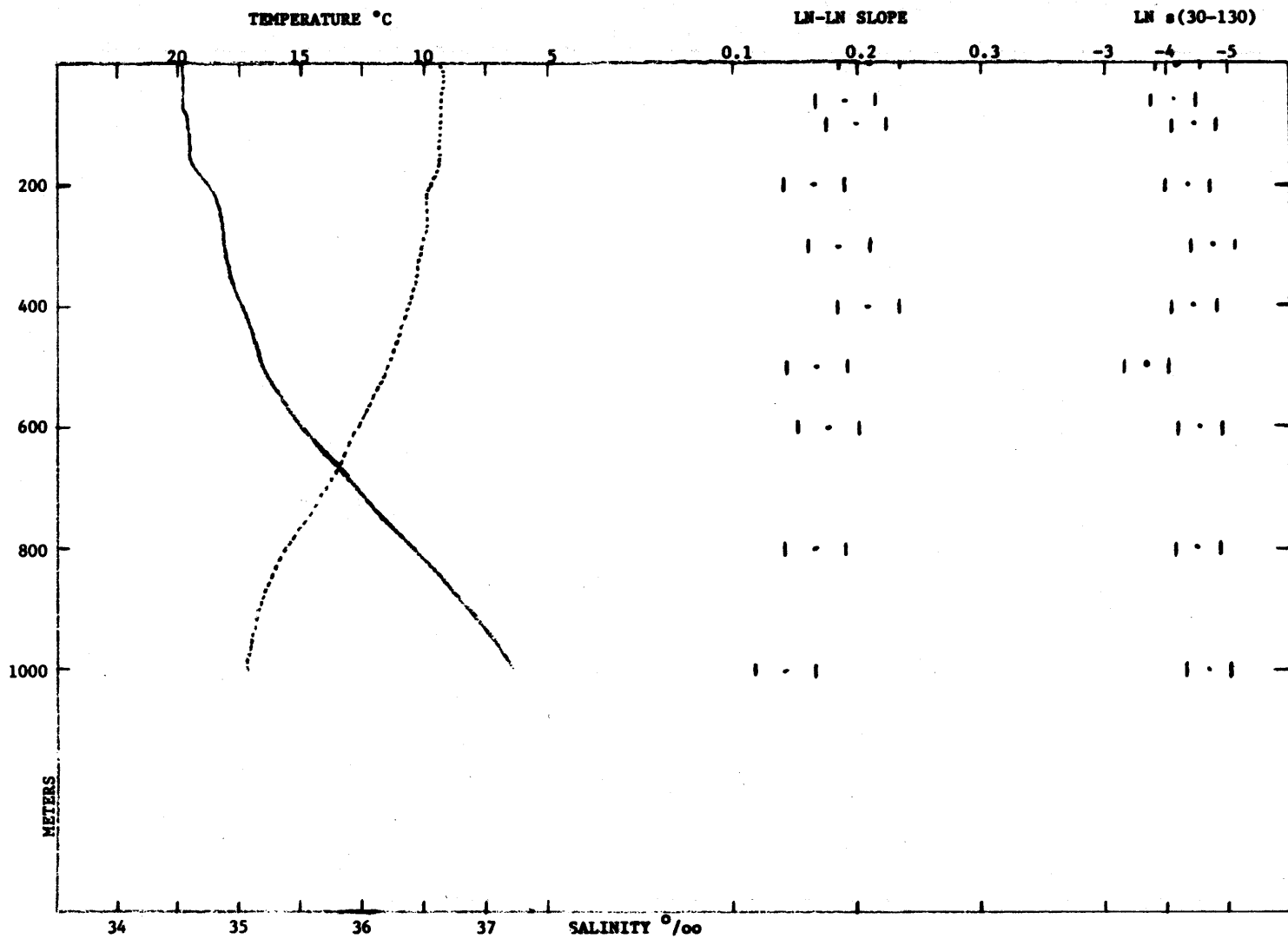


Fig. 4.5-20. On 30 Jan. 1964 at 32°05'N and 65°20'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

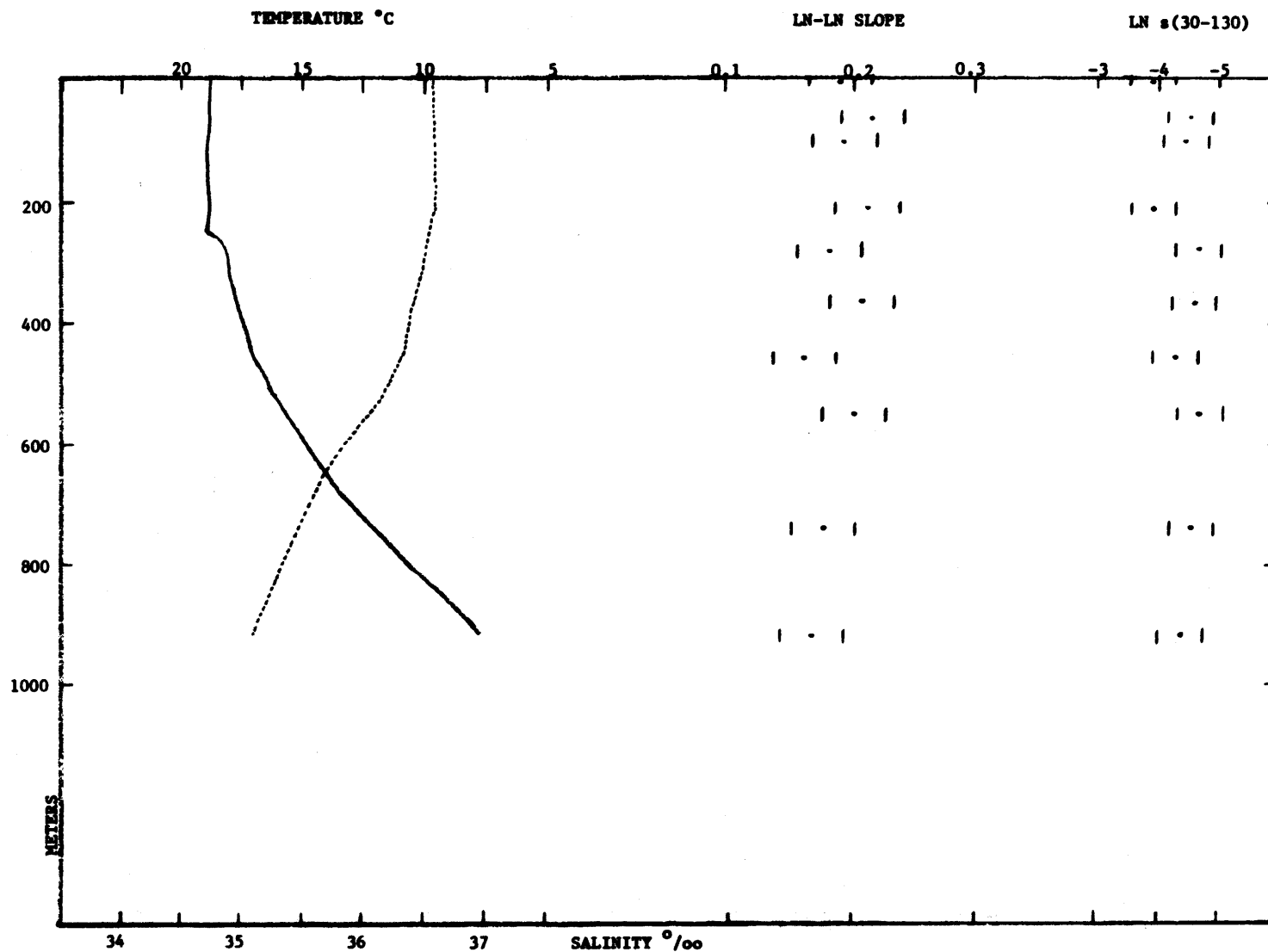


Fig. 4.5-21. On 30 Jan. 1964 at 32°56'N and 65°57'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

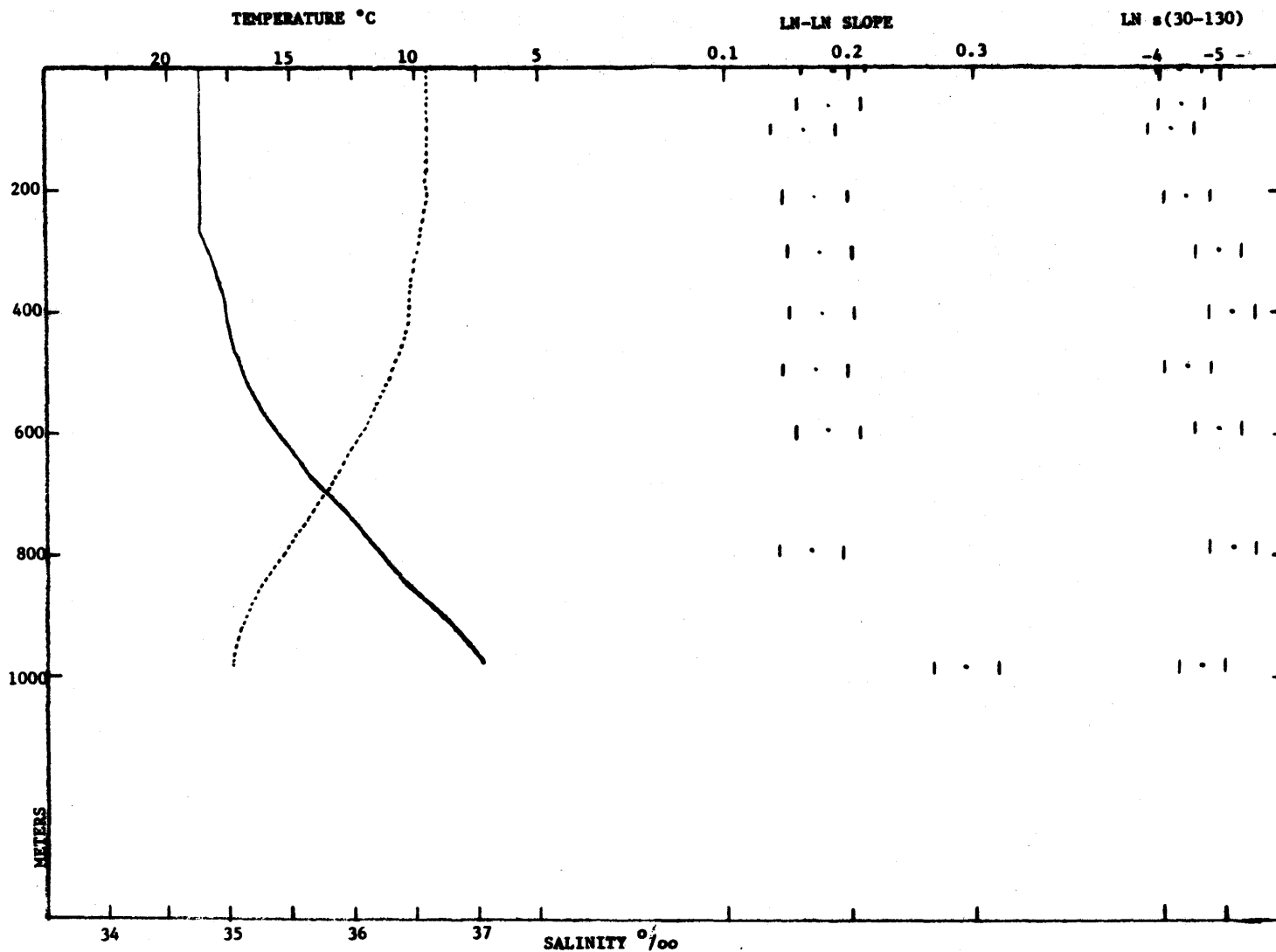


Fig. 4.5-22. On 31 Jan. 1964 at 34°05'N and 66°38'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

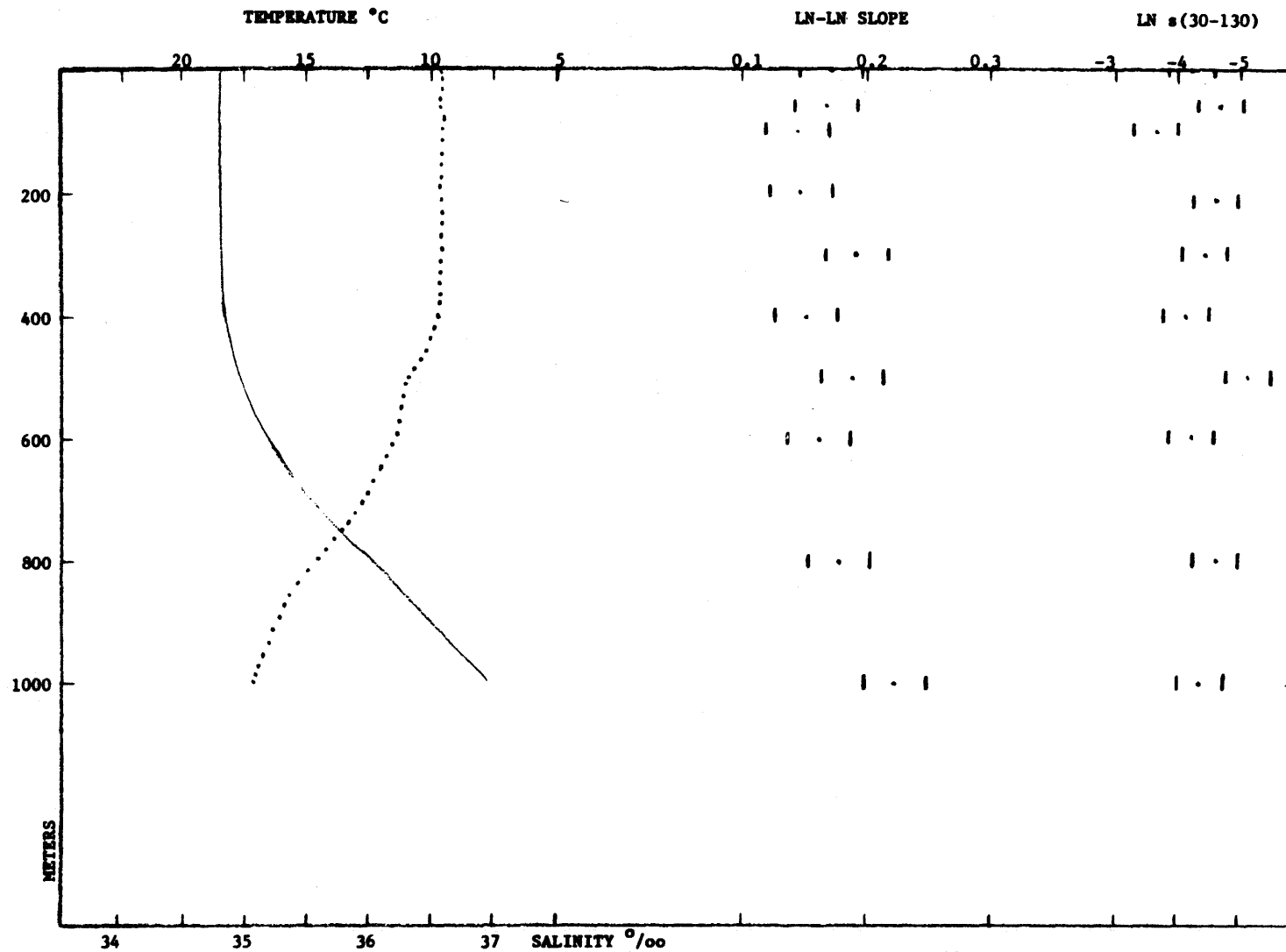


Fig. 4.5-23. On 31 Jan. 1964 at 34°58'N and 67°04'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

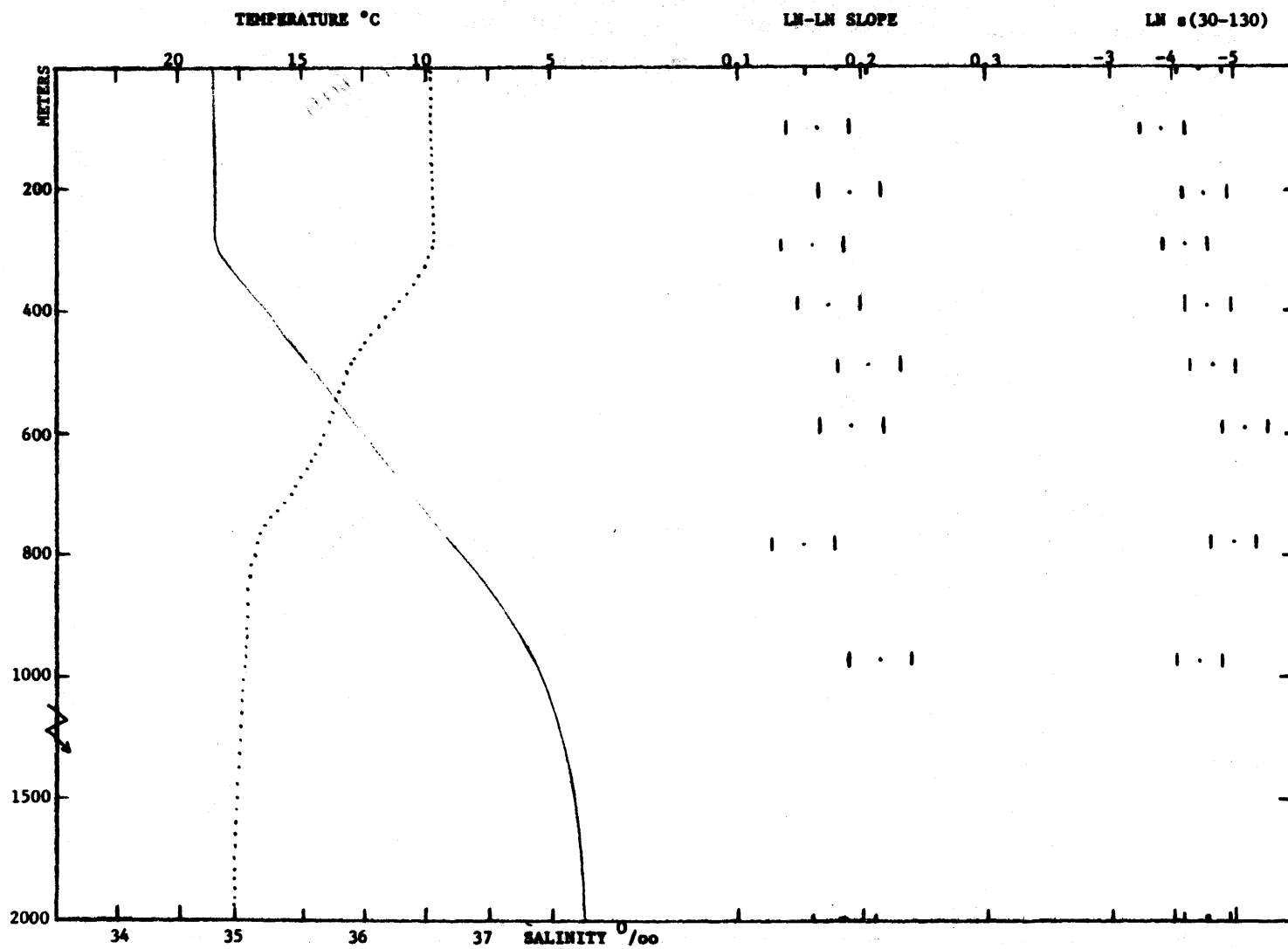


Fig. 4.5-24. On 31 Jan. 1964 at 36°03'N and 67°39'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

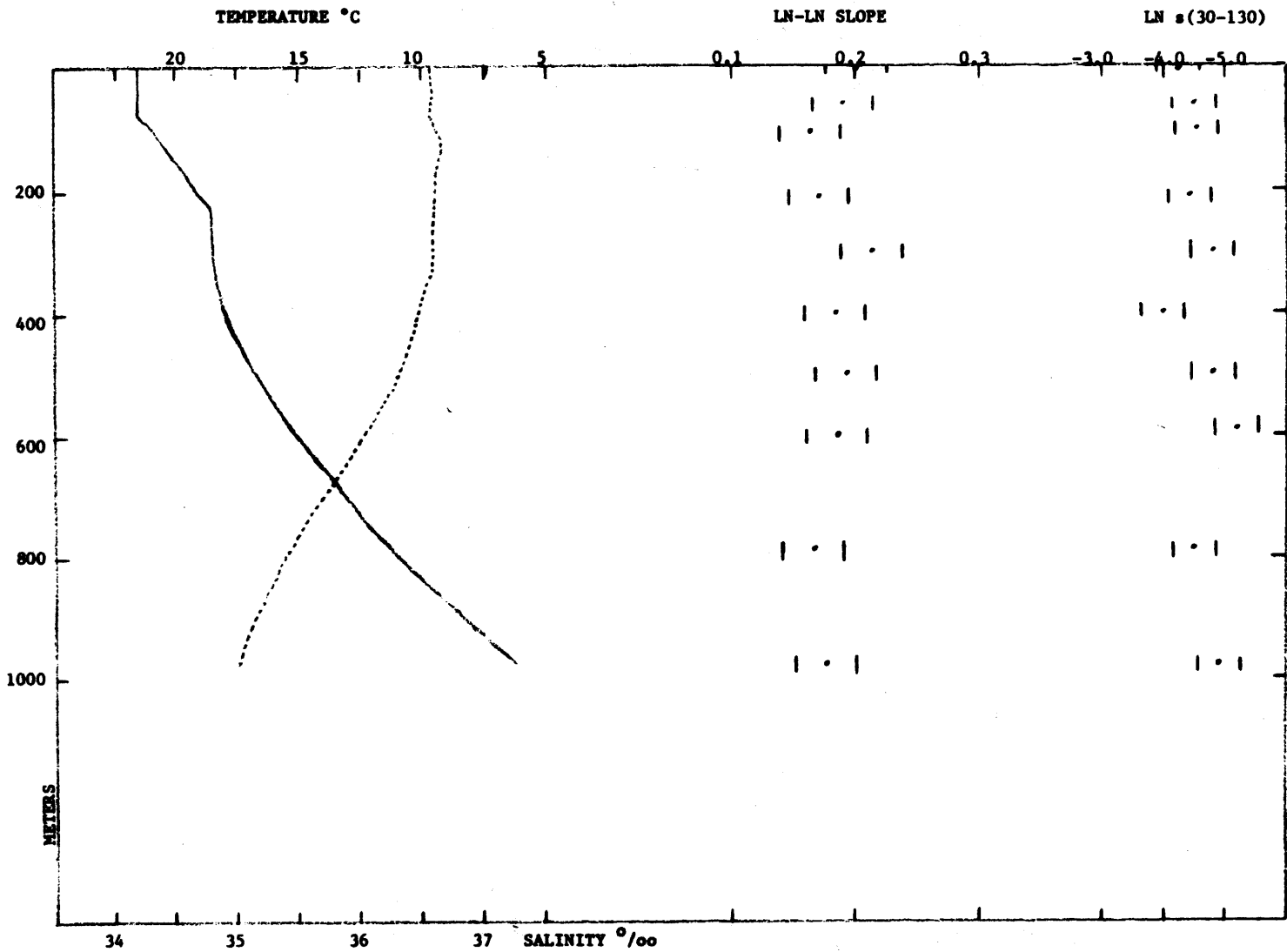


Fig. 4.5-25. On 1 Feb. 1964 at 37°39'N and 68°38'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

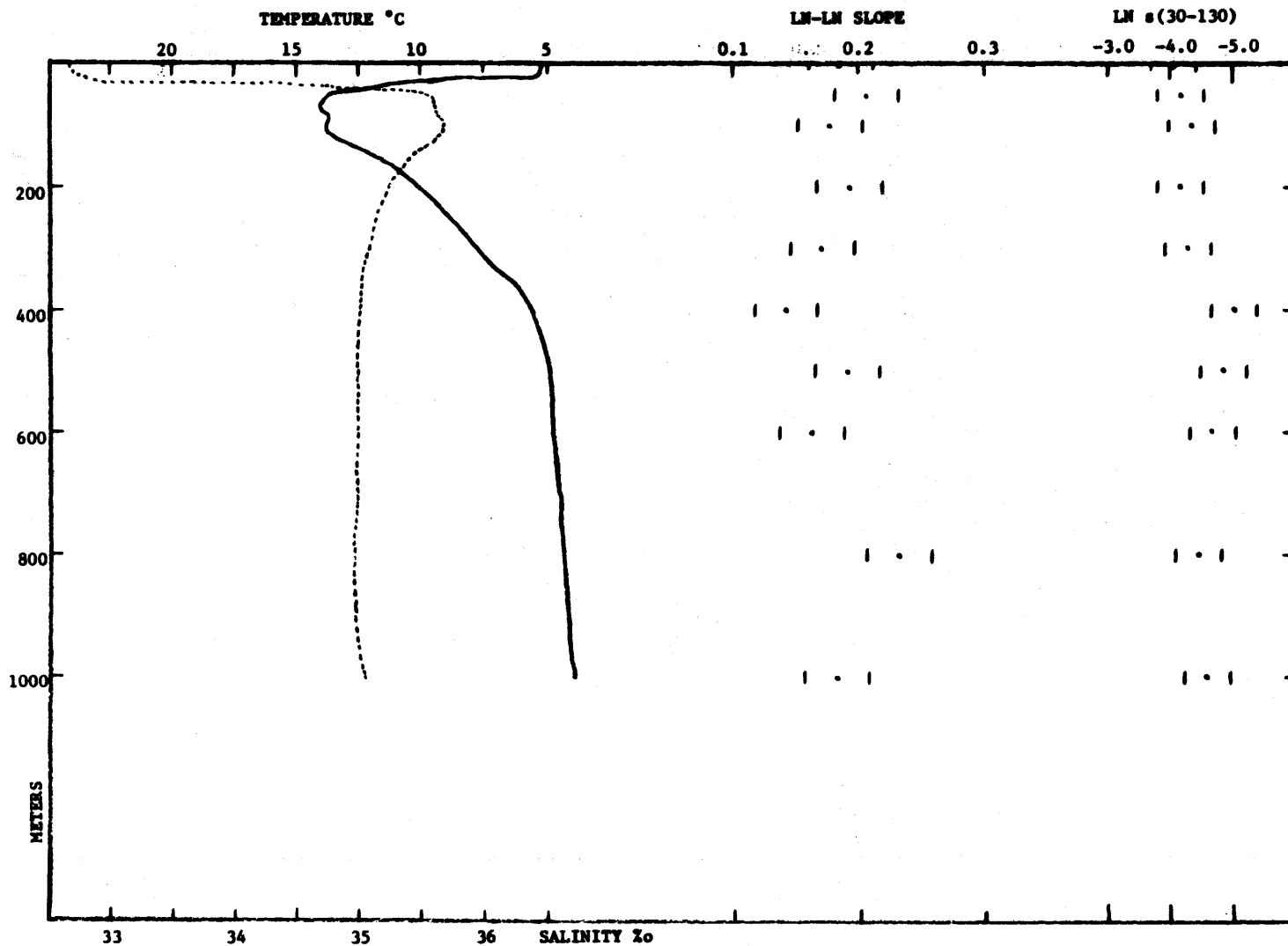


Fig. 4.5-26. On 1 Feb. 1964 at 38°58'N and 69°32'W: temperature, salinity (dotted), ln-ln slope, and ln s(30-130) against depth.

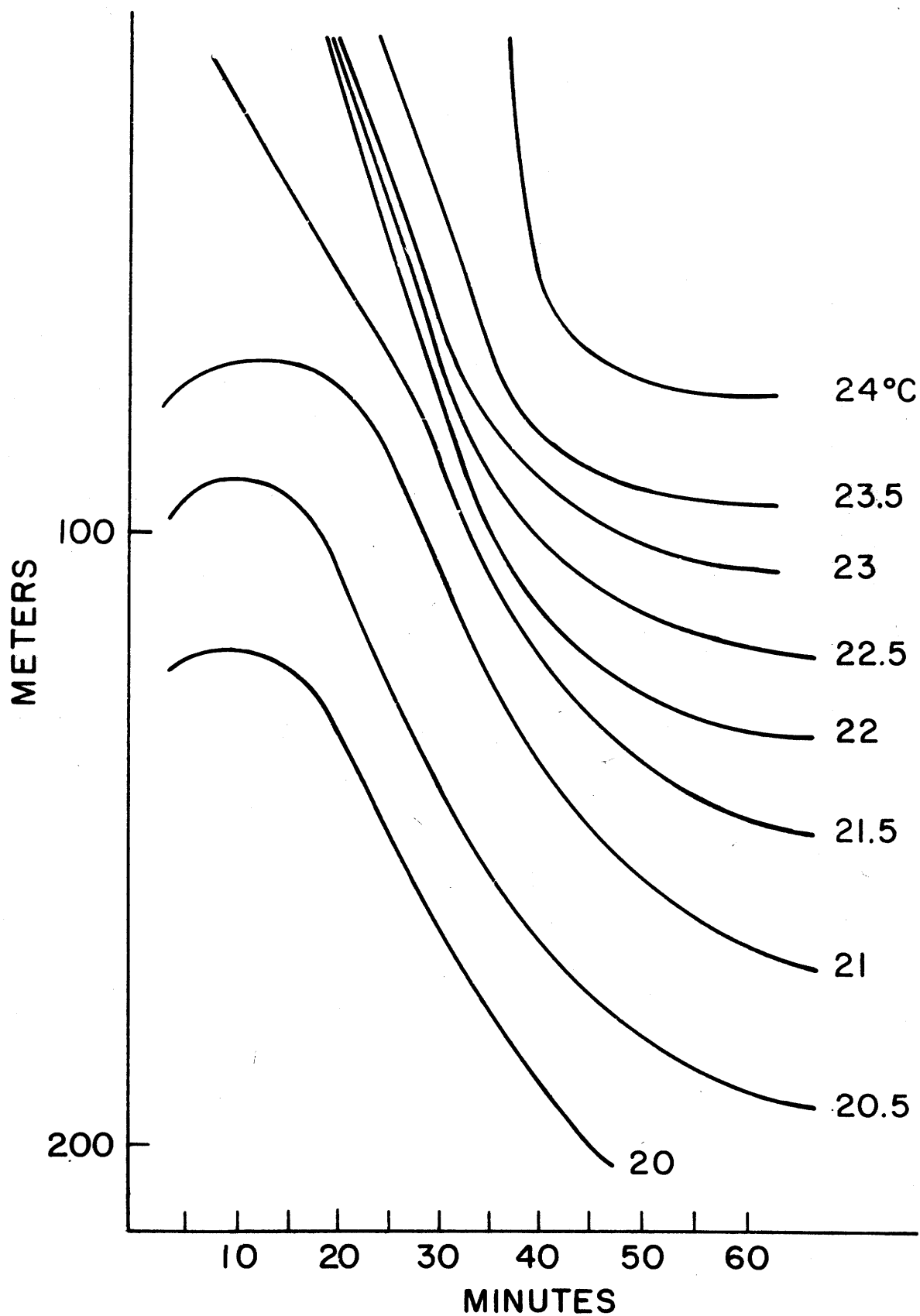


Fig. 4.5-27. A generalized temperature section across a thermal front: depth against minutes of latitude.



ing of the results of the surface samples in the neighborhood of the thermal front into arbitrary temperature intervals showed that the ratio,  $\sigma(30^\circ)/\sigma(45^\circ)$ , in the 22.8° water,  $3.080 \pm 0.103$ , was different from the average of all other samples,  $3.323 \pm 0.123$ , while the magnitude of the scattering showed no differences. Figure 4.5-28 gives these quantities as a function of temperature and shows that there was no difference on either side of the front in the ratio or in the magnitude of the scattering. At the 22.8° isotherm a strongly developed line of weed, which is generally taken to be a sign of surface convergence, was noted once. Coincidentally the lowest value of the ratio was observed.

#### 4.55 "Determination of the Scattering Coefficient by Measurement at One Angle"

To test the hypothesis that the scattering coefficient can be determined from the measurement of  $\sigma(\theta)$  at one angle the ratios,  $s/\sigma(\theta)$  and  $s(30-130)/\sigma(\theta)$  were computed. The average of these ratios and their standard deviations yielded the results given in Table 4-1. These values show that  $s(30-130)$  can be determined with a standard deviation of less than 6% by measurement of  $\sigma(45^\circ)$  but they also show that a bias is introduced by the water type.

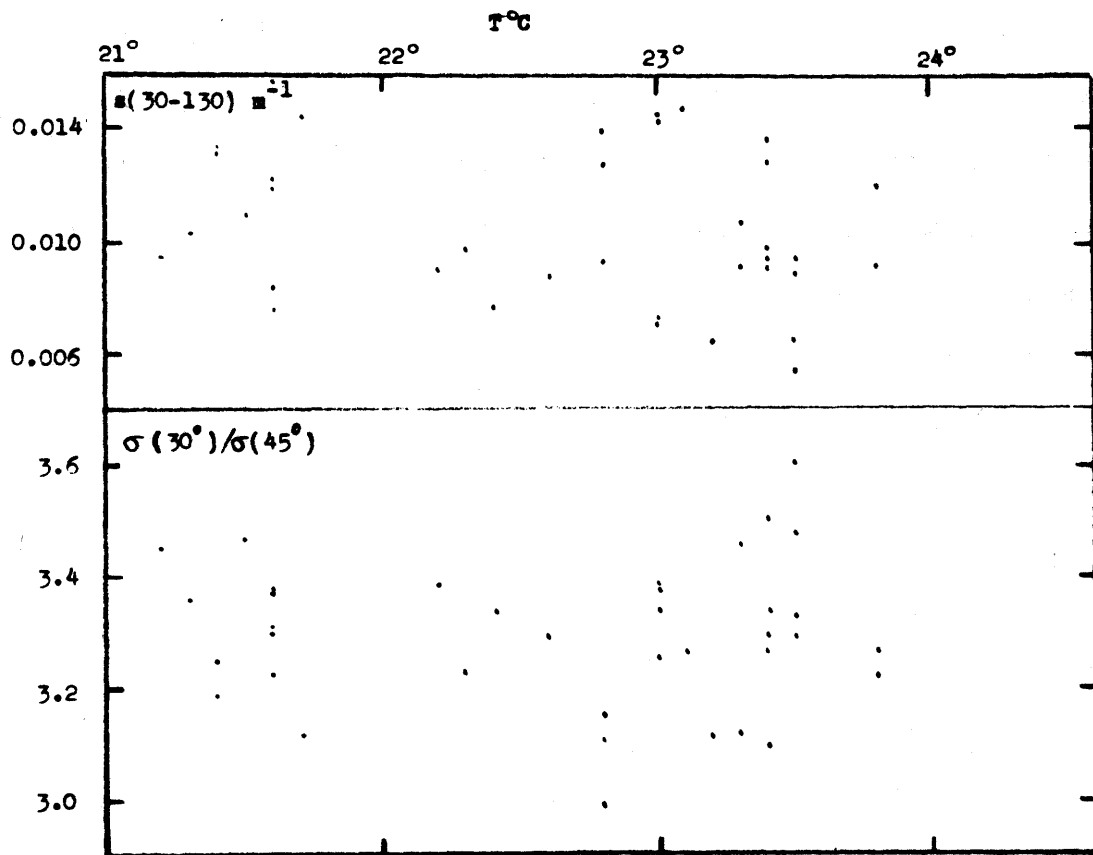


Fig. 4.5-28.  $s(30-130)$  and  $\sigma(30^\circ)/\sigma(45^\circ)$  as a function of temperature in the neighborhood of the thermal front.

TABLE 4-1

	$s(30-130)/\sigma(30^\circ)$	$s(30-130)/\sigma(45^\circ)$	$s/\sigma(30^\circ)$	$s/\sigma(45^\circ)$
	1.134±0.053	3.739±0.111	4.801±0.450	16.38±2.86
	1.207±0.097	4.044±0.202	5.417±0.712	18.05±2.83
water	1.171±0.070	4.119±0.209	6.064±1.663	21.96±7.75
ter	1.174±0.064	4.220±0.159	6.358±1.141	22.97±5.53
er	1.323±0.022	3.845±0.033	4.399±0.240	12.79±0.81
(including Bermuda water)	1.173±0.069	4.118±0.227	5.976±1.265	21.33±6.10

#### 4.56 "Total Scattering Coefficient"

The calculated values of the total scattering coefficient are subject to the errors discussed in Chapter Three which are introduced by extrapolation in the low angle range. In clear sea water the extrapolated values for  $0^\circ$  ran approximately a factor of five lower than that measured by Kozlyaninov (1957) for  $1^\circ$  and the measured values for  $\sigma(30^\circ)/\sigma(90^\circ)$  were smaller than the one reported by him; however, the samples in coastal water exhibited ratios that were near his value.

The values of the scattering coefficient ran from  $0.8\text{m}^{-1}$  in coastal waters to  $0.02\text{m}^{-1}$  in the clearest Sargasso waters, while the bulk of the open ocean values were in the neighborhood of  $0.04\text{m}^{-1}$ . These were considerably higher than those reported by Tyler (1961a) for the region between San Pedro Bay and San Clemente Island which were  $0.125\text{m}^{-1}$  closest to the California coast and decreased to  $0.1\text{m}^{-1}$  farthest from land.

Tyler's measurement of  $\sigma(90^\circ)$  was approximately a factor of three below the value for theoretical water calculated by the method of Dawson and Hulburt (1941), and the data reported here are occasionally as much as 30% below the theoretical value. The measurements of other investigators of the absolute value of the volume scattering function do

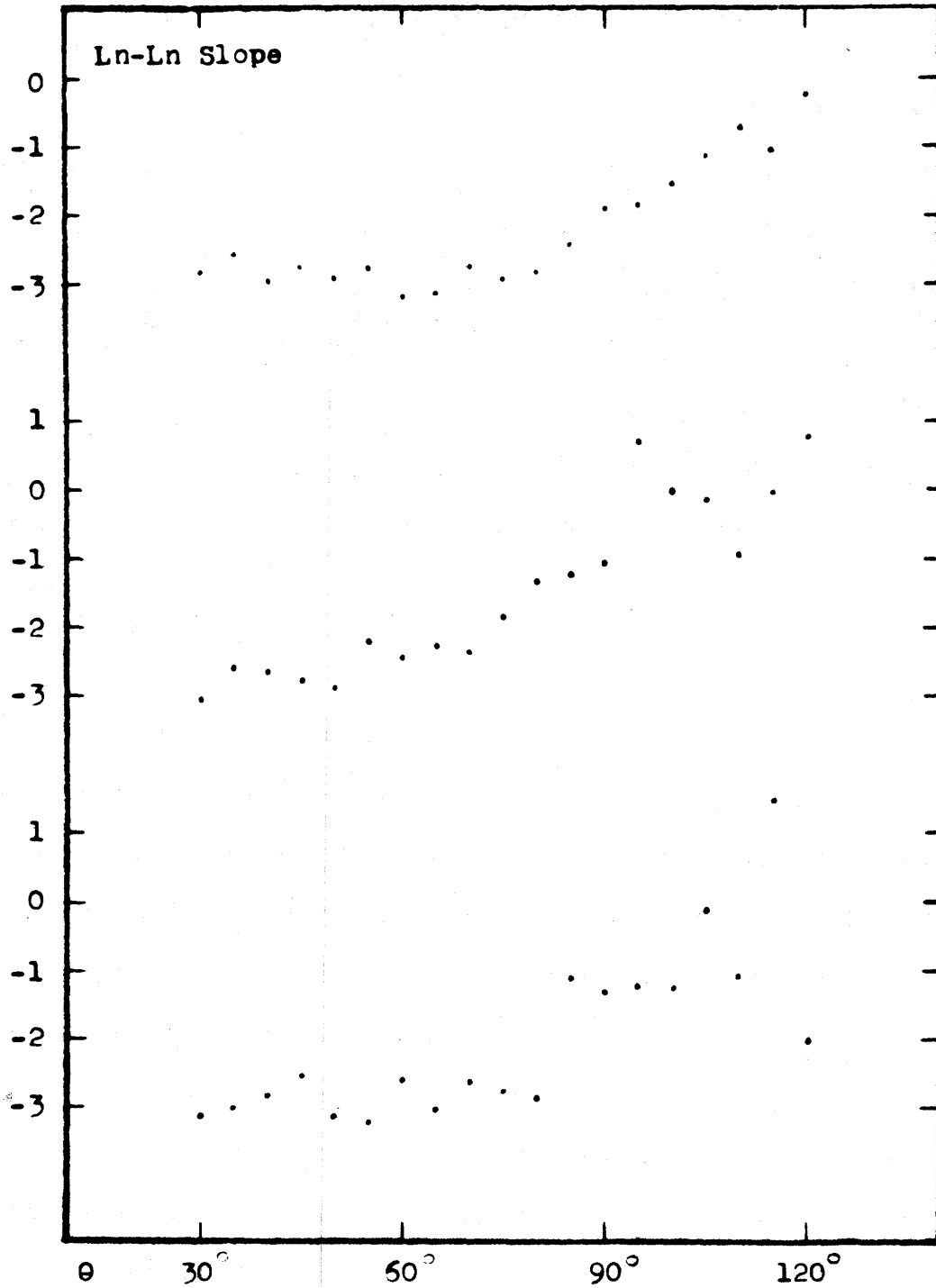


Fig. 4.5-29. ln-ln slopes against  $\theta$  for sample numbers: CH42/2, CH42/38, and CR101/13.

not show a discrepancy; thus, Jerlov (1961) shows the curve for theoretical water slightly below his measured values throughout the back scattering region.

#### 4.57 "Ln-Ln Slope"

The ln-ln slope, when plotted against angle, frequently showed that  $\sigma(\theta)$  was an exponential function of  $\theta$  at angles between  $30^\circ$  and  $90^\circ$ . Three examples of this behavior are shown in Figure 4.5-28. A single region of horizontal line behavior may be shown extending all the way to  $90^\circ$  or there may be two or three successive levels. No trends in either magnitude or extent of these features with water characteristics are immediately obvious.

#### 4.58 "Summary"

The results for the five major water types and for the thermal front show that surface samples in the western North Atlantic can be characterized to some extent by the ratio  $\sigma(30^\circ)/\sigma(45^\circ)$  and by the partial scattering coefficient,  $s(30-130)$ ; however, no correlation was found between these scattering parameters and temperature, salinity or depth in the hydrographic station samples. These latter samples did show the complexity of subsurface particulate distributions.

It has also been shown that  $s(30-130)$  can be determined by measurement of  $\sigma(45^\circ)$  if one is willing to accept a 6% uncertainty.

## CHAPTER FIVE

## SPECULATION AND SUGGESTIONS

A broad look at light scattering in sea water has revealed that it may prove to be a useful tool in many branches of oceanography. Sizable variations in the magnitude and shape of the volume scattering function were observed throughout the area surveyed.

An increase in the measured values of forward scattering was observed coincident with two minor thermal fronts and a sharp peak was noticed near the western edge of the Gulf Stream. The later peak may have been associated with the cold ribbon of shelf water discussed by Ford et al (1952); however, the data are not good enough to make such a claim yet.

These observations illustrate the necessity of work with "in situ" instruments. The forward scattering measurements were plagued with bubble troubles during rough weather; these bubbles contributed substantially to the scattering and some of them were created by the sampling system. The continuous trace of the forward scattering, however, provided a type of picture not previously available. It was possible to observe directly the extent of variations in the total scattering and to link them to other physical parameters. Similar continuous studies in

the vertical dimension would reveal layers of accumulation and paucity of particles.

Jerlov (1961) points to the constancy of the volume scattering function as an important feature of sea water. In detail this is not the case, rather the shape varies with the water type. This variation can be detected by measuring the ratio  $\sigma(30^\circ)/\sigma(45^\circ)$  for which purpose simple "in situ" instrumentation should be devised. If the absolute value of  $\sigma(30^\circ)$  is determined, a relatively precise estimate of  $s(30-130)$  can also be made. Figure 5.1 shows  $s(30-130)/\sigma(30^\circ)$  plotted against  $\sigma(30^\circ)/\sigma(45^\circ)$ . The best straight line that can be drawn through these points as determined by the method of least squares is also plotted, showing that an improvement in precision is made by using such a regression equation rather than the numerical average of all the values of  $s(30-130)/\sigma(\theta)$ .

The study of many aspects of oceanography may be enhanced by the employment of such a device. Features such as convection cells may lend themselves to study by these means, and, on a broader scale, the mixing between the slope and shelf water could be a fruitful topic for research.



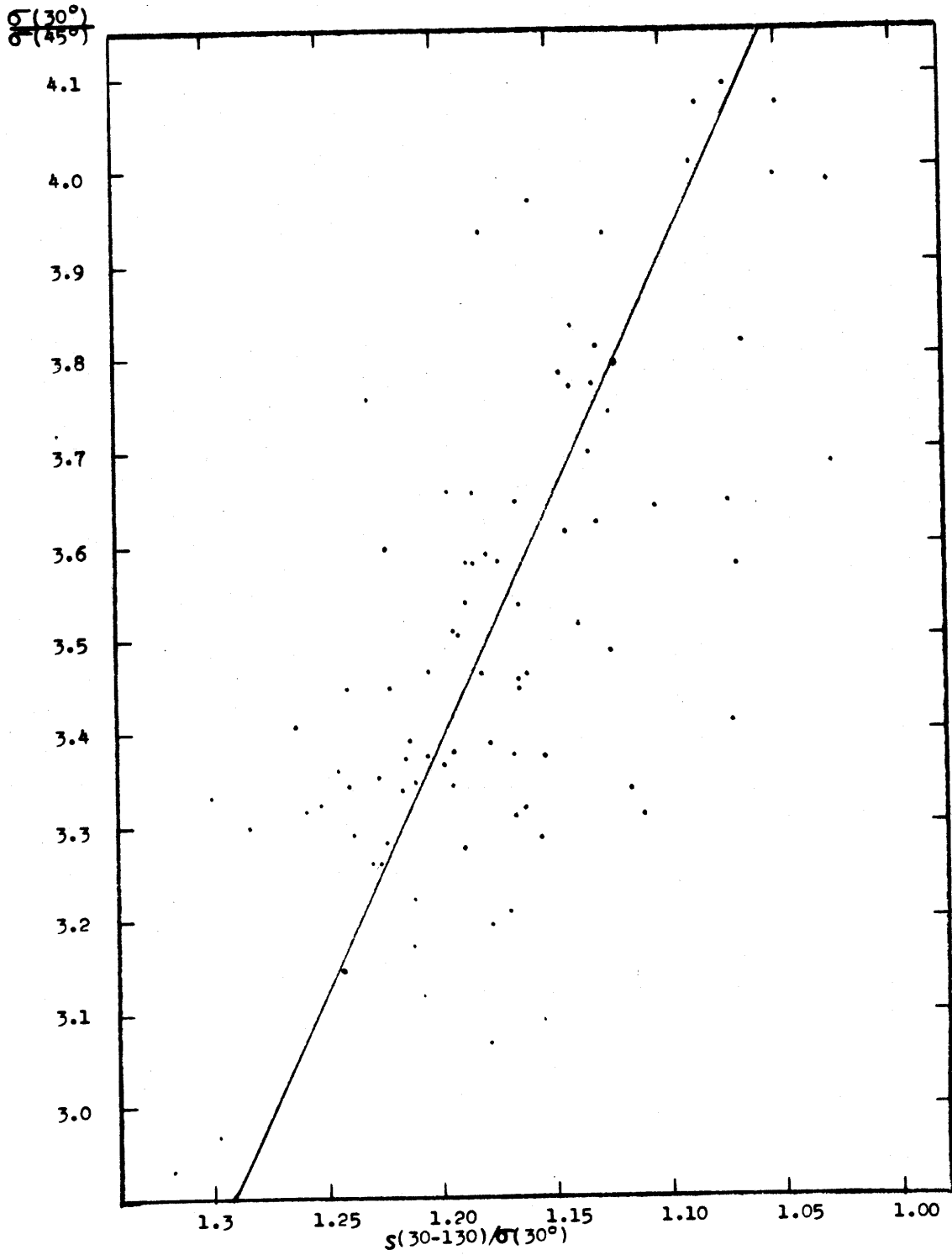


Fig. 5-1.  $s(30-130)/\sigma(30^\circ)$  against  $\sigma(30^\circ)/\sigma(45^\circ)$ .

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## BIOGRAPHIC SKETCH

The author, Athelstan Frederick Spilhaus, Jr., was born in Boston, Massachusetts on 21 May 1938. His secondary school education was at the Saint Paul Academy, a private military, country day school in Saint Paul, Minnesota. He entered M. I. T. in September 1955. In June 1959 he received an S. B. in Chemical Engineering and in June 1960 an S. M. in Geology and Geophysics. Since that time he has been pursuing a doctoral program at M. I. T. in which the research phases were carried out at Woods Hole Oceanographic Institution.

During the school year 1960-61 he held a teaching assistantship in the Department of Geology and Geophysics. In the years 1961-62 and 1963-64 he held research assistantships while, a Gulf Research and Development Corp. fellowship supported him in 1962-63. At present he is a research assistant.

He is a member of Sigma Xi and numerous professional societies.

In 1960 he married Sharon Brown of Saint Paul, Minnesota. They have one son, Athelstan Frederick, III, born in 1962.

## APPENDICES

## APPENDIX A

## OBSERVED DATA

The data obtained using the Brice-Phoenix Light Scattering Photometer are tabulated on the following pages in the form in which they appear on punched cards for the computer input. Each sample is represented by four cards, the first card of which is a title card giving the sample number, the date, and the time when the sample was run. A complete list of positions, temperatures and salinities for the samples is given at the end of this section. Reference to this list is made by means of the sample number which appears after the slash in the first group of numbers. The symbols preceding the slash indicate the ship and cruise on which the data was taken. The numbers in parentheses indicate the station number. CH represents R/V Chain and CR, R/V Crawford. The remaining three lines contain the scattering data. Reading from left to right each group of seven numbers describes the value at one angle starting at  $30^\circ$  and going through  $135^\circ$ . The two remaining groups describe the transmitted beam before and after the angular measurements were made. The first three numbers in any group of seven are the output of the photomultiplier as recorded on the strip chart recorder. The remaining num-



bers, all ones and zeros, indicate which neutral density filters were in place when the measurement was made. These are arranged in order of increasing density. The first number represents the filter with the lowest density, and a one indicates that the filter represented was in the beam, while a zero indicates that it was not.

1 CR 101/1	18 XI 63	2000H	CELL=1						
8.001101	4.301101	5.401110	7.100110	4.700110	7.101010	5.001010	7.501100		
6.201100	4.601100	8.000100	6.500100	5.900100	5.600100	5.000100	4.900100		
4.750100	4.900100	5.150100	6.200100	7.600100	8.850100	8.610111	9.650111		
1 CR 101/2	18 XI 63	2100H	CELL=1						
5.251101	5.651110	7.000110	4.500110	6.001010	4.001010	6.001100	4.351100		
7.300100	5.700100	4.600100	4.000100	7.201000	6.401000	6.251000	6.001000		
6.101000	6.401000	6.801000	7.801000	9.501000	5.800100	7.800111	8.400111		
1 CR 101/3	18 XI 63	2215H	CELL=1						
5.201101	6.001110	7.300110	4.600110	6.501010	4.401010	6.601100	4.801100		
3.801100	6.150100	5.000100	4.150100	3.700100	3.450100	3.300100	3.250100		
3.300100	3.450100	3.750100	4.300100	5.100100	6.200100	8.700111	9.000111		
1 CR 101/4	19 XI 63	0000H	CELL=1						
5.201101	6.001110	7.500110	4.900110	6.301010	4.601010	6.501100	5.001100		
7.800100	6.400100	5.000100	4.150100	3.790100	3.300100	3.150100	3.050100		
3.150100	3.250100	3.500100	3.900100	4.700100	5.700100	9.100111	9.050111		
1 CR 101/5	19 XI 63	0300H	CELL=1						
6.701110	7.000110	4.200110	5.201010	6.501100	4.701100	6.800100	5.200100		
4.050100	3.250100	5.401000	4.351000	3.901000	3.651000	3.551000	3.551000		
3.551000	3.801000	4.201000	4.501000	5.251000	6.401000	8.700111	7.800111		
1 CR 101/6	19 XI 63	0600H	CELL=1						
8.300110	4.600110	5.401010	6.801100	4.701100	7.000100	4.700100	3.600100		
5.701000	4.601000	3.801000	3.251000	5.900000	5.400000	5.300000	5.300000		
5.400000	5.750000	6.500000	7.400000	4.201000	5.101000	6.620111	6.600111		
1 CR 101/7	19 XI 63	0720H	CELL=1						
6.151110	7.050110	4.200110	5.201010	7.201100	5.501100	3.801100	6.100100		
4.600100	7.601000	6.001000	5.601000	4.901000	4.751000	4.501000	4.500100		
4.251000	4.751000	5.201000	5.501000	6.301000	9.101000	5.051111	5.301111		
1 CR 101/46	3 XII 63	1000H	CELL=1						
8.601011	5.001011	6.351101	8.601110	6.051110	8.900110	6.700110	5.200110		
8.251010	6.751010	5.551010	9.451100	8.351100	7.601100	7.051100	6.651100		
6.601100	6.901100	7.201100	7.901100	8.851100	5.251010	8.501111	8.601111		
1 CR 101/8	19 XI 63	0830H	CELL=2						
4.200110	4.501010	5.501100	7.400100	5.100100	7.201000	5.201000	4.001000		
6.200000	5.100000	4.150000	3.800000	3.400000	3.250000	3.200000	3.150000		
3.150000	3.300000	3.550000	4.000000	4.550000	5.350000	5.651111	5.251111		
1 CR 101/9	19 XI 63	0930H	CELL=2						
4.950110	5.401010	3.401010	4.501100	6.150100	4.350100	6.701000	5.201000		
4.051000	6.700000	6.200000	5.400000	4.750000	4.500000	4.200000	4.200000		
4.200000	4.400000	4.900000	5.300000	5.800000	7.000000	9.150111	9.250111		
1 CR 101/10	19 XI 63	1040H	CELL=2						
7.901010	8.501100	5.101100	6.850100	4.760100	6.831000	5.211000	4.001000		
6.350000	5.250000	4.420000	3.850000	3.500000	3.400000	3.320000	3.350000		
3.410000	3.600000	4.020000	4.480000	5.200000	6.370000	8.300111	8.400111		
1 CR 101/11	19 XI 63	1130H	CELL=2						
6.201010	7.001100	8.500100	5.700100	3.800100	5.801000	4.601000	7.400000		
5.800000	4.950000	4.600000	4.200000	4.300000	4.200000	4.100000	4.150000		
4.100000	4.150000	5.100000	5.700000	5.700000	6.700000	5.901111	5.351111		
1 CR 101/12	19 XI 63	1330H	CELL=2						
9.401010	5.251010	5.651100	7.430100	5.000100	7.201000	5.251000	3.951000		
6.300000	4.850000	4.050000	3.530000	3.250000	3.000000	3.000000	3.000000		
3.000000	3.050000	3.500000	3.820000	4.300000	5.000000	4.751111	4.301111		
1 CR 101/13	19 XI 63	1410H	CELL=2						
8.701010	4.701010	5.651100	7.500100	5.300100	3.700100	5.301000	8.400000		
6.500000	5.300000	4.400000	3.700000	3.500000	3.300000	3.200000	3.150000		
3.300000	3.400000	3.900000	4.400000	4.900000	5.800000	4.501111	4.431111		
1 CR 101/14	19 XI 63	1510H	CELL=2						
7.301010	8.451100	4.821100	6.400100	4.200100	5.821000	4.271000	6.700000		
5.020000	3.950000	3.420000	3.000000	2.800000	2.600000	2.500000	2.700000		

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2.800000	2.870000	3.200000	3.530000	4.000000	4.800000	4.401111	4.251111
1 CR 101/15 19 XI 63 1605H CELL=2							
7.801010	7.701100	4.801100	6.250100	8.401000	6.101000	4.351000	6.850000
5.420000	4.300000	3.500000	3.070000	2.800000	2.700000	2.650000	2.650000
2.750000	2.850000	3.250000	3.600000	4.100000	4.850000	4.451111	4.501111
1 CR 101/16 19 XI 63 1630H CELL=2							
4.651001	4.851010	5.951100	3.951100	5.550100	3.750100	5.351000	4.001000
6.500000	5.200000	4.350000	3.650000	3.320000	3.200000	3.000000	2.900000
3.000000	3.200000	3.500000	3.800000	4.350000	5.250000	4.561111	4.401111
1 CR 101/17 19 XI 63 1710H CELL=2							
9.021010	4.601010	5.301100	6.600100	4.400100	6.201000	4.601000	7.200000
5.650000	4.500000	3.850000	3.400000	3.200000	2.950000	2.950000	2.950000
3.100000	3.200000	3.490000	3.900000	4.450000	5.250000	4.401111	4.401111
1 CR 101/18 19 XI 63 1740H CELL=2							
5.900110	6.701010	7.501100	4.801100	6.800100	4.600100	6.901000	5.401000
8.800000	6.800000	5.900000	5.100000	4.650000	4.400000	4.150000	4.300000
4.300000	4.300000	4.750000	5.150000	5.800000	6.550000	9.200111	9.320111
1 CR 101/19 19 XI 63 1820H CELL=2							
8.731010	9.151100	5.201100	7.250100	5.000100	7.301000	5.551000	8.600000
6.720000	5.370000	4.400000	3.850000	3.490000	3.270000	3.230000	3.200000
3.100000	3.170000	3.450000	3.700000	4.100000	4.900000	9.500111	8.400111
1 CR 101/20 19 XI 63 1840H CELL=2							
5.001010	5.031100	5.700100	7.001000	5.101000	7.600000	5.900000	4.500000
3.700000	3.000000	2.600000	2.200000	2.000000	1.950000	1.900000	1.950000
2.050000	2.050000	2.400000	2.650000	2.950000	3.520000	8.400111	9.050111
1 CR 101/21 19 XI 63 1930 CELL=2							
5.451010	5.721100	6.730100	8.401000	5.531000	8.100000	6.170000	4.900000
4.080000	3.370000	2.880000	2.650000	2.450000	2.370000	2.320000	2.400000
2.510000	2.550000	2.850000	3.200000	3.610000	4.500000	8.500111	8.700111
1 CR 101/22 19 XI 63 2045H CELL=2							
5.501010	5.701100	6.600100	8.351000	5.401000	7.900000	5.770000	4.500000
3.550000	2.900000	2.500000	2.200000	2.000000	1.900000	1.820000	1.900000
1.920000	2.000000	2.300000	2.500000	2.740000	3.190000	8.150111	7.700111
1 CR 101/23 19 XI 63 2200H CELL=2							
7.501010	8.301100	4.751100	6.050100	8.531000	5.901000	9.300000	6.850000
5.350000	4.500000	3.720000	3.330000	3.010000	2.860000	2.850000	2.780000
2.870000	3.000000	3.260000	3.750000	4.230000	5.150000	9.500111	9.400111
1 CR 101/24 19 XI 63 2300H CELL=2							
5.861010	6.201100	7.400100	4.650100	6.331000	9.200000	6.900000	5.400000
4.180000	3.430000	3.000000	2.680000	2.520000	2.400000	2.400000	2.400000
2.500000	2.550000	3.000000	3.450000	4.000000	4.800000	8.950111	9.150111
1 CR 101/25 19 XI 63 2350H CELL=2							
5.701010	5.931100	7.400100	4.700100	6.501000	4.601000	7.000000	5.230000
4.100000	3.400000	2.950000	2.550000	2.350000	2.350000	2.250000	2.300000
2.400000	2.600000	2.950000	3.400000	4.050000	5.100000	9.350111	9.000111
1 CR 101/26 20 XI 63 0045H CELL=2							
8.501100	4.701100	5.700100	7.451000	5.321000	7.300000	5.650000	4.200000
3.500000	2.800000	2.500000	2.250000	2.100000	2.000000	2.000000	2.100000
2.100000	2.200000	2.450000	2.800000	3.200000	3.700000	8.500111	8.350111
1 CR 101/27 20 XI 63 0250H CELL=2							
4.901010	5.401100	6.950100	8.601000	5.801000	4.651000	7.000000	5.500000
4.080000	3.400000	2.950000	2.600000	2.300000	2.250000	2.250000	2.100000
2.120000	2.200000	2.450000	2.650000	3.050000	3.450000	7.450111	7.450111
1 CR 101/28 20 XI 63 0445H CELL=2							
4.601010	5.001100	6.300100	8.001000	5.501000	8.300000	6.200000	4.750000
3.850000	3.050000	2.650000	2.450000	2.100000	2.000000	1.950000	1.900000
1.950000	2.050000	2.400000	2.700000	3.300000	3.750000	6.650111	6.850111

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1 CR 101/29 20 XI 63 0640H CELL=2							
7.501100	8.350100	4.800100	6.451000	8.900000	6.400000	4.650000	3.650000
2.900000	2.350000	2.000000	1.800000	1.650000	1.500000	1.500000	1.550000
1.600000	1.630000	1.750000	1.950000	2.250000	2.650000	6.850111	7.000111
1 CR 101/30 20 XI 63 0730H CELL=2							
9.700100	5.400100	6.001000	7.800000	5.200000	3.800000	2.950000	2.300000
1.850000	1.600000	1.300000	1.150000	1.150000	1.130000	1.150000	1.200000
1.240000	1.250000	1.400000	1.550000	1.850000	2.250000	6.700111	7.050111
1 CR 101/31 20 XI 63 0830H CELL=2							
7.301100	7.950100	4.500100	5.651000	7.950000	5.700000	4.430000	3.370000
2.800000	2.250000	1.950000	1.700000	1.630000	1.500000	1.550000	1.500000
1.550000	1.620000	1.900000	2.000000	2.200000	2.650000	6.500111	6.600111
1 CR 101/32 20 XI 63 1030H CELL=2							
6.351100	6.600100	7.201000	4.701000	6.200000	4.600000	3.600000	2.850000
2.350000	1.950000	1.650000	1.500000	1.400000	1.400000	1.400000	1.400000
1.500000	1.550000	1.750000	2.000000	2.220000	2.650000	6.650111	6.500111
1 CR 101/33 20 XI 63 1230H CELL=2							
8.501100	4.501100	5.350100	6.651000	4.801000	6.600000	4.920000	3.950000
3.200000	2.610000	2.160000	2.000000	1.820000	1.760000	1.750000	1.710000
1.750000	1.850000	2.100000	2.200000	2.450000	2.950000	6.750111	7.100111
1 CR 101/34 20 XI 63 1330H CELL=2							
5.701100	6.000100	6.701000	4.201000	5.900000	4.550000	3.500000	2.800000
2.350000	1.900000	1.600000	1.400000	1.350000	1.300000	1.400000	1.400000
1.400000	1.450000	1.550000	1.700000	1.900000	2.250000	7.100111	6.750111
1 CR 101/35 20 XI 63 1430H CELL=2							
5.951010	5.951100	7.050100	8.701000	5.701000	4.151000	6.500000	4.900000
4.000000	3.250000	2.850000	2.500000	2.300000	2.150000	2.200000	2.200000
2.300000	2.400000	2.600000	2.700000	3.130000	3.650000	6.900111	6.900111
1 CR 101/36 20 XI 63 1530H CELL=2							
7.351100	7.300100	8.551000	5.201000	7.400000	5.500000	4.100000	3.220000
2.600000	2.120000	1.650000	1.550000	1.480000	1.400000	1.350000	1.400000
1.450000	1.450000	1.550000	1.780000	2.050000	2.400000	6.980111	6.650111
1 CR 101/37 20 XI 63 1630H CELL=2							
7.101100	7.600100	8.901000	5.351000	7.400000	5.500000	4.200000	3.200000
2.700000	2.200000	1.700000	1.600000	1.400000	1.400000	1.400000	1.450000
1.500000	1.550000	1.700000	1.850000	2.050000	2.400000	6.400111	6.000111
1 CR 101/38 20 XI 63 1730H CELL=2							
5.551100	5.750100	6.801000	8.800000	5.650000	4.200000	3.330000	2.750000
2.150000	1.750000	1.500000	1.300000	1.220000	1.200000	1.250000	1.250000
1.300000	1.350000	1.470000	1.650000	1.930000	2.330000	6.030111	6.550111
1 CR 101/39 20 XI 63 1910H CELL=2							
6.401010	6.401100	7.250100	9.001000	6.051000	8.650000	7.000000	5.450000
4.250000	3.350000	2.800000	2.400000	2.200000	2.050000	2.050000	2.100000
2.150000	2.250000	2.400000	2.700000	3.050000	3.600000	5.501111	4.751111
1 CR 101/40 20 XI 63 1930H CELL=2							
7.981100	8.550100	5.050100	6.301000	8.550000	6.300000	5.100000	3.980000
3.340000	2.800000	2.430000	2.200000	2.050000	2.140000	2.150000	2.150000
2.200000	2.340000	2.650000	2.950000	3.350000	3.950000	5.001111	5.011111
1 CR 101/41 20 XI 63 2030H CELL=2							
7.551100	8.000100	9.001000	5.501000	7.450000	5.600000	4.150000	3.400000
2.750000	2.320000	2.100000	1.850000	1.780000	1.700000	1.700000	1.730000
1.830000	1.860000	2.050000	2.300000	2.550000	2.980000	5.301111	4.901111
1 CR 101/42 20 XI 63 2130H CELL=2							
8.221100	8.600100	4.800100	5.951000	7.900000	5.750000	4.350000	3.450000
2.800000	2.300000	2.000000	1.850000	1.650000	1.600000	1.600000	1.650000
1.700000	1.750000	1.950000	2.200000	2.500000	3.080000	8.400111	8.050111
1 CR 101/43 20 XI 63 2230H CELL=2							

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6.751100	7.300100	8.151000	5.201000	7.200000	4.950000	3.650000	2.950000
2.300000	1.900000	1.750000	1.550000	1.500000	1.450000	1.450000	1.480000
1.480000	1.550000	1.700000	1.850000	2.150000	2.550000	8.100111	7.900111
1 CR 101/44	20 XI 63	2330H	CELL=2				
5.751100	6.150100	6.951000	8.400000	5.500000	3.900000	2.850000	2.300000
1.830000	1.500000	1.350000	1.300000	1.230000	1.180000	1.200000	1.200000
1.300000	1.280000	1.410000	1.600000	1.850000	2.350000	7.350111	7.250111
1 CR 101/45	21 XI 63	1940H	CELL=2	ST GEORGES	HBR		
6.251011	7.151101	8.901110	5.901110	8.400110	6.200110	4.600110	6.901010
5.601010	4.501010	7.201100	6.451100	5.501100	4.951100	4.601100	4.351100
4.251100	4.351100	4.451100	4.701100	5.201100	6.201100	8.151111	7.251111
1 CR 101/47	3 XII 63	1035H	CELL=2	=2 BOUY	ST DAVIDS		
5.001110	6.000110	7.601010	5.051010	7.101100	5.101100	7.600100	5.850100
4.650100	7.601000	6.251000	5.451000	5.001000	4.601000	4.351000	4.401000
4.351000	4.601000	4.801000	5.351000	6.301000	7.501000	7.821111	7.821111
1 CR 101/483	XII 63	1130H	CELL=2	100 FM	CURVE BOUY		
6.501110	7.500110	4.750110	6.351010	8.451100	6.351100	4.801100	7.600100
6.200100	4.900100	8.151000	7.051000	6.101000	5.851000	5.501000	5.101000
5.301000	5.501000	5.401000	5.901000	6.901000	8.001000	6.401111	5.901111
1 CR 101/49	3 XII 63	1200H	CELL=2				
6.101110	6.500110	8.401010	5.201010	6.801100	5.301100	3.801100	5.700100
4.500100	7.601000	6.501000	5.901000	5.101000	4.701000	4.451000	4.401000
4.301000	4.501000	5.001000	5.301000	5.901000	7.201000	5.101111	4.401111
1 CR 101/50	3 XII 63	1300H	CELL=2				
5.350110	5.701010	7.001100	4.301100	6.150100	4.500100	7.001000	5.401000
8.400000	6.350000	8.600000	5.200000	4.750000	4.150000	4.300000	4.500000
4.400000	4.600000	5.100000	5.550000	6.550000	8.250000	5.121111	5.331111
1 CR 101/51	3 XII 63	1400H	CELL=2				
7.301010	7.651100	4.601100	6.100100	4.100100	6.051000	4.701000	8.200000
6.200000	4.900000	3.900000	3.650000	3.250000	3.200000	3.200000	3.050000
3.200000	3.450000	3.700000	4.150000	4.750000	5.850000	5.101111	5.171111
1 CR 101/52	3 XII 63	1500H	CELL=2				
8.101010	8.501100	5.001100	6.450100	4.650100	6.501000	4.951000	7.900000
5.900000	4.900000	4.200000	3.600000	3.250000	3.100000	3.050000	2.950000
3.050000	3.150000	3.550000	3.850000	4.500000	5.400000	9.670111	8.100111
1 CR 101/52	3 XII 63	1500H	CELL=2				
8.101010	8.501100	5.001100	6.450100	4.650100	6.501000	4.951000	7.900000
5.900000	4.900000	4.200000	3.600000	3.250000	3.100000	3.050000	2.950000
3.050000	3.150000	3.550000	3.850000	4.500000	5.400000	9.670111	8.100111
1 CR 101/53	3 XII 63	1600H	CELL=2				
7.401010	7.701100	9.400100	5.900100	8.401000	6.201000	9.500000	7.300000
5.600000	4.550000	4.050000	3.650000	3.150000	3.050000	2.900000	3.000000
3.100000	3.200000	3.400000	3.900000	4.450000	5.250000	5.281111	5.101111
1 CR 101/54	3 XII 63	1700H	CELL=2				
6.501010	6.901100	8.500100	5.500100	7.851000	5.601000	8.600000	6.650000
5.050000	4.250000	3.600000	3.250000	2.850000	2.700000	2.650000	2.650000
2.750000	2.850000	3.050000	3.400000	3.900000	4.700000	5.101111	5.251111
1 CR 101/55	3 XII 63	1800H	CELL=2				
4.900110	5.151010	6.151100	7.850100	5.700100	7.801000	5.901000	4.701000
7.300000	6.100000	5.200000	4.100000	3.850000	3.500000	3.400000	3.350000
3.500000	3.650000	3.850000	4.200000	4.800000	5.800000	9.970111	9.650111
1 CR 101/56	3 XII 63	1900H	CELL=2				
4.951010	5.401100	6.800100	8.701000	5.751000	8.600000	6.350000	5.100000
4.150000	3.450000	3.000000	2.500000	2.300000	2.220000	2.250000	2.200000
2.250000	2.380000	2.550000	2.800000	3.300000	4.000000	8.230111	8.500111
1 CR 101/57	3 XII 63	2000H	CELL=2				
5.751010	6.201100	7.750100	4.750100	6.701000	4.951000	7.500000	5.900000

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4.500000	3.700000	3.300000	2.800000	2.500000	2.350000	2.250000	2.400000
2.400000	2.500000	2.650000	2.900000	3.250000	4.000000	8.320111	8.250111
1 CR 101/58 3 XII 63 2100H CELL=2							
5.251010	5.401100	6.600100	4.200100	5.801000	8.550000	6.500000	5.000000
4.050000	3.600000	2.950000	2.500000	2.350000	2.150000	2.080000	2.050000
2.100000	2.150000	2.350000	2.550000	2.950000	3.380000	8.650111	7.400111
1 CR 101/59 3 XII 63 2200H CELL=2							
9.701100	5.151100	6.550100	8.351000	5.701000	8.300000	6.200000	5.000000
4.000000	3.300000	2.900000	2.400000	2.200000	2.050000	2.050000	2.150000
2.150000	2.220000	2.370000	2.700000	3.050000	3.500000	8.900111	8.400111
1 CR 101/60 3 XII 63 2300H CELL=2							
5.501010	6.051100	7.500100	4.650100	6.501000	9.750000	7.150000	5.600000
4.700000	3.750000	3.000000	2.850000	2.550000	2.400000	2.250000	2.350000
2.350000	2.500000	2.650000	2.900000	3.300000	3.900000	8.550111	8.820111
1 CR 101/61 4 XII 63 0100H CELL=2							
8.601100	9.100100	5.500100	7.501000	4.801000	7.850000	5.500000	4.700000
3.700000	3.100000	2.600000	2.300000	2.180000	2.100000	2.050000	2.150000
2.200000	2.250000	2.500000	2.700000	3.150000	3.700000	9.650111	9.750111
1 CR 101/62 4 XII 63 0300H CELL=2							
6.201010	6.901100	8.050100	5.200100	7.101000	5.101000	7.700000	5.550000
4.650000	3.700000	3.020000	2.650000	2.400000	2.350000	2.250000	2.250000
2.300000	2.400000	2.550000	2.850000	3.150000	3.900000	9.970111	9.300111
1 CR 101/63 4 XII 63 0500H CELL=2							
6.401010	7.001100	4.201100	5.400100	8.001000	5.501000	8.500000	6.500000
5.350000	4.300000	3.750000	3.450000	3.100000	2.850000	2.850000	2.850000
3.000000	3.100000	3.400000	3.800000	4.200000	5.100000	5.251111	5.061111
1 CR 101/64 4 XII 63 0800 CELL=2							
8.501010	4.901010	6.001100	8.100100	5.850100	8.501000	6.001000	5.001000
7.500000	6.250000	5.800000	5.000000	4.500000	4.050000	3.800000	3.900000
4.000000	4.200000	4.500000	5.000000	5.650000	6.800000	5.051111	4.831111
1 CR 101/65 4 XII 63 1140H CELL=2							
8.501010	9.201100	5.501100	7.150100	4.600100	7.351000	5.501000	4.101000
3.151000	6.000000	5.100000	4.500000	4.000000	3.700000	3.650000	3.600000
3.700000	3.900000	4.400000	4.750000	5.450000	6.450000	9.600111	9.050111
1 CR 101/66 4 XII 63 CELL=2 1315H STA 1575 PIPE SURFACE							
5.051010	5.451100	7.350100	4.400100	5.801000	4.401000	7.300000	5.400000
4.300000	3.500000	3.000000	2.600000	2.400000	2.300000	2.270000	2.300000
2.450000	2.500000	2.800000	3.100000	3.550000	4.220000	5.001111	5.051111
1 CR 101/67 4 XII 63 CELL=2 1410H STA 1575 SURFACE							
5.951010	6.501100	7.450100	5.020100	7.101000	5.251000	3.951000	6.000000
5.400000	4.000000	3.400000	3.000000	2.750000	2.600000	2.500000	2.450000
2.520000	2.600000	2.800000	3.150000	3.500000	4.250000	9.400111	8.700111
1 CR 101/68 4 XII 63 1425H STA 1575 50M BOTTLE							
6.401010	7.101100	9.300100	5.800100	4.500100	6.201000	4.601000	7.600000
6.200000	5.000000	4.300000	3.650000	3.450000	3.250000	3.200000	3.100000
3.250000	3.350000	3.550000	3.830000	4.400000	5.400000	8.150111	8.850111
1 CR 101/69 4 XII 63 1440H STA 1575 100M BOTTLE							
8.501010	4.701010	5.701100	7.500100	5.200100	7.551000	5.751000	8.600000
7.400000	6.000000	5.050000	4.450000	3.900000	3.600000	3.550000	3.650000
3.550000	3.600000	3.700000	4.150000	4.700000	5.650000	9.350111	9.300111
1 CR 101/70 4 XII 63 STA 1575 400M BOTTLE							
5.201100	6.000100	7.501000	5.001000	7.350000	5.300000	4.400000	3.400000
2.850000	2.450000	2.200000	1.910000	1.850000	1.850000	1.850000	1.900000
2.000000	2.050000	2.200000	2.400000	2.750000	3.300000	4.871111	4.801111
1 CR 101/71 4 XII 63 1520H STA 1575 700M BOTTLE							
6.801100	8.100100	5.000100	6.501000	4.701000	7.200000	5.500000	4.500000
3.800000	3.100000	2.700000	2.600000	2.350000	2.350000	2.350000	2.350000

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2.450000	2.500000	2.800000	3.150000	3.450000	4.050000	4.801111	4.851111
1CR101/72	4XII63	1535H	STA 1575	1000M	BOTTLE		
5.701010	6.801100	8.500100	5.900100	8.101000	6.101000	4.601000	7.400000
6.150000	5.150000	4.400000	3.950000	3.750000	3.500000	3.550000	3.450000
3.550000	3.650000	3.950000	4.300000	4.800000	5.700000	4.801111	4.951111
1CR101/73	4XII63	1550H	STA 1575	1500M	BOTTLE		
6.351100	6.850100	8.101000	5.301000	7.900000	6.000000	4.750000	3.800000
3.200000	2.800000	2.550000	2.400000	2.350000	2.350000	2.400000	2.350000
2.550000	2.600000	2.850000	3.200000	3.500000	4.050000	4.851111	5.001111
1CR101/74	4XII63	1610H	STA 1575	2000M	BOTTLE		
7.501010	4.201010	5.001100	6.900100	4.650100	6.901000	5.151000	8.500000
6.850000	5.500000	4.800000	4.250000	3.900000	3.700000	3.700000	3.600000
3.700000	3.850000	4.150000	4.500000	5.100000	6.100000	4.901111	4.951111
1 CR 101/75	4 XII 63	1750H	CELL=2				
4.851010	5.351100	6.700100	8.651000	6.401000	4.901000	7.500000	5.700000
4.550000	3.600000	3.100000	2.750000	2.650000	2.600000	2.600000	2.550000
2.750000	2.850000	3.350000	3.700000	4.120000	4.900000	8.950111	9.950111
1 CR 101/76	4 XII 63	2310H	CELL=2				
8.701010	4.851010	5.651100	7.500100	4.950100	7.001000	5.101000	4.251000
6.500000	5.600000	4.600000	4.200000	3.600000	3.350000	3.500000	3.600000
3.800000	4.000000	4.200000	4.650000	5.350000	6.650000	5.301111	5.201111
1 CR 101/77	4 XII 63	2340H	CELL=2				
5.300110	6.001010	7.151100	9.150100	5.800100	4.000100	5.701000	9.200000
7.300000	6.100000	5.350000	4.800000	4.500000	4.200000	4.000000	4.000000
4.050000	4.100000	4.600000	5.100000	5.900000	7.200000	5.151111	5.101111
1 CR 101/78	4 XII 63	2400H	CELL=2				
7.501010	8.401100	4.751100	6.100100	8.301000	5.801000	8.900000	7.050000
5.800000	4.600000	4.100000	3.650000	3.350000	3.300000	3.150000	3.200000
3.250000	3.400000	3.760000	4.200000	4.650000	5.600000	5.351111	5.201111
1 CR 101/79	5 XII 63	0020H	CELL=2				
8.401100	9.550100	5.800100	7.551000	5.101000	7.600000	5.800000	4.650000
3.750000	3.200000	2.800000	2.600000	2.400000	2.310000	2.300000	2.350000
2.450000	2.600000	2.800000	3.100000	3.520000	4.200000	8.800111	9.990111
1 CR 101/80	5 XII 63	0040H	CELL=2				
5.851010	6.501100	8.100100	5.100100	6.601000	5.001000	7.200000	6.000000
4.550000	3.800000	3.300000	2.850000	2.620000	2.550000	2.450000	2.550000
2.520000	2.600000	2.860000	3.200000	3.600000	4.350000	9.600111	4.901111
1 CR 101/81	5 XII 63	0100H	CELL=2				
5.051010	5.601100	6.650100	8.301000	5.651000	8.500000	6.350000	5.100000
4.200000	3.500000	2.950000	2.750000	2.600000	2.520000	2.600000	2.650000
2.750000	2.800000	3.100000	3.500000	3.950000	4.850000	5.001111	5.351111
1 CR 101/82	5 XII 63	0130H	CELL=2				
5.101010	5.651100	6.500100	8.201000	5.501000	8.000000	6.150000	4.800000
3.900000	3.300000	2.800000	2.580000	2.400000	2.340000	2.350000	2.350000
2.500000	2.650000	3.000000	3.300000	3.670000	4.360000	5.351111	5.501111
1 CR 101/83	5 XII 63	0200H	CELL=2				
9.151100	5.001100	6.250100	7.851000	5.251000	8.000000	5.850000	4.800000
3.900000	3.250000	2.800000	2.550000	2.400000	2.300000	2.300000	2.400000
2.450000	2.580000	2.800000	3.150000	3.550000	4.250000	5.401111	5.501111
1 CR 101/84	5 XII 63	0230H	CELL=2				
5.901010	6.301100	7.450100	4.600100	6.151000	9.400000	7.050000	5.300000
4.300000	3.700000	3.100000	2.800000	2.650000	2.600000	2.600000	2.600000
2.700000	2.900000	3.300000	3.750000	4.400000	5.450000	5.371111	5.601111
1 CR 101/85	5 XII 63	0300H	CELL=2				
6.401010	7.151100	8.750100	5.700100	7.601000	5.401000	8.600000	7.000000
5.500000	4.500000	3.700000	3.250000	3.030000	3.000000	3.000000	2.850000
3.150000	3.100000	3.350000	3.650000	4.150000	5.050000	5.451111	5.601111

1 CR 101/86 5 XII 63 0330H CELL=2  
 7.601010 8.051100 5.001100 6.600100 9.201000 6.301000 5.001000 7.850000  
 7.080000 5.550000 4.800000 4.300000 4.000000 3.900000 3.850000 3.800000  
 3.950000 4.200000 4.550000 5.000000 5.750000 6.800000 7.001111 8.451111  
 1 CR 101/87 5 XII 63 0400H CELL=2  
 5.201110 5.700110 7.001010 9.151100 6.301100 9.100100 6.550100 5.100100  
 8.151000 6.251000 5.401000 4.601000 8.500000 7.810000 7.650000 7.750000  
 7.800000 8.150000 4.351000 4.751000 5.601000 6.701000 8.251111 8.351111  
 1 CR 101/88 5 XII 63 0430H CELL=2 END VIS BUBBLES  
 5.300110 5.801010 6.901100 9.250100 6.250100 8.851000 6.751000 5.251000  
 8.250000 6.900000 5.750000 5.250000 4.700000 4.700000 4.500000 4.550000  
 4.600000 4.850000 5.350000 6.200000 7.300000 8.800000 8.301111 8.251111  
 1 CR 101/89 5 XII 63 0500H CELL=2  
 7.001110 7.900110 4.900110 6.301010 4.351010 6.401100 5.001100 7.200100  
 5.700100 4.500100 3.800100 3.300100 3.000100 2.600100 2.600100 5.301000  
 5.601000 5.301000 5.601000 6.301000 3.650100 4.500100 8.301111 8.251111  
 1 CR 101/90 5 XII 63 0530H CELL=2  
 6.200110 7.201010 8.501100 5.401100 7.300100 5.350100 7.601000 6.001000  
 4.501000 7.900000 6.850000 5.900000 5.700000 5.200000 5.100000 5.100000  
 5.300000 5.600000 6.100000 7.000000 8.000000 4.551000 8.221111 8.221111  
 1 CR 101/91 5 XII 63 0600H CELL=2  
 4.150110 4.501010 5.651100 7.150100 4.950100 7.151000 5.001000 3.851000  
 6.350000 5.200000 4.400000 4.970000 3.700000 3.600000 3.550000 3.700000  
 3.750000 3.850000 4.150000 4.820000 5.550000 6.600000 8.301111 8.301111  
 1 CR 101/92 5 XII 63 0700H CELL=2  
 5.500110 5.901010 7.451100 4.801100 6.800100 4.700100 7.301000 5.401000  
 8.800000 7.150000 6.450000 5.450000 5.200000 4.900000 4.700000 4.700000  
 4.850000 5.000000 5.350000 5.850000 6.450000 7.250000 8.451111 8.201111  
 1 CR 101/93 5 XII 63 0800H CELL=2  
 8.350110 4.700110 6.001010 7.201100 5.101100 7.350100 5.350100 8.401000  
 6.501000 5.601000 4.601000 8.000000 7.350000 7.050000 6.700000 6.850000  
 6.900000 7.250000 7.500000 8.450000 9.650000 5.551000 8.261111 8.201111  
 1CR101/94 5XII63 0900H STA 1576 PIPE SAMPLE CELL=2  
 8.300110 9.101010 5.701010 7.401100 5.001100 7.000100 5.350100 3.950100  
 6.501000 5.201000 4.501000 7.780000 6.750000 6.400000 6.200000 6.100000  
 6.300000 6.500000 6.950000 7.700000 4.351000 5.001000 8.151111 7.601111  
 1CR101/95 5XII63 STA 1576 SURFACE BOTTLE  
 5.450110 6.251010 7.551100 4.951100 7.000100 5.000100 7.551000 5.701000  
 4.651000 8.150000 6.750000 6.100000 5.650000 5.450000 5.250000 5.450000  
 5.450000 5.550000 6.200000 7.100000 8.000000 4.651000 7.321111 7.451111  
 1CR101/96 5XII63 STA 1576 50M BOTTLE  
 6.720110 7.401010 9.351100 6.001100 8.500100 5.900100 8.601000 6.601000  
 5.351000 8.800000 7.500000 6.500000 5.850000 5.650000 5.550000 5.250000  
 5.550000 5.650000 6.200000 6.750000 7.750000 9.150000 7.781111 7.751111  
 1CR101/97 5XII63 STA 1576 100M BOTTLE  
 9.051010 5.051010 6.401100 8.400100 5.750100 8.451000 6.401000 4.801000  
 7.800000 6.650000 5.700000 5.000000 4.600000 4.300000 4.280000 4.400000  
 4.400000 4.600000 4.900000 5.300000 6.000000 7.100000 8.001111 8.051111  
 1CR101/98 5XII63 1035H STA 1576 400M BOTTLE  
 5.501010 6.001100 7.700100 4.840100 7.051000 4.701000 8.000000 5.900000  
 4.900000 4.150000 3.400000 3.150000 2.950000 2.820000 2.850000 2.950000  
 3.100000 3.100000 3.380000 3.800000 4.150000 4.920000 8.021111 8.101111  
 1CR101/99 5XII63 1040H STA 1576 700M BOTTLE  
 5.351010 5.951100 7.700100 5.100100 7.301000 5.301000 8.350000 6.600000  
 5.400000 4.550000 4.000000 3.500000 3.400000 3.350000 3.350000 3.400000  
 3.600000 3.500000 3.900000 4.280000 4.700000 5.550000 8.151111 8.121111  
 1CR101/100 5XII63 STA 1576 1000M BOTTLE



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3.901010	4.001100	5.000100	6.501000	4.601000	7.200000	5.500000	4.400000
3.800000	3.200000	2.800000	2.600000	2.550000	2.500000	2.600000	2.700000
2.750000	2.800000	2.950000	3.300000	3.650000	4.350000	8.051111	8.001111
1CR101/101	5XII63 1125H STA 1576 1500M BOTTLE						
5.201010	5.051100	5.500100	6.951000	5.001000	3.701000	5.800000	4.800000
3.900000	3.300000	2.900000	2.700000	2.550000	2.550000	2.550000	2.700000
2.800000	2.800000	2.960000	3.400000	3.800000	4.350000	7.981111	7.901111
1CR101/102	5XII63 1140H STA 1576 2000M BOTTLE						
5.501100	5.750100	7.501000	5.001000	7.500000	5.400000	4.400000	3.600000
3.150000	2.650000	2.380000	2.200000	2.100000	2.150000	2.200000	2.300000
2.450000	2.500000	2.700000	2.900000	3.300000	3.800000	8.051111	8.051111
1CR101/103	5XII63 1700H STA 1577 PIPE SAMPLE						
4.801110	5.200110	6.051010	7.801100	5.201100	3.801100	5.100100	7.551000
6.101000	5.351000	4.301000	7.500000	6.550000	6.050000	5.900000	6.000000
6.200000	6.200000	6.700000	7.400000	4.101000	5.101000	8.001111	7.901111
1CR101/104	5XII63 1745H STA 1577 18M BOTTLE						
8.200110	9.251010	5.551010	7.201100	4.551100	6.600100	5.000100	6.801000
5.601000	4.501000	8.000000	6.700000	6.000000	5.600000	5.400000	5.500000
5.750000	5.780000	6.000000	6.700000	7.650000	9.350000	8.051111	7.901111
1CR101/105	5XII63 1805H STA 1577 60M BOTTLE						
4.750110	5.651010	6.551100	8.600100	5.800100	8.101000	6.201000	4.651000
7.000000	6.100000	5.200000	4.450000	4.100000	4.000000	3.900000	3.850000
4.150000	4.300000	4.450000	4.900000	5.650000	6.900000	8.001111	7.951111
1CR101/106	5XII63 1825H STA 1577 100M BOTTLE						
5.601010	6.201100	7.800100	5.000100	6.801000	5.001000	7.350000	5.750000
4.850000	3.700000	3.200000	2.850000	2.650000	2.500000	2.500000	2.500000
2.500000	2.600000	2.850000	3.100000	3.400000	4.050000	4.801111	4.521111
1CR101/107	5XII63 1855H STA 1577 140M BOTTLE						
5.401100	6.350100	7.701000	5.001000	7.000000	5.050000	3.700000	2.900000
2.400000	1.950000	1.650000	1.500000	1.400000	1.400000	1.400000	1.420000
1.450000	1.500000	1.550000	1.700000	1.900000	2.230000	6.950111	6.200111
1CR101/108	5XII63 1915H STA 1577 180M BOTTLE						
5.001100	5.900100	7.101000	4.801000	6.800000	4.700000	3.700000	2.900000
2.250000	1.850000	1.600000	1.480000	1.350000	1.350000	1.300000	1.350000
1.380000	1.400000	1.560000	1.700000	1.940000	2.250000	5.900111	5.800111
1CR101/109	5XII63 STA 1577 200M BOTTLE SUSPECT 0						
6.501100	7.900100	5.100100	6.701000	4.751000	7.200000	5.500000	4.250000
3.450000	2.900000	2.600000	2.300000	2.170000	2.150000	2.150000	2.250000
2.330000	2.400000	2.700000	3.100000	3.750000	4.700000	6.500111	5.500111
1CR101/110	5XII63 STA 1578 PIPE SAMPLE						
5.180111	5.831011	7.001101	9.201110	6.201110	4.501110	6.500110	5.000110
7.701010	6.201010	5.201010	8.701100	7.801100	7.101100	6.751100	6.451100
6.651100	6.801100	7.301100	8.101100	9.351100	5.621010	7.951111	8.001111
1CR101/111	5XII63 STA 1578 7M BOTTLE						
7.901011	8.901101	5.401101	7.101110	9.950110	6.850110	5.000110	7.601010
5.801010	9.201100	7.701100	6.401100	5.701100	5.201100	4.851100	4.701100
4.771100	5.051100	5.381100	6.031100	6.951100	8.631100	7.951111	8.051111
1CR101/112	5XII63 2300H STA 1578 17M BOTTLE						
8.281011	9.281101	5.651101	7.381110	5.001110	7.150110	5.150110	3.900110
6.101010	4.801010	8.101100	6.801100	6.101100	5.601100	5.201100	5.051100
5.101100	5.301100	5.701100	6.321100	7.401100	8.961100	8.001111	8.051111
1CR101/113	5XII63 STA 1578 27M BOTTLE						
8.101011	9.301101	5.651101	7.401110	5.051110	7.250110	5.250110	8.001010
6.201010	4.901010	8.151100	6.901100	6.001100	5.551100	5.151100	5.001100
5.101100	5.251100	5.651100	6.451100	7.401100	9.001100	8.051111	8.101111
1CR101/114	5XII63 STA 1578 37M BOTTLE						
7.081011	7.821101	4.781101	6.251110	8.800110	6.200110	9.101010	6.901010

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5.301010	8.401100	6.901100	6.001100	5.301100	4.701100	4.501100	4.301100
4.401100	4.601100	4.901100	5.551100	6.351100	7.771100	8.101111	8.051111
1CR101/115	5XII63	2340H	STA 1578	47M	BOTTLE		
8.051011	9.101101	5.501101	7.151110	4.851110	6.950110	5.100110	7.651010
5.851010	9.551100	7.901100	6.721100	5.901100	5.251100	4.921100	4.821100
4.901100	5.101100	5.501100	6.171100	7.201100	8.821100	8.001111	8.001111
1CR101/116	5XII63	STA 1578	57M	BOTTLE			
6.851011	7.681101	9.301110	6.101110	8.500110	6.000110	9.001010	6.701010
5.101010	8.451100	6.751100	5.751100	5.081100	4.601100	4.301100	4.221100
4.201100	4.401100	4.651100	5.351100	6.151100	7.451100	8.001111	8.151111
1CR101/117	5XII63	0020H	STA 1578	65M	BOTTLE	BOTTOM	
5.550111	6.351011	7.951101	5.201101	7.051110	4.950110	7.650110	5.750110
8.951010	7.051010	5.801010	5.001010	8.881100	8.051100	7.451100	7.301100
7.401100	7.651100	8.251100	9.201100	5.301010	6.301010	7.901111	7.951111
1CR101/118	6XII63	0900H	BETWEEN	HBR	BOUY'S		
8.300111	4.750111	5.701011	7.401101	5.101101	7.201110	5.351110	8.200110
6.400110	4.900110	8.301010	6.951010	6.051010	5.501010	5.051010	4.901010
5.021010	5.201010	5.601010	6.201010	7.201010	8.651010	7.651111	7.651111
1 CR 101/119	6 XII	63	0910H	AT	WHOI	DOCK	
5.250111	5.901011	7.201101	9.551110	6.451110	4.501110	6.600110	5.050110
7.351010	5.801010	4.551010	7.351100	6.251100	5.551100	5.301100	5.251100
5.401100	5.701100	6.251100	7.101100	8.251100	5.001010	7.851111	7.201111
1 CH42/1	1700 H	15164					
6.701011	7.901101	4.851101	6.501110	9.000110	6.250110	4.700110	7.051010
5.351010	4.351010	7.151100	5.901100	5.301100	4.751100	4.601100	4.401100
4.451100	4.601100	4.951100	5.401100	6.301100	8.051100	7.801111	7.731111
1 CH42/2	1800H	15164					
4.751011	5.401101	6.851110	9.000110	6.250110	4.450110	6.651010	4.951010
7.651100	6.201100	5.101100	8.800100	7.800100	7.200100	6.800100	6.650100
6.750100	7.150100	7.700100	8.700100	5.051100	6.201100	7.781111	7.921111
1 CH42/3	1900H	15164					
4.551101	5.401110	6.900110	8.851010	6.001010	8.501100	6.301100	4.801100
7.450100	6.100100	5.150100	9.001000	8.001000	7.101000	7.001000	6.701000
7.101000	7.301000	8.001000	4.500100	5.200100	6.550100	7.681111	7.651111
1 CH42/4	2000H	15164					
7.301101	8.351110	5.301110	7.200110	4.950110	7.001010	5.201010	8.001100
6.201100	4.901100	8.600100	7.350100	6.500100	6.000100	5.700100	5.550100
5.650100	5.900100	6.300100	7.100100	8.400100	5.051100	7.651111	7.551111
1 CH42/5	2100H	15164					
8.001110	9.300110	5.650110	7.501010	5.301010	7.401100	5.601100	8.500100
6.700100	5.350100	4.600100	7.901000	7.201000	6.751000	6.201000	6.001000
6.001000	6.351000	7.001000	7.801000	9.151000	5.600100	7.761111	7.701111
1 CH42/6	2200H	15164					
6.100110	7.001010	8.601100	5.501100	7.700100	5.500100	7.851000	6.101000
4.751000	4.001000	6.600000	6.000000	5.500000	5.100000	5.100000	5.100000
5.200000	5.300000	5.800000	6.550000	7.700000	4.551000	7.801111	7.751111
1 CH42/7	2300H	15164					
6.000110	6.701010	4.151010	5.351100	7.600100	5.500100	8.001000	6.201000
4.601000	8.050000	6.650000	6.000000	5.500000	5.150000	5.150000	5.150000
5.250000	5.400000	5.950000	6.750000	8.000000	4.801000	7.721111	7.701111
1 CH42/8	0800H	16164					
5.500110	6.351010	7.901100	5.251100	7.500100	5.500100	7.851000	6.001000
4.751000	3.901000	6.650000	5.700000	5.250000	4.850000	4.900000	4.950000
5.050000	5.250000	5.850000	6.800000	8.000000	4.801000	7.631111	7.661111
1 CH42/9	0900H	16164					
9.401010	5.051010	6.101100	8.000100	5.350100	7.601000	5.701000	4.451000
7.350000	6.000000	5.200000	4.700000	4.300000	5.150000	3.900000	4.050000

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4.200000	4.300000	4.750000	5.200000	6.200000	7.650000	7.561111	7.551111
1 CH42/10	1000H	16164					
6.051010	6.701100	8.600100	5.700100	7.901000	5.901000	4.601000	7.500000
6.100000	5.150000	4.500000	4.100000	3.850000	3.750000	3.750000	3.800000
3.900000	4.000000	4.450000	5.000000	5.650000	6.900000	7.401111	7.401111
1 CH42/11	1100H	16164					
6.301010	7.001100	4.301100	5.900100	8.251000	6.001000	4.601000	7.400000
5.850000	4.850000	4.200000	3.650000	3.400000	3.300000	3.250000	3.500000
3.650000	3.650000	3.900000	4.500000	5.300000	6.500000	7.351111	7.331111
1 CH42/12	1200H	16164					
4.750110	5.301010	6.251100	8.200100	5.700100	8.301000	6.151000	4.651000
7.800000	6.350000	5.350000	4.700000	4.250000	4.020000	4.000000	4.050000
4.100000	4.250000	4.750000	5.200000	6.100000	7.400000	7.401111	7.301111
1 CH42/13	1300H	16164					
6.550110	7.151010	8.501100	5.351100	7.650100	5.400100	8.101000	6.201000
5.001000	8.400000	7.100000	6.250000	5.700000	5.300000	5.200000	5.200000
5.300000	5.400000	5.800000	6.600000	7.700000	9.600000	7.401111	7.431111
1 CH42/14	1530H	16164					
4.801010	5.201100	6.550100	8.701000	6.101000	9.000000	6.800000	5.350000
4.400000	3.650000	3.150000	2.800000	2.600000	2.520000	2.600000	2.700000
2.800000	2.800000	3.100000	3.450000	4.080000	5.000000	7.551111	7.401111
1 CH42/15	1600H	16164					
9.000110	5.100110	6.151010	8.501100	5.651100	8.500100	6.500100	5.000100
7.901000	6.501000	5.551000	4.821000	9.200000	8.600000	8.300000	8.300000
8.250000	8.600000	4.451000	4.901000	5.601000	6.801000	7.441111	7.371111
1 CH42/16	1620H	16164					
9.301100	5.301100	6.800100	4.600100	6.301000	4.501000	7.200000	5.700000
4.500000	3.950000	3.250000	2.850000	2.750000	2.600000	2.700000	2.780000
2.900000	3.130000	3.300000	3.600000	4.150000	5.100000	7.471111	7.351111
1 CH42/17	1637H	16164					
6.200110	7.301010	9.251100	6.301100	8.900100	6.350100	4.950100	7.851000
6.201000	5.101000	8.600000	7.650000	6.700000	6.280000	6.150000	6.120000
6.150000	6.300000	6.800000	7.600000	8.700000	5.150000	7.351111	7.351111
1 CH42/18	1700H	16164					
4.601010	5.751100	7.250100	4.950100	7.001000	5.301000	4.001000	6.600000
5.250000	4.450000	3.800000	3.500000	3.250000	3.200000	3.150000	3.200000
3.400000	3.250000	3.550000	4.000000	4.600000	5.400000	7.351111	7.301111
1 CH42/19	1741H	16164					
4.751010	5.501100	7.200100	4.700100	6.751000	5.101000	7.800000	6.200000
5.000000	4.150000	3.650000	3.300000	3.100000	3.050000	3.050000	3.150000
3.150000	3.200000	3.400000	3.800000	4.250000	5.200000	7.351111	7.231111
1 CH42/20	1800H	16164					
6.851100	3.801100	5.150100	6.501000	4.651000	7.200000	5.650000	4.500000
3.800000	3.300000	3.000000	2.800000	2.700000	2.650000	2.700000	2.700000
2.800000	2.950000	3.200000	3.630000	4.120000	5.000000	7.191111	7.131111
1 CH42/21	1833H	16164					
6.651110	7.850110	4.800110	6.551010	9.001100	6.701100	5.001100	8.000100
6.500100	5.300100	8.901000	7.801000	7.051000	6.201000	6.001000	6.001000
5.901000	6.001000	6.601000	7.151000	8.151000	4.950100	7.101111	7.221111
1 CH42/22	1858H	16164					
7.401100	8.700100	5.300100	7.201000	5.151000	3.901000	6.500000	5.300000
4.350000	3.750000	3.350000	3.200000	3.100000	2.900000	3.000000	3.100000
3.250000	3.350000	4.000000	4.530000	5.220000	6.450000	7.151111	7.151111
1 CH42/23	1920H	16164					
4.671010	5.301100	6.500100	4.500100	6.501000	4.651000	7.200000	5.850000
4.900000	4.150000	3.750000	3.200000	3.050000	2.900000	3.000000	3.050000
3.150000	3.200000	3.550000	3.900000	4.450000	5.450000	7.261111	7.201111

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1 CH42/24	1940H	16164						
6.301100	6.800100	4.300100	5.501000	8.300000	6.100000	4.700000	3.900000	
3.200000	2.820000	2.450000	2.350000	2.250000	2.200000	2.300000	2.400000	
2.400000	2.450000	2.700000	3.100000	3.600000	4.200000	7.211111	7.131111	
1 CH42/25	1955H	16164						
7.101100	7.650100	4.800100	6.401000	4.851000	7.500000	5.600000	4.400000	
3.900000	3.350000	2.950000	2.750000	2.450000	2.400000	2.500000	2.650000	
2.700000	2.700000	2.900000	3.200000	3.700000	4.300000	7.301111	7.101111	
1 CH42/26	2020H	16164						
4.601010	5.201100	6.850100	4.500100	6.401000	4.801000	7.500000	5.900000	
4.800000	4.100000	3.500000	3.200000	2.950000	2.900000	2.900000	2.900000	
3.000000	3.050000	3.350000	3.650000	4.300000	5.100000	7.221111	7.151111	
1 CH42/27	2055H	16164						
7.550110	9.051010	5.701010	7.601100	5.501100	8.100100	6.200100	4.850100	
7.751000	6.501000	5.401000	4.801000	9.000000	8.400000	8.100000	7.800000	
7.900000	8.150000	8.900000	4.751000	5.601000	7.001000	7.001111	7.001111	
1 CH42/28	2110H	16164						
6.600110	7.551010	9.351100	6.201100	8.700100	6.300100	4.750100	7.501000	
6.051000	4.901000	8.400000	7.400000	6.850000	5.250000	5.200000	5.150000	
5.200000	6.500000	7.000000	7.600000	8.850000	5.251000	7.161111	7.101111	
1 CH42/29	0930H	17164						
4.701010	5.251100	6.600100	4.500100	6.451000	4.551000	7.150000	5.500000	
4.350000	3.650000	3.100000	2.750000	2.650000	2.550000	2.600000	2.700000	
2.800000	2.850000	3.050000	3.500000	4.000000	4.850000	7.381111	7.221111	
1 CH42/30	1007H	17164						
5.451010	6.051100	8.000100	5.200100	7.551000	5.601000	8.600000	6.500000	
5.400000	4.450000	3.900000	3.550000	3.300000	3.200000	3.250000	3.250000	
3.350000	3.450000	3.750000	4.100000	4.750000	5.750000	7.401111	7.341111	
1 CH42/31	1030H	17164						
5.901010	6.901100	8.600100	5.850100	8.201000	6.001000	4.601000	7.600000	
6.000000	5.000000	4.200000	3.800000	3.500000	3.400000	3.450000	3.500000	
3.600000	3.700000	4.150000	4.600000	5.350000	6.550000	7.301111	7.271111	
1 CH42/32	1050H	17164						
6.601010	7.651100	4.701100	6.450100	4.450100	6.501000	4.901000	3.751000	
6.550000	5.400000	4.650000	4.300000	3.700000	3.600000	3.750000	3.700000	
3.750000	3.850000	4.150000	4.700000	5.300000	6.300000	7.311111	7.271111	
1 CH42/33	1110H	17164						
6.401100	7.650100	4.750100	6.751000	4.701000	7.150000	5.700000	4.600000	
3.650000	3.150000	2.800000	2.500000	2.400000	2.400000	2.450000	2.530000	
2.600000	2.650000	2.850000	3.150000	3.600000	4.300000	7.311111	7.301111	
1 CH42/34	1125H	17164						
5.551100	6.650100	4.300100	5.301000	8.000000	5.800000	4.600000	3.700000	
3.050000	2.700000	2.350000	2.250000	2.150000	2.150000	2.250000	2.400000	
2.450000	2.500000	2.850000	3.150000	3.550000	4.400000	7.261111	7.251111	
1 CH42/35	1145H	17164						
5.351010	6.201100	8.100100	5.200100	7.751000	5.651000	8.800000	6.900000	
5.550000	4.700000	3.900000	3.600000	3.250000	3.300000	3.150000	3.300000	
3.300000	3.450000	3.700000	4.120000	4.900000	5.850000	7.251111	7.301111	
1 CH42/36	1245H	17164						
4.651100	5.350100	7.101000	4.801000	7.000000	5.300000	4.250000	3.550000	
2.900000	2.550000	2.400000	2.300000	2.200000	2.130000	2.250000	2.350000	
2.450000	2.500000	2.800000	3.000000	3.450000	4.150000	7.271111	7.201111	
1 CH42/37	1305H	17164						
4.801010	5.471100	6.800100	9.151000	6.351000	4.651000	7.400000	5.800000	
4.950000	4.000000	3.450000	3.100000	3.000000	2.900000	3.000000	3.100000	
3.200000	3.300000	3.500000	3.950000	4.600000	5.600000	7.251111	7.171111	
1 CH42/38	1325H	17164						

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8.101100	9.000100	5.700100	7.601000	5.251000	7.650000	6.000000	4.750000
3.900000	3.250000	2.850000	2.600000	2.450000	2.350000	2.480000	2.550000
2.650000	2.700000	2.900000	3.250000	3.800000	4.600000	7.191111	7.211111
1 CH42/39	1345H	17164					
9.151100	5.251100	6.700100	4.100100	6.601000	4.701000	7.300000	5.700000
4.550000	4.000000	3.500000	3.100000	2.800000	2.700000	2.750000	2.850000
2.950000	3.000000	3.300000	3.650000	4.200000	5.130000	7.151111	7.251111
1 CH42/40	1410H	17164					
4.301100	5.200100	6.901000	4.401000	6.700000	5.050000	3.850000	3.200000
2.700000	2.280000	2.100000	2.000000	1.930000	1.910000	2.100000	2.200000
2.230000	2.300000	2.500000	2.800000	3.150000	3.800000	7.151111	7.151111
1 CH42/41	1430H	17164					
4.851010	5.601100	7.250100	9.451000	7.001000	5.001000	8.000000	6.200000
5.100000	4.300000	3.700000	3.300000	3.200000	3.020000	3.080000	3.100000
3.150000	3.300000	3.550000	3.850000	4.500000	5.400000	7.301111	7.131111
1 CH42/42	1450H	17164					
6.501010	7.201100	8.700100	6.000100	8.401000	6.101000	4.601000	7.300000
6.250000	5.100000	4.350000	3.800000	3.530000	3.450000	3.500000	3.550000
3.500000	3.650000	4.000000	4.500000	5.200000	6.350000	7.101111	7.221111
1 CH42/43	2245H	17164					
9.101100	5.101100	6.100100	8.001000	5.701000	8.350000	6.500000	4.900000
4.100000	3.350000	2.900000	2.650000	2.450000	2.350000	2.400000	2.500000
2.600000	2.650000	2.950000	3.300000	3.900000	4.850000	6.951111	6.971111
1 CH42/44	2315H	17164					
9.351010	5.151010	6.251100	8.400100	5.700100	8.051000	6.101000	4.651000
8.250000	6.500000	5.350000	4.650000	4.300000	4.200000	4.200000	4.200000
4.200000	4.150000	4.550000	5.050000	5.950000	7.300000	7.021111	7.111111
1 CH42/45	2340H	17164					
9.000110	5.150110	6.501010	8.501100	6.201100	9.100100	6.800100	5.200100
8.451000	7.151000	5.851000	5.351000	4.701000	4.301000	4.001000	4.051000
4.001000	4.101000	4.301000	4.751000	5.451000	6.501000	7.111111	7.081111
1 CH42/46	2355H	17164					
5.050110	5.751010	7.301100	4.801100	6.850100	5.100100	7.501000	5.801000
9.600000	7.850000	6.600000	5.800000	5.250000	4.850000	4.800000	4.750000
4.850000	4.850000	5.300000	5.950000	7.000000	8.350000	7.071111	7.021111
1 CH42/47	0015H	18164					
4.950110	5.551010	7.001100	9.350100	6.550100	4.700100	7.151000	5.601000
9.250000	7.450000	6.350000	5.700000	5.150000	4.850000	4.850000	4.900000
5.000000	5.100000	5.500000	6.100000	7.100000	8.800000	7.101111	7.101111
1 CH42/48	0030H	18164					
4.901010	5.801100	7.500100	4.950100	7.001000	5.151000	7.900000	6.200000
5.000000	4.150000	3.600000	3.200000	2.950000	2.800000	2.850000	2.900000
3.000000	3.100000	3.400000	3.750000	4.350000	5.300000	7.101111	6.951111
1 CH42/49	0050H	18164					
8.801010	5.051010	6.501100	8.800100	6.200100	8.901000	6.801000	5.151000
8.500000	6.950000	5.900000	5.150000	4.650000	4.350000	4.400000	4.350000
4.350000	4.450000	4.900000	5.400000	6.400000	7.850000	7.061111	7.081111
1 CH42/50	0105H	18164					
7.201100	8.050100	4.900100	6.601000	4.601000	6.700000	5.150000	4.200000
3.450000	3.000000	2.550000	2.400000	2.350000	2.250000	2.350000	2.500000
2.550000	2.650000	3.000000	3.400000	4.050000	5.150000	7.031111	7.051111
1 CH42/51	0125H	18164					
4.301010	4.801100	6.150100	8.301000	5.801000	4.301000	6.400000	5.150000
4.200000	3.600000	3.150000	2.900000	2.680000	2.650000	2.700000	2.750000
2.850000	2.950000	3.200000	3.650000	4.350000	5.500000	7.101111	7.051111
1 CH42/52	0145H	18164					
5.701100	6.300100	7.701000	5.201000	7.750000	5.700000	4.500000	3.700000

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3.100000	2.700000	2.450000	2.200000	2.100000	2.100000	2.200000	2.300000
2.400000	2.500000	2.700000	3.050000	3.650000	4.600000	7.001111	7.101111
1 CH42/53	0200H	18164					
7.901100	4.401100	5.500100	7.301000	5.101000	7.650000	6.050000	4.700000
3.950000	3.500000	3.000000	2.700000	2.500000	2.500000	2.550000	2.700000
2.700000	2.800000	3.150000	3.600000	4.250000	5.300000	7.001111	6.901111
1 CH42/54		18164					
5.750110	6.801010	4.301010	5.701100	8.500100	6.150100	9.451000	7.301000
6.151000	5.101000	9.000000	7.950000	7.100000	6.550000	6.500000	6.450000
6.400000	6.600000	7.000000	8.000000	4.401000	5.451000	7.001111	6.931111
1 CH42/55	2235H	18164					
7.700110	8.551010	5.351010	6.901100	4.751100	7.200100	5.250100	8.201000
6.701000	5.251000	8.950000	8.100000	7.300000	6.800000	6.500000	6.500000
6.700000	6.700000	7.250000	8.100000	4.601000	5.551000	7.451111	7.201111
1 CH42/56	2300H	18164					
4.950110	5.601010	6.901100	9.000100	6.300100	9.201000	6.751000	5.501000
8.800000	7.250000	6.200000	5.350000	4.800000	4.500000	4.350000	4.450000
4.650000	4.650000	5.050000	5.750000	6.800000	8.350000	7.351111	7.351111
1 CH42/57	2320H	18164					
7.501010	8.701100	5.501100	7.500100	5.300100	8.001000	5.751000	4.601000
7.600000	6.200000	5.400000	4.750000	4.250000	4.050000	4.050000	4.100000
4.150000	4.300000	4.600000	5.250000	6.100000	7.600000	7.251111	7.251111
1 CH42/58	2340H	18164					
4.400110	5.201010	6.601100	9.200100	6.600100	4.800100	7.501000	5.851000
4.801000	8.400000	7.150000	6.700000	6.000000	5.900000	5.650000	5.850000
6.000000	6.200000	6.800000	7.350000	8.850000	5.201000	7.151111	7.131111
1 CH42/59	0005H	19164					
8.101010	4.751010	5.901100	8.400100	6.000100	8.801000	7.101000	5.401000
9.400000	7.750000	6.700000	6.300000	5.700000	5.550000	5.350000	5.400000
5.500000	5.650000	6.450000	7.050000	8.100000	9.600000	7.121111	7.151111
1 CH42/60	0025H	19164					
4.450110	5.201010	6.751100	4.601100	6.600100	5.000100	7.601000	6.001000
4.901000	8.500000	7.250000	6.550000	6.000000	5.800000	5.750000	5.800000
5.900000	6.200000	6.800000	7.600000	8.600000	5.051000	7.151111	7.251111
1 CH42/61	0035H	19164					
9.101010	4.851010	5.951100	8.100100	5.500100	8.201000	6.151000	4.801000
7.900000	6.450000	5.700000	4.950000	4.600000	4.350000	4.350000	4.350000
4.400000	4.900000	5.600000	6.450000	7.650000	9.550000	7.091111	7.001111
1 CH42/62	0055H	19164					
5.300110	6.001010	7.501100	4.801100	6.900100	5.100100	7.701000	5.851000
4.801000	8.000000	6.750000	5.900000	5.400000	5.150000	5.050000	5.050000
5.050000	5.300000	5.850000	6.500000	7.500000	9.300000	7.121111	7.101111
1 CH42/63	0110H	19164					
5.801010	6.701100	8.500100	5.500100	7.801000	5.751000	4.451000	6.900000
5.750000	4.900000	4.100000	3.650000	3.450000	3.250000	3.300000	3.400000
3.500000	3.800000	4.100000	4.600000	5.400000	6.700000	7.101111	7.181111
1 CH42/64	0135H	19164					
7.501010	4.401010	5.501100	7.500100	5.500100	8.201000	6.001000	5.901000
8.300000	7.100000	6.000000	5.400000	5.050000	4.800000	4.800000	4.850000
5.000000	5.200000	5.800000	6.500000	7.650000	9.300000	7.071111	7.201111
1 CH42/65	0200H	19164					
6.151010	6.651100	7.700100	5.200100	7.401000	5.401000	8.200000	6.600000
5.250000	4.500000	3.700000	3.300000	3.150000	3.000000	3.100000	3.250000
3.400000	3.550000	4.100000	4.650000	5.400000	4.900000	7.251111	7.151111
1 CH42/66	0220H	19164					
8.701010	4.851010	6.301100	8.200100	5.650100	8.401000	6.101000	4.751000
7.850000	6.500000	5.450000	4.700000	4.300000	4.150000	4.250000	4.350000

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4.350000	4.450000	5.150000	5.850000	7.050000	8.850000	7.151111	7.201111
1 CH42/67	0235H	19164					
6.401010	7.301100	4.601100	6.200100	8.801000	6.401000	4.801000	7.750000
6.300000	5.150000	4.300000	3.900000	3.650000	3.500000	3.600000	3.600000
3.650000	3.800000	4.150000	4.750000	5.650000	7.000000	7.191111	7.201111
1 CH42/68	0250H	19164					
7.301010	8.201100	5.151100	7.050100	5.000100	7.501000	5.401000	4.551000
7.250000	6.400000	5.500000	4.950000	4.650000	4.300000	4.300000	4.400000
4.400000	4.750000	5.050000	5.700000	6.650000	8.200000	7.221111	7.201111
1 CH42/69	1245H	19164					
7.801100	8.800100	5.500100	7.301000	5.301000	7.800000	5.700000	4.600000
3.700000	3.150000	2.650000	2.450000	2.350000	2.280000	2.400000	2.530000
2.600000	2.700000	2.900000	3.320000	3.900000	4.750000	7.371111	7.351111
1 CH42/70	1310H	19164					
5.000110	6.001010	7.301100	9.850100	6.800100	4.900100	7.501000	5.601000
4.551000	7.500000	6.500000	5.700000	5.100000	4.850000	4.750000	4.800000
4.900000	5.000000	5.350000	6.100000	7.100000	8.700000	7.301111	7.301111
1 CH42/71	1335H	19164					
9.101100	5.151100	6.750100	4.400100	6.101000	4.401000	7.000000	5.550000
4.500000	3.800000	3.250000	2.900000	2.800000	2.650000	2.700000	2.750000
2.850000	2.950000	3.200000	3.600000	4.220000	5.250000	7.201111	7.151111
1 CH42/72	1355H	19164					
6.801010	7.901100	5.051100	7.050100	4.900100	7.101000	5.451000	8.850000
7.200000	6.000000	5.100000	4.700000	4.200000	4.000000	4.150000	4.100000
4.200000	4.250000	4.550000	5.000000	5.720000	7.000000	7.231111	7.101111
1 CH42/73	19164						
8.901100	4.851100	5.800100	7.701000	5.501000	8.000000	6.000000	4.750000
3.950000	3.350000	2.750000	2.500000	2.400000	2.350000	2.450000	2.550000
2.600000	2.650000	2.950000	3.300000	3.900000	4.700000	7.211111	7.151111
1 CH42/74	1525H	19164					
8.901100	4.701100	5.750100	7.351000	5.251000	7.750000	6.100000	4.850000
3.850000	3.250000	2.800000	2.550000	2.350000	2.350000	2.500000	2.550000
2.700000	2.800000	3.000000	3.500000	4.150000	5.200000	7.201111	7.201111
1 CH42/75	2235H	19164					
9.001100	4.901100	6.200100	8.001000	5.701000	8.650000	6.500000	5.300000
4.350000	3.650000	3.150000	2.850000	2.700000	2.600000	2.720000	2.850000
2.900000	3.000000	3.300000	3.650000	4.300000	5.300000	7.381111	7.381111
1 CH42/76	2330H	19164					
5.351010	5.801100	7.400100	4.800100	6.851000	5.101000	7.800000	6.100000
5.100000	4.300000	3.800000	3.350000	3.050000	2.950000	3.100000	3.100000
3.200000	3.250000	3.500000	4.100000	4.700000	5.650000	7.301111	7.331111
1 CH42/77	2340H	19164					
5.601010	5.801100	7.100100	4.800100	6.601000	5.101000	8.300000	6.600000
5.500000	4.400000	3.750000	3.300000	3.150000	3.000000	3.100000	3.150000
3.200000	3.300000	3.700000	4.100000	4.700000	5.800000	7.301111	7.271111
1 CH42/78	0005H	20164					
9.401100	5.251100	6.550100	4.300100	6.251000	8.800000	7.000000	5.450000
4.650000	3.800000	3.350000	3.000000	2.800000	2.750000	2.800000	2.900000
2.900000	3.000000	3.220000	3.650000	4.250000	5.250000	7.201111	7.201111
1 CH42/79	0020H	20164					
5.701010	6.751100	8.800100	5.850100	8.251000	6.101000	9.400000	7.350000
6.150000	4.950000	4.350000	4.000000	3.600000	3.400000	3.450000	3.500000
3.600000	3.700000	4.050000	4.600000	5.300000	6.650000	7.301111	7.301111
1 CH42/80	0040H	20164					
6.601010	7.651100	4.701100	6.600100	9.301000	6.701000	5.101000	8.100000
6.600000	5.400000	4.800000	4.250000	3.900000	3.650000	3.700000	3.750000
3.950000	4.100000	4.500000	5.100000	5.800000	7.300000	7.251111	7.251111

1	CH42/81	0055H	20164						
	5.301100	5.900100	7.801000	4.901000	7.250000	5.550000	4.250000	3.400000	
	3.000000	2.550000	2.350000	2.200000	2.150000	2.150000	2.250000	2.400000	
	2.550000	2.650000	2.950000	3.350000	3.900000	4.950000	7.271111	7.271111	
1	CH42/82	0110H	20164						
	7.501100	8.700100	5.450100	7.501000	5.301000	8.100000	6.350000	4.950000	
	4.250000	3.500000	3.200000	2.800000	2.750000	2.650000	2.750000	2.800000	
	2.950000	3.000000	3.200000	3.600000	4.150000	5.050000	7.301111	7.301111	
1	CH42/83	0130H	20164						
	4.801100	5.550100	3.550100	4.501000	6.300000	4.900000	3.900000	3.100000	
	2.850000	2.350000	2.100000	1.950000	1.900000	1.950000	2.100000	2.150000	
	2.250000	2.250000	2.500000	2.800000	3.250000	3.800000	7.351111	7.301111	
1	CH42/84	0150H	20164						
	5.350110	6.151010	7.601100	4.951100	7.300100	5.100100	7.801000	6.051000	
	4.851000	8.250000	7.100000	6.400000	5.950000	5.450000	5.400000	5.450000	
	5.600000	5.850000	6.250000	7.000000	8.300000	5.001000	7.221111	7.201111	
1	CH42/85	0235H	20164						
	6.101010	7.001100	8.800100	6.100100	8.651000	6.201000	4.751000	8.000000	
	6.700000	5.500000	4.900000	4.300000	4.050000	3.900000	3.900000	3.900000	
	4.050000	4.250000	4.400000	5.000000	5.600000	6.850000	7.301111	7.281111	
1	CH42/86	0335H	20164						
	5.700110	6.701010	8.501100	5.801100	8.300100	6.100100	4.650100	7.401000	
	6.151000	5.151000	9.050000	8.100000	7.600000	6.900000	7.000000	7.000000	
	7.200000	7.500000	8.000000	8.750000	4.801000	5.801000	7.131111	7.201111	
1	CH42/87	2155H	20164						
	6.501010	7.001100	8.100100	5.500100	7.301000	5.201000	8.200000	6.500000	
	5.400000	4.400000	3.600000	3.300000	2.850000	2.700000	2.850000	2.950000	
	3.150000	3.150000	3.500000	4.050000	4.750000	5.900000	7.361111	7.501111	
1	CH42/88	2225H	20164						
	8.501100	8.000100	4.800100	6.451000	9.100000	6.650000	5.200000	4.200000	
	3.400000	3.000000	2.550000	2.300000	2.150000	2.100000	2.250000	2.300000	
	2.300000	2.300000	2.500000	2.800000	3.150000	3.900000	7.451111	7.151111	
1	CH42/89	2245H	20164						
	9.001100	5.251100	3.401100	4.800100	6.101000	4.401000	3.401000	2.651000	
	2.201000	1.851000	3.350000	3.000000	2.720000	2.650000	2.700000	2.900000	
	2.900000	3.000000	3.200000	3.500000	4.100000	5.000000	7.251111	7.201111	
1	CH42/90	2305H	20164						
	5.101100	5.800100	6.801000	4.501000	6.500000	4.700000	3.800000	3.050000	
	2.600000	2.200000	2.000000	1.850000	1.750000	1.750000	1.900000	2.000000	
	2.050000	2.100000	2.250000	2.550000	3.000000	3.650000	7.201111	7.221111	
1	CH42/91	2325H	20164						
	7.000100	7.901000	5.101000	7.100000	5.100000	3.900000	3.150000	2.600000	
	2.100000	1.900000	1.750000	1.600000	1.600000	1.600000	1.750000	1.850000	
	1.950000	1.950000	2.100000	2.320000	2.650000	3.250000	7.281111	7.301111	
1	CH42/92	2340H	20164						
	8.001100	4.501100	5.700100	8.101000	5.651000	8.100000	6.300000	5.000000	
	4.200000	3.500000	3.100000	2.750000	2.650000	2.600000	2.600000	2.750000	
	2.850000	2.900000	3.150000	3.500000	4.050000	4.950000	7.231111	7.241111	
1	CH42/93	0005H	21164						
	8.800100	4.900100	6.251000	8.600000	6.500000	4.700000	3.600000	3.000000	
	2.450000	2.150000	1.900000	1.800000	1.750000	1.750000	1.900000	2.000000	
	2.050000	2.100000	2.300000	2.500000	2.950000	3.500000	7.151111	7.251111	
1	CH42/94	0035H	21164						
	7.351100	4.151100	5.350100	7.201000	5.001000	7.900000	6.100000	4.900000	
	4.100000	3.450000	3.000000	2.750000	2.650000	2.600000	2.650000	2.700000	
	2.850000	2.850000	3.100000	3.550000	4.000000	4.850000	7.251111	7.251111	
1	CH42/95	0100H	21164						
	6.701100	7.900100	4.800100	6.351000	4.601000	7.200000	5.500000	4.400000	
	3.650000	3.150000	2.750000	2.500000	2.300000	2.300000	2.450000	2.550000	



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2.650000	2.650000	2.900000	3.300000	3.800000	4.850000	7.201111	7.221111
1 CH42/96	0130H	21164					
9.351100	5.001100	6.200100	7.751000	5.501000	8.350000	6.300000	5.100000
4.250000	3.650000	3.050000	2.750000	2.600000	2.450000	2.550000	2.650000
2.650000	2.800000	3.000000	3.350000	3.900000	4.700000	7.201111	7.151111
1 CH42/97	0150H	21164					
5.201010	5.701100	7.200100	4.650100	6.501000	4.801000	7.450000	6.000000
5.000000	3.900000	3.400000	3.050000	2.850000	2.800000	2.950000	2.950000
3.050000	3.150000	3.400000	3.900000	4.500000	5.650000	7.121111	7.151111
1 CH42/98	1140H	22164					
5.901100	6.500100	4.100100	5.201000	7.500000	5.500000	4.150000	3.350000
2.950000	2.400000	2.200000	1.950000	1.850000	1.850000	1.930000	2.050000
2.160000	2.200000	2.400000	2.700000	3.150000	3.900000	7.281111	7.301111
1 CH42/99	1245H	22164					
7.401100	8.000100	4.800100	6.401000	4.551000	6.750000	5.200000	4.150000
3.500000	2.900000	2.500000	2.250000	2.200000	2.200000	2.300000	2.350000
2.450000	2.500000	2.700000	3.100000	3.450000	4.350000	7.331111	7.401111
1 CH42/100	1345H	22164					
7.901010	8.851100	5.301100	7.100100	4.900100	7.101000	5.301000	8.500000
6.750000	5.500000	4.700000	4.250000	3.750000	3.650000	3.650000	3.750000
3.850000	3.900000	4.150000	4.650000	5.450000	6.650000	7.341111	7.341111
1 CH42/101	1515H	22164					
7.501100	8.300100	5.100100	6.501000	4.601000	6.800000	5.500000	4.400000
3.500000	3.000000	2.500000	2.300000	2.200000	2.200000	2.300000	2.350000
2.500000	2.500000	2.650000	3.000000	3.450000	4.150000	7.431111	7.451111
1 CH42/102	1615H	22164					
9.251100	4.851100	6.150100	8.001000	5.601000	4.201000	6.300000	4.900000
4.200000	3.300000	2.900000	2.600000	2.400000	2.300000	2.400000	2.500000
2.600000	2.600000	2.900000	3.230000	3.850000	4.900000	7.411111	7.301111
1 CH42/103	1815H	22164					
7.101010	7.701100	4.601100	6.350100	8.851000	6.501000	4.951000	7.700000
6.300000	5.100000	4.500000	3.950000	3.750000	3.550000	3.550000	3.600000
3.650000	3.700000	4.000000	4.500000	5.350000	6.300000	7.451111	7.371111
1 CH42/104		22164					
7.801010	4.301010	5.151100	7.000100	4.900100	7.251000	5.601000	8.800000
7.100000	5.900000	5.100000	4.400000	4.150000	4.000000	3.900000	3.950000
4.050000	4.150000	4.500000	5.050000	5.750000	7.050000	7.211111	7.251111
1 CH42/105		23164					
7.101010	8.201100	5.001100	6.500100	4.700100	6.701000	5.001000	8.200000
6.500000	5.500000	4.650000	4.050000	3.750000	3.700000	3.600000	3.700000
3.800000	3.800000	4.250000	4.700000	5.400000	6.600000	7.501111	7.421111
1 CH42/106	1330H	23164					
9.551100	5.201100	6.450100	8.501000	6.151000	9.100000	7.000000	5.500000
4.500000	3.750000	3.250000	2.900000	2.700000	2.600000	2.650000	2.750000
2.850000	2.950000	3.100000	3.450000	4.050000	4.800000	7.461111	7.281111
1 CH42/107	1430H	23164					
6.701100	7.200100	4.250100	5.451000	3.701000	6.000000	4.600000	3.700000
3.000000	2.550000	2.200000	2.000000	1.900000	1.900000	2.000000	2.100000
2.200000	2.300000	2.450000	2.750000	3.100000	3.800000	7.121111	7.151111
1 CH42/108	1525H	23164					
7.401010	8.101100	4.851100	6.500100	9.501000	6.751000	5.301000	8.150000
6.750000	5.600000	4.850000	4.300000	4.100000	3.900000	3.950000	3.950000
4.000000	4.100000	4.400000	4.850000	5.650000	6.700000	7.111111	7.221111
1 CH42/109	1620H	23164					
6.351010	7.201100	8.900100	6.000100	8.401000	6.001000	9.500000	7.450000
5.900000	4.900000	4.500000	4.000000	3.650000	3.550000	3.600000	3.650000
3.800000	4.000000	4.500000	5.150000	6.000000	7.250000	7.231111	7.201111

1	CH42/110	2200H	23164						
	4.851010	5.301100	3.151100	8.401000	6.001000	8.750000	6.500000	5.500000	
	4.500000	3.700000	3.050000	2.800000	2.600000	2.500000	2.600000	2.700000	
	2.850000	3.000000	3.200000	3.600000	4.250000	5.250000	7.401111	7.401111	
1	CH42/111	2240H	23164						
	5.000110	5.701010	7.001100	9.250100	6.500100	4.650100	7.251000	5.501000	
	4.501000	7.500000	6.300000	5.600000	5.150000	4.750000	4.750000	4.650000	
	4.750000	4.900000	5.350000	6.000000	6.950000	8.550000	7.251111	7.201111	
1	CH42/112	2300H	23164						
	6.501010	7.301100	9.500100	6.000100	8.201000	6.101000	4.551000	7.600000	
	6.250000	5.100000	4.300000	3.850000	3.450000	3.300000	3.350000	3.300000	
	3.400000	3.600000	3.850000	4.500000	5.250000	6.550000	7.201111	7.201111	
1	CH42/113	2315H	23164						
	6.301010	7.401100	9.300100	6.350100	4.400100	6.501000	5.001000	7.400000	
	4.800000	4.100000	3.500000	3.300000	3.150000	3.050000	3.150000	3.200000	
	3.350000	3.350000	3.700000	4.000000	4.500000	5.500000	7.301111	7.151111	
1	CH42/114	0015H	24164						
	6.101010	6.401100	8.200100	5.500100	7.701000	5.501000	5.001000	7.700000	
	6.000000	5.200000	4.500000	3.700000	3.500000	3.250000	3.400000	3.550000	
	3.650000	3.700000	3.900000	4.450000	5.100000	6.200000	7.151111	7.201111	
1	CH42/115	.0035H	24164						
	9.301100	5.301100	6.900100	4.700100	6.551000	4.751000	7.550000	6.000000	
	5.000000	4.250000	3.650000	3.350000	3.050000	2.950000	3.200000	3.200000	
	3.500000	3.300000	3.650000	4.150000	4.800000	6.100000	7.201111	7.251111	
1	CH42/116	0045H	24164						
	4.801010	5.251100	6.400100	8.801000	5.851000	9.300000	6.700000	5.350000	
	4.300000	3.700000	3.150000	2.750000	2.700000	2.600000	2.750000	2.750000	
	2.900000	3.000000	3.350000	3.850000	4.600000	5.800000	7.211111	7.221111	
1	CH42/117	0100H	24164						
	8.251100	9.300100	5.800100	7.901000	5.501000	8.200000	6.550000	5.000000	
	4.050000	3.350000	2.950000	2.700000	2.600000	2.450000	2.600000	2.600000	
	2.700000	2.750000	3.000000	3.450000	4.050000	5.100000	7.181111	7.201111	
1	CH42/118	0115H	24164						
	4.851010	5.601100	7.300100	5.000100	6.701000	5.601000	8.000000	6.150000	
	5.000000	4.350000	3.700000	3.300000	3.100000	3.000000	3.050000	3.100000	
	3.250000	3.250000	3.650000	4.200000	4.900000	6.050000	7.231111	7.201111	
1	CH42/119	0130H	24164						
	6.201010	7.101100	9.050100	6.100100	8.501000	6.101000	9.900000	7.650000	
	6.100000	5.000000	4.350000	3.800000	3.500000	3.400000	3.300000	3.400000	
	3.450000	3.650000	3.950000	4.400000	5.100000	6.300000	7.181111	7.121111	
1	CH42/120	0140H	24164						
	8.701010	5.101010	6.301100	8.500100	5.900100	8.601000	6.251000	5.001000	
	8.100000	6.600000	5.800000	5.000000	4.600000	4.400000	4.300000	4.200000	
	4.350000	4.500000	4.800000	5.300000	6.200000	7.700000	6.951111	6.951111	
1	CH42/121	1930H	24164						
	8.701010	4.701010	5.801100	7.900100	5.500100	8.001000	5.901000	4.751000	
	7.700000	6.600000	5.500000	4.650000	4.250000	4.100000	4.150000	4.200000	
	4.300000	4.500000	4.900000	5.600000	6.400000	7.900000	7.361111	7.501111	
1	CH42/122	2100H	24164						
	5.101010	5.651100	7.000100	8.651000	6.151000	9.200000	7.000000	5.500000	
	4.500000	3.650000	3.100000	2.750000	2.600000	2.450000	2.650000	2.700000	
	2.800000	2.850000	3.100000	3.450000	3.950000	4.850000	7.301111	7.321111	
1	CH42/123	2115H	24164						
	8.201010	4.501010	5.701100	7.600100	5.250100	8.101000	5.901000	4.701000	
	7.900000	6.000000	5.600000	5.000000	4.250000	4.200000	4.100000	4.100000	
	4.200000	4.300000	4.800000	5.550000	6.150000	7.600000	7.331111	7.311111	
1	CH42/124	2130H	24164						

9.001010	4.951010	6.151100	8.350100	5.700100	8.501000	6.201000	5.101000
8.200000	6.600000	5.700000	5.000000	4.600000	4.300000	4.350000	4.350000
4.550000	4.550000	5.000000	5.800000	6.750000	8.200000	7.261111	7.251111
1 CH42/125	2140H	24164					
8.001100	4.651100	6.100100	7.601000	5.601000	8.500000	6.500000	5.200000
4.250000	3.650000	3.200000	2.900000	2.750000	2.650000	2.700000	2.900000
2.900000	3.000000	3.300000	3.650000	4.200000	5.200000	7.301111	7.351111
1 CH42/126	2215H	24164					
4.801010	5.701100	7.300100	4.800100	7.001000	5.101000	8.200000	6.500000
5.300000	4.500000	4.000000	3.550000	3.350000	3.200000	3.250000	3.300000
3.300000	3.450000	3.900000	4.400000	5.100000	6.300000	7.211111	7.201111
1 CH42/127	2255H	24164					
8.501100	4.701100	6.100100	8.501000	5.701000	8.500000	6.600000	5.500000
4.250000	3.650000	3.200000	2.850000	2.700000	2.700000	2.750000	2.900000
2.950000	3.000000	3.200000	3.650000	4.300000	5.150000	7.431111	7.301111
1 CH42/128	2320H	24164					
5.001100	5.700100	7.701000	4.851000	7.500000	5.200000	4.300000	3.350000
2.800000	2.500000	2.100000	2.000000	1.900000	1.900000	2.000000	2.100000
2.200000	2.300000	2.400000	2.750000	3.150000	3.800000	7.171111	7.151111
1 CH42/129	2340H	24164					
6.901100	7.600100	4.800100	6.501000	4.601000	7.100000	5.500000	4.200000
3.550000	3.000000	2.650000	2.600000	2.250000	2.250000	2.350000	2.450000
2.450000	2.550000	2.800000	3.200000	3.650000	4.450000	7.131111	7.131111
1 CH42/130	0005H	25164					
4.201100	4.850100	6.201000	8.600000	6.400000	4.500000	3.650000	3.000000
2.500000	2.200000	2.000000	1.850000	1.750000	1.750000	1.950000	2.000000
2.100000	2.150000	2.350000	2.600000	3.050000	3.700000	7.181111	7.251111
1 CH42/131	0025H	25164					
5.601010	6.401100	7.900100	5.250100	7.201000	5.201000	8.000000	6.450000
5.100000	4.300000	3.800000	3.400000	3.100000	3.050000	3.050000	3.050000
3.100000	3.300000	3.600000	4.000000	4.600000	5.650000	7.181111	7.201111
1 CH42/132	0045H	25164					
6.800110	7.001010	8.301100	5.301100	7.600100	5.300100	8.201000	6.401000
5.001000	9.500000	7.500000	6.800000	6.200000	5.800000	5.700000	5.500000
5.700000	5.750000	6.250000	7.000000	8.250000	9.900000	7.101111	7.051111
1 CH42/133	1003H	25164					
6.101010	7.001100	8.500100	5.400100	7.601000	5.401000	8.250000	6.500000
5.000000	4.250000	3.700000	3.250000	3.000000	2.900000	3.000000	3.200000
3.250000	3.300000	3.600000	4.200000	4.950000	6.400000	6.931111	6.901111
1 CH42/134	1020H	25164					
7.201100	8.400100	4.900100	6.251000	4.601000	6.750000	5.000000	4.200000
3.400000	2.850000	2.400000	2.250000	2.050000	2.000000	2.150000	2.250000
2.400000	2.400000	2.600000	2.950000	3.400000	4.100000	6.851111	6.921111
1 CH42/135	1030H	25164					
6.101010	6.751100	4.251100	5.400100	7.901000	5.501000	8.900000	6.700000
5.650000	4.600000	4.000000	3.600000	3.300000	3.200000	3.300000	3.300000
3.300000	3.450000	3.650000	4.250000	4.850000	6.050000	6.951111	6.801111
1 CH42/136	1 45H	25164					
7.951010	8.801100	5.451100	7.200100	5.000100	7.201000	5.501000	8.600000
6.950000	5.700000	5.000000	4.350000	4.000000	3.750000	3.950000	3.950000
4.050000	4.150000	4.400000	5.250000	5.800000	7.200000	6.821111	6.821111
1 CH42/137	1100H	25164					
8.501100	5.001100	6.200100	8.301000	5.601000	8.500000	6.400000	5.300000
4.250000	3.600000	3.160000	2.650000	2.600000	2.450000	2.450000	2.500000
2.600000	2.700000	2.950000	3.200000	3.800000	4.600000	6.851111	6.871111
1 CH42/138	1115H	25164					
5.901100	6.900100	4.150100	5.551000	7.600000	5.700000	4.300000	3.350000

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2.850000	2.400000	2.100000	1.900000	1.750000	1.800000	1.930000	1.950000
2.100000	2.100000	2.300000	2.550000	3.000000	3.550000	6.831111	6.831111
1 CH42/139	1130H	25164					
4.951010	5.651100	7.100100	9.301000	6.301000	4.701000	7.400000	5.800000
4.750000	3.900000	3.300000	2.950000	2.800000	2.750000	2.750000	2.750000
2.900000	2.950000	3.200000	3.550000	4.200000	5.000000	6.681111	6.681111
1 CH42/140	1145H	25164					
8.551100	4.801100	6.000100	7.601000	5.451000	8.000000	6.300000	4.750000
4.100000	3.400000	3.000000	2.650000	2.500000	2.450000	2.600000	2.600000
2.700000	2.750000	3.000000	3.350000	3.850000	4.750000	6.751111	6.801111
1 CH42/141	1230H	25164					
9.251100	5.101100	6.400100	8.201000	5.851000	8.650000	6.400000	5.150000
4.350000	3.750000	3.150000	2.850000	2.500000	2.350000	2.500000	2.650000
2.800000	2.800000	3.000000	3.400000	3.950000	4.750000	6.881111	6.851111
1 CH42/142	1245H	25164					
8.801100	4.651100	5.800100	7.401000	5.401000	7.800000	6.000000	4.700000
3.800000	3.200000	2.800000	2.550000	2.350000	2.350000	2.400000	2.500000
2.650000	2.780000	3.150000	3.650000	4.400000	5.450000	6.781111	6.651111
1 CH42/143	1315H	25164					
8.601100	4.501100	5.700100	7.251000	5.201000	7.700000	6.250000	5.000000
4.100000	3.400000	3.100000	2.900000	2.800000	2.800000	2.850000	2.950000
3.250000	3.500000	4.100000	4.800000	5.850000	7.350000	6.681111	6.661111
1 CH42/144	1500H	25164					
5.751010	6.401100	8.000100	5.250100	7.301000	5.400000	8.500000	6.900000
5.600000	4.750000	4.100000	3.700000	3.550000	3.350000	3.450000	3.600000
3.700000	3.850000	4.300000	4.850000	5.800000	7.250000	6.701111	6.751111
1 CH42/145	1530H	25164					
4.751010	5.451100	6.400100	8.351000	5.701000	8.500000	6.550000	5.200000
4.350000	3.700000	3.200000	2.850000	2.650000	2.600000	2.650000	2.750000
3.000000	3.100000	3.300000	3.700000	4.350000	5.300000	6.871111	6.861111
1 CH42/146	2340H	25164					
6.451010	7.401100	9.400100	6.100100	8.501000	6.051000	4.751000	7.950000
6.250000	5.200000	4.450000	3.950000	3.700000	3.500000	3.500000	3.450000
3.650000	3.800000	4.150000	4.500000	5.200000	6.400000	6.801111	6.751111
1 CH42/147	0005H	26164					
4.750110	5.351010	6.651100	9.150100	6.400100	9.101000	7.151000	5.501000
4.551000	7.500000	6.300000	5.600000	5.100000	4.900000	4.750000	4.600000
4.700000	5.100000	5.300000	6.000000	7.250000	8.650000	6.651111	6.651111
1 CH42/148	0020H	26164					
7.001010	7.901100	4.801100	6.400100	9.101000	6.601000	5.001000	8.300000
6.500000	5.500000	4.800000	4.100000	3.800000	3.650000	3.700000	3.650000
3.750000	3.800000	4.200000	4.900000	5.750000	7.200000	6.631111	6.631111
1 CH42/149	0035H	26164					
8.001010	8.601100	5.201100	7.000100	4.700100	6.801000	5.201000	8.300000
6.800000	5.500000	4.600000	4.200000	3.900000	3.700000	3.600000	3.650000
3.750000	3.850000	4.250000	4.800000	5.600000	7.000000	6.751111	6.681111
1 CH42/150	0050H	26164					
6.951010	7.701100	9.850100	6.200100	9.001000	6.401000	4.801000	7.650000
6.400000	5.150000	4.550000	3.950000	3.500000	3.400000	3.400000	3.400000
3.500000	3.650000	4.050000	4.600000	5.500000	6.850000	6.691111	6.731111
1 CH42/151	0105H	26164					
6.551010	6.901100	8.350100	5.300100	7.601000	5.351000	8.450000	6.700000
5.700000	4.600000	4.000000	3.500000	3.200000	3.150000	3.100000	3.200000
3.350000	3.450000	3.800000	4.350000	5.150000	6.500000	6.661111	6.701111
1 CH42/152	0120H	26164					
6.700110	7.901010	4.901010	6.401100	4.501100	6.700100	4.950100	8.001000
6.351000	5.201000	9.100000	7.800000	7.100000	6.500000	6.250000	6.350000

6.400000	6.600000	7.200000	8.100000	9.450000	5.501000	6.711111	6.601111
1 CH42/153	0135H	26164					
7.401010	8.251100	4.901100	6.400100	8.801000	6.501000	4.801000	7.800000
6.600000	5.250000	4.500000	4.000000	3.550000	3.400000	3.550000	3.450000
3.550000	3.700000	4.150000	4.800000	5.900000	7.500000	6.611111	6.701111
1 CH42/154	0150H	26164					
5.301100	5.800100	7.351000	4.801000	7.000000	5.000000	4.300000	3.400000
2.800000	2.350000	2.150000	2.000000	1.900000	1.900000	2.100000	2.150000
2.300000	2.350000	2.600000	3.050000	3.550000	4.550000	6.701111	6.651111
1 CH42/155	0205H	26164					
6.151010	6.751100	8.650100	5.650100	8.001000	5.851000	9.300000	7.400000
5.700000	4.750000	4.100000	3.600000	3.300000	3.250000	3.250000	3.250000
3.350000	3.450000	3.800000	4.250000	4.850000	6.000000	6.701111	6.631111
1 CH42/156	0215H	26164					
6.301100	6.850100	8.601000	5.801000	8.500000	6.400000	5.100000	4.200000
3.400000	2.900000	2.550000	2.400000	2.200000	2.150000	2.250000	2.350000
2.500000	2.500000	2.700000	3.050000	3.700000	4.450000	6.551111	6.651111
1 CH42/157	0330H	26164					
6.551010	7.151100	4.501100	5.900100	8.301000	5.901000	4.501000	7.300000
5.800000	5.100000	4.300000	3.600000	3.450000	3.250000	3.400000	3.300000
3.400000	3.450000	3.900000	4.400000	5.200000	6.400000	6.751111	6.751111
1 CH42/158	0355H	26164					
5.100110	5.901010	7.401100	4.701100	7.100100	5.100100	7.501000	5.901000
4.901000	7.900000	6.700000	5.850000	5.300000	5.150000	5.000000	5.000000
5.150000	5.250000	5.650000	6.450000	7.550000	9.200000	6.781111	6.751111
1 CH42/159	0415H	26164					
8.951010	4.901010	6.101100	8.050100	5.650100	8.201000	5.901000	4.701000
8.000000	6.400000	5.500000	4.750000	4.550000	4.150000	4.150000	4.100000
4.200000	4.350000	4.700000	5.200000	6.150000	7.700000	6.751111	6.701111
1 CH42/160	0430H	26164					
6.351010	7.051100	9.000100	6.000100	8.251000	5.801000	9.000000	7.000000
5.750000	4.700000	4.050000	3.500000	3.350000	3.150000	3.200000	3.300000
3.400000	3.500000	3.800000	4.250000	5.000000	6.250000	6.801111	6.701111
1 CH42/161	26164	0445H	ST610	4-60M			
7.201010	7.651100	9.000100	5.650100	8.101000	5.901000	9.300000	7.300000
5.800000	4.800000	4.000000	3.450000	3.200000	3.000000	3.100000	3.100000
3.300000	3.400000	3.700000	4.250000	5.000000	6.300000	6.681111	6.711111
1 CH42/162	26164	0500H	ST610	5-80M			
6.301010	6.351100	7.700100	4.900100	6.901000	5.151000	8.100000	6.300000
5.000000	4.250000	3.550000	3.100000	2.900000	2.750000	2.850000	2.850000
3.050000	3.150000	3.450000	3.900000	4.650000	5.800000	6.651111	6.711111
1 CH42/163	26164	0510H	ST610	6-100M			
4.751010	5.251100	6.750100	9.001000	6.301000	9.650000	7.400000	5.850000
4.600000	3.900000	3.300000	3.050000	2.800000	2.750000	2.700000	2.850000
2.950000	3.000000	3.250000	3.700000	4.350000	5.400000	6.681111	6.551111
1 CH42/164	26164	0525H	ST610	7-120			
7.951100	4.551100	5.900100	7.801000	5.451000	8.100000	6.150000	5.000000
4.000000	3.500000	3.000000	2.700000	2.550000	2.450000	2.450000	2.600000
2.750000	2.750000	3.000000	3.350000	4.000000	4.800000	6.581111	6.651111
1 CH42/165	26164	0540H	ST610	8-140M			
5.151010	5.851100	7.550100	4.950100	7.001000	5.001000	7.700000	6.000000
4.850000	4.050000	3.450000	3.100000	2.900000	2.750000	2.800000	2.850000
2.950000	3.000000	3.300000	3.700000	4.400000	5.450000	6.681111	6.681111
1 CH42/166	26164	0555H	ST610	9-160M			
8.100100	4.600100	5.751000	8.000000	5.900000	4.400000	3.400000	2.650000
2.350000	1.950000	1.750000	1.700000	1.600000	1.650000	1.800000	1.930000
2.050000	2.150000	2.350000	2.650000	3.150000	4.000000	6.721111	6.751111

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1 CH42/167	26164 0610H	ST610	10-200M						
7.801100	9.100100	5.600100	7.201000	5.001000	7.500000	5.700000	4.400000		
3.650000	3.000000	2.800000	2.550000	2.400000	2.300000	2.400000	2.550000		
2.500000	2.700000	2.900000	3.450000	3.900000	4.900000	6.761111	6.751111		
1 CH42/168	27164 2335H	28 51N	66 36.5W	T=21.0					
5.251010	5.701100	7.200100	8.901000	6.501000	9.350000	7.300000	5.700000		
4.850000	4.150000	3.450000	3.300000	3.000000	3.000000	3.150000	3.200000		
3.350000	3.450000	3.850000	4.400000	5.000000	6.300000	9.831111	9.651111		
1 CH42/169	28164 0030H	28 49.5N	66 27W	T=21.3					
7.451010	8.201100	4.901100	6.500100	9.201000	6.701000	5.201000	8.500000		
6.500000	5.500000	4.650000	4.300000	3.750000	3.750000	3.750000	3.850000		
4.000000	4.200000	4.550000	5.100000	6.250000	7.500000	9.781111	9.801111		
1 CH42/170	28164 0130H	28 35.5N	66 19.5W	T=22.3					
6.601010	7.601100	9.300100	6.000100	8.501000	5.801000	4.801000	7.300000		
6.250000	5.000000	4.450000	4.000000	3.700000	3.700000	3.750000	3.700000		
3.900000	4.150000	4.500000	5.200000	5.850000	7.250000	9.651111	9.701111		
1 CH42/171	28164 0235H	28 28.5W	66 12.5W	T=23.3					
6.351010	7.201100	8.750100	5.400100	7.601000	5.801000	9.100000	6.950000		
5.800000	4.750000	4.300000	3.700000	3.500000	3.400000	3.500000	3.600000		
3.750000	3.850000	4.300000	4.900000	5.850000	7.150000	9.651111	9.751111		
1 CH42/172	28164 0330H	28 34N	66 07W	T=22.8					
4.900110	5.501010	6.701100	9.100100	6.100100	8.701000	6.651000	5.251000		
8.500000	7.100000	6.050000	5.400000	4.950000	4.650000	4.800000	5.150000		
5.100000	5.300000	5.650000	6.500000	7.500000	9.000000	9.551111	9.601111		
1 CH42/173	29164 1230H	28 51N	63 07W	ST611 PIPE SURF					
5.351010	6.001100	7.400100	4.700100	6.601000	4.701000	7.650000	6.150000		
5.200000	4.200000	3.550000	3.300000	3.050000	3.000000	3.100000	3.250000		
3.400000	3.550000	3.800000	4.250000	4.950000	6.100000	9.951111	9.801111		
1 CH42/174	29164 1255H	ST611	1-SURFACE						
5.400110	6.301010	7.401100	4.801100	7.100100	4.900100	7.601000	5.901000		
4.601000	7.750000	6.550000	5.900000	5.300000	5.000000	5.000000	5.100000		
5.250000	5.400000	5.850000	6.600000	7.500000	9.200000	9.671111	9.701111		
1 CH42/175	29164 1315H	ST611	2-60M						
5.850110	4.651010	8.101100	5.251100	7.700100	5.500100	9.001000	7.001000		
5.601000	4.401000	8.350000	7.200000	6.600000	6.050000	6.000000	6.100000		
6.200000	6.400000	6.700000	7.500000	8.500000	5.101000	9.851111	9.801111		
1 CH42/176	29164 1330H	ST611	3-100M						
7.200110	8.401010	5.501010	7.001100	4.901100	7.200100	5.600100	9.001000		
7.201000	6.051000	5.001000	9.200000	8.200000	7.900000	7.650000	7.350000		
7.500000	7.750000	8.300000	9.350000	5.201000	6.401000	9.751111	9.701111		
1 CH42/177	29164 1350H	ST611	4-210M						
8.401010	4.951010	6.401100	8.550100	5.900100	8.801000	6.701000	5.351000		
8.850000	7.100000	6.300000	5.450000	5.100000	4.750000	4.800000	4.800000		
5.000000	5.150000	5.550000	6.200000	7.200000	8.750000	9.671111	9.671111		
1 CH42/178	ST 611	5-300M	29164 1400H						
5.801010	6.751100	9.050100	5.900100	8.701000	6.251000	5.001000	8.100000		
6.500000	5.450000	4.700000	4.250000	3.950000	3.850000	3.850000	3.950000		
4.150000	4.250000	4.650000	5.250000	6.150000	7.500000	9.671111	9.601111		
1 CH42/179	29164 1415H	ST611	6-400M						
9.251010	5.501010	7.501100	5.001100	7.250100	5.400100	8.401000	6.601000		
5.501000	9.100000	8.000000	6.950000	6.500000	6.200000	6.150000	5.900000		
6.000000	6.100000	6.800000	7.450000	8.600000	5.101000	9.651111	9.731111		
1 CH42/180	29164 1435H	ST611	7-500M						
8.001010	4.551010	5.901100	8.700100	6.150100	4.300100	7.001000	5.151000		
8.600000	7.200000	6.300000	5.500000	5.300000	5.100000	5.000000	4.900000		
5.350000	5.500000	5.800000	6.450000	7.500000	9.300000	9.701111	9.601111		
1 CH42/181	29164 1455H	ST611	8-700M						

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6.700110	7.601010	9.201100	6.701100	8.900100	6.300100	9.701000	7.601000
6.201000	5.101000	8.650000	7.800000	7.100000	6.700000	6.800000	6.750000
7.000000	7.050000	7.800000	8.750000	4.801000	5.901000	9.601111	9.581111
1 CH42/182	29164 1515H ST611 9-1000M	QUE + 90					
6.701010	7.301100	5.201100	7.150100	5.100100	7.301000	5.701000	4.601000
7.750000	6.700000	6.000000	5.250000	5.050000	5.000000	5.200000	5.300000
5.400000	5.750000	5.900000	6.550000	7.650000	9.600000	9.601111	9.991111
1 CH42/183	29164 2320H ST612 29 57N 64 04W	PIPE SURFACE					
9.051010	5.201010	6.401100	8.500100	5.900100	8.401000	6.701000	5.001000
8.500000	7.250000	6.350000	5.750000	5.200000	5.150000	4.950000	5.050000
5.050000	5.300000	5.650000	6.500000	7.400000	9.000000	8.951111	9.001111
1 CH42/184	29164 2350H ST612 1-SURFACE						
5.950110	6.901010	8.501100	5.601100	8.000100	5.600100	8.701000	6.951000
5.601000	4.901000	8.500000	7.300000	6.800000	6.350000	6.250000	6.400000
6.400000	6.750000	7.450000	8.500000	4.701000	5.751000	8.821111	8.821111
1 CH42/185	30164 0005H ST 612 2-60M						
8.551010	4.851010	5.951100	8.000100	5.600100	8.201000	6.301000	4.951000
8.500000	7.000000	5.850000	5.200000	4.800000	4.600000	4.700000	4.750000
4.900000	5.000000	5.500000	6.100000	7.300000	9.050000	8.971111	8.851111
1 CH42/186	30164 0025H ST612 3-100M						
4.800110	5.451010	6.751100	8.950100	6.150100	4.400100	6.901000	5.401000
9.000000	7.600000	6.550000	5.750000	5.300000	4.950000	4.900000	5.050000
5.200000	5.400000	5.800000	6.550000	7.600000	9.500000	8.851111	8.851111
1 CH42/187	30164 0045H ST612 4-210						
5.550110	6.301010	7.901100	5.201100	7.450100	5.300100	8.301000	6.351000
5.101000	8.600000	7.400000	6.350000	6.000000	5.600000	5.600000	5.500000
5.700000	5.850000	6.400000	7.350000	8.800000	5.451000	8.801111	8.801111
1 CH42/188	30164 0100H ST612 6-400M						
6.951010	7.901100	4.901100	6.400100	9.201000	6.601000	5.001000	8.250000
6.600000	5.600000	4.900000	4.350000	4.100000	3.900000	4.000000	4.150000
4.250000	4.400000	4.850000	5.650000	7.000000	8.950000	8.781111	8.801111
1 CH42/189	30164 015H ST612 8-700M						
8.351100	4.701100	6.300100	8.351000	5.901000	9.150000	7.000000	5.850000
4.600000	3.950000	3.600000	3.400000	3.200000	3.150000	3.350000	3.450000
3.550000	3.750000	4.100000	4.700000	5.600000	6.900000	8.871111	8.871111
1 CH42/190	30164 0130H ST612 5-300M						
5.101010	5.701100	7.400100	4.800100	6.851000	5.051000	7.750000	6.200000
5.000000	4.150000	3.650000	3.250000	3.150000	3.050000	3.200000	3.250000
3.400000	3.550000	3.900000	4.400000	5.200000	6.350000	8.821111	8.751111
1 CH42/191	30164 0145H ST612 9-1000M						
7.801010	4.001010	5.201100	6.900100	5.350100	7.351000	5.751000	9.100000
7.500000	6.300000	5.500000	5.150000	4.800000	4.600000	4.750000	4.800000
4.900000	5.000000	5.450000	6.100000	7.150000	8.650000	8.731111	8.731111
1 CH42/192	30164 0200H ST612 M-600M						
6.351010	7.201100	9.050100	5.900100	8.501000	6.301000	4.801000	7.900000
6.150000	5.200000	4.700000	4.350000	3.950000	3.900000	4.000000	4.050000
4.150000	4.350000	4.800000	5.450000	6.500000	8.400000	8.731111	8.751111
1 CH42/193	30164 0740H ST613 31 3N 64 47W	PIPE SURFACE					
5.400110	6.051010	7.601100	4.701100	6.700100	5.000100	7.851000	6.151000
5.001000	4.201000	7.400000	6.650000	6.100000	5.700000	5.700000	5.750000
5.900000	6.400000	6.500000	7.400000	8.750000	5.051000	9.031111	9.021111
1 CH42/194	30164 0815H ST 613 1-SURFACE						
6.400110	7.601010	5.001010	6.101100	8.850100	6.350100	4.850100	7.651000
6.301000	5.101000	9.450000	8.300000	7.500000	6.850000	6.750000	6.800000
6.950000	7.150000	7.800000	8.700000	4.951000	5.901000	8.901111	8.751111
1 CH42/195	30164 0835H ST613 2-60M						
7.601010	8.501100	5.201100	6.800100	4.800100	7.201000	5.501000	8.900000

	7.250000	6.000000	5.200000	4.750000	4.350000	4.100000	4.200000	4.350000
	4.600000	4.700000	5.200000	6.000000	7.100000	8.650000	8.751111	8.781111
1 CH42/196	30I64 0850H	ST613	3-100M					
	9.101010	5.101010	6.301100	8.500100	5.850100	8.751000	6.601000	5.201000
	8.350000	7.000000	5.800000	5.200000	4.850000	4.600000	4.650000	4.700000
	4.800000	4.900000	5.400000	6.000000	7.050000	8.650000	8.861111	8.721111
1 CH42/197	30I64 0910H	ST613	4-210M					
	7.200110	8.351010	5.201010	7.051100	4.901100	7.350100	5.500100	8.551000
	6.751000	5.601000	4.701000	8.550000	7.700000	7.300000	7.250000	7.100000
	7.250000	7.700000	8.350000	4.601000	5.351000	6.701000	8.701111	8.851111
1 CH42/198	30I64 0925H	ST613	10-1000M					
	7.001010	8.001100	4.801100	6.600100	9.401000	6.801000	5.501000	9.000000
	7.400000	6.250000	5.500000	4.800000	4.700000	4.400000	4.500000	4.800000
	4.800000	5.000000	5.400000	6.000000	7.000000	8.300000	8.871111	8.901111
1 CH42/199	30I64 0945H	ST613	5-300M					
	8.751010	5.001010	6.501100	8.800100	6.300100	9.001000	6.901000	5.501000
	9.100000	7.750000	6.750000	6.050000	5.550000	5.300000	5.350000	5.400000
	5.650000	5.850000	6.400000	7.400000	8.750000	5.351000	8.731111	8.751111
1 CH42/200	30I64 1000H	ST613	7-500M					
	5.201010	6.201100	8.300100	5.600100	7.901000	6.001000	9.400000	7.400000
	6.050000	5.100000	4.600000	4.300000	3.850000	3.800000	3.900000	3.950000
	4.100000	4.200000	4.550000	5.100000	6.100000	7.700000	8.781111	8.801111
1 CH42/201	30I64 1015H	ST613	9-800M					
	6.001100	7.000100	4.750100	6.601000	4.601000	7.200000	5.850000	4.600000
	4.000000	3.400000	3.000000	2.800000	2.700000	2.700000	2.850000	2.950000
	3.100000	3.250000	3.550000	3.950000	4.600000	5.700000	8.851111	8.851111
1 CH42/202	30I64 1035H	ST613	6-500M					
	9.051100	5.101100	6.600100	9.101000	6.401000	4.701000	7.650000	5.950000
	4.900000	4.200000	3.800000	3.520000	3.300000	3.250000	3.400000	3.550000
	3.750000	3.950000	4.530000	4.900000	5.750000	7.300000	8.701111	8.951111
1 CH42/203	30I64 1050H	ST613	8-600M					
	8.701100	5.001100	6.700100	9.001000	6.401000	4.801000	7.750000	6.300000
	5.100000	4.350000	3.850000	3.600000	3.500000	3.350000	3.500000	3.700000
	3.800000	4.100000	4.400000	5.000000	5.800000	7.100000	8.881111	8.901111
1 CH42/204	30I64 1410H	ST614 32	4.5N 65 20.3W PIPE SURF					
	6.751010	7.501100	9.500100	6.000100	8.501000	6.401000	5.001000	8.000000
	6.500000	5.300000	4.500000	4.050000	3.800000	3.650000	3.550000	3.700000
	4.050000	4.200000	4.500000	5.150000	6.000000	7.300000	8.701111	8.651111
1 CH42/205	30I64 1445H	ST614	1-SURFACE					
	9.051010	4.951010	6.201100	8.500100	6.000100	9.001000	6.701000	5.301000
	8.700000	7.300000	6.450000	5.550000	5.250000	5.100000	4.850000	4.850000
	4.900000	5.300000	5.700000	6.550000	7.600000	9.200000	8.551111	8.631111
1 CH42/206	30I64 1500H	ST614	2-60M					
	4.850110	5.551010	6.851100	9.050100	6.500100	4.700100	7.051000	5.601000
	9.300000	7.500000	6.500000	5.750000	5.250000	5.100000	5.000000	5.100000
	5.350000	5.300000	6.000000	6.800000	7.800000	4.651000	8.601111	8.651111
1 CH42/207	30I64 1520H	ST614	8-600M					
	5.901010	6.501100	9.000100	5.500100	8.001000	5.701000	9.350000	7.600000
	6.200000	5.200000	4.600000	4.050000	3.800000	3.700000	3.850000	4.000000
	4.000000	4.150000	4.450000	5.050000	5.850000	7.150000	8.551111	8.551111
1 CH42/208	30I64 1535H	ST614	7-500M					
	6.950110	8.151010	5.151010	7.001100	4.951100	7.400100	5.650100	8.801000
	7.101000	6.051000	5.101000	9.200000	8.250000	7.900000	7.650000	7.600000
	7.700000	7.850000	8.600000	4.551000	5.201000	6.301000	8.551111	8.601111
1 CH42/209	30I64 1550H	ST614	6-400M					
	6.201010	7.001100	9.200100	5.900100	8.901000	6.251000	4.851000	7.900000
	6.500000	5.600000	4.850000	4.500000	4.050000	4.150000	4.150000	4.350000



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4.650000	4.850000	5.300000	6.000000	7.300000	9.300000	8.351111	8.351111
1 CH42/210	30164 1605H	ST614	9-800M				
5.751010	6.901100	8.700100	5.850100	8.301000	6.051000	4.701000	7.600000
6.200000	5.400000	4.650000	4.150000	4.000000	3.700000	3.900000	4.000000
4.050000	4.250000	4.600000	5.300000	6.200000	7.850000	8.351111	8.421111
1 CH42/211	30164 1620H	ST614	10-1000M				
7.951100	5.001100	6.450100	9.001000	6.501000	4.901000	8.000000	6.400000
5.500000	4.750000	4.400000	3.900000	3.900000	3.850000	3.950000	4.100000
4.300000	4.500000	4.850000	5.450000	6.400000	7.800000	8.461111	8.551111
1 CH42/212	30164 1635H	ST614	5-300M				
8.901100	5.101100	6.400100	8.751000	6.101000	9.500000	7.400000	6.100000
4.950000	4.300000	3.750000	3.600000	3.400000	3.350000	3.400000	3.500000
3.700000	3.800000	4.250000	4.850000	5.500000	6.650000	8.531111	8.501111
1 CH42/213	30164 1650H	ST614	4-210M				
7.151010	4.101010	5.301100	7.300100	5.100100	7.601000	5.751000	9.200000
7.500000	6.400000	5.450000	4.850000	4.550000	4.400000	4.300000	4.350000
4.500000	4.650000	5.000000	5.650000	6.650000	7.900000	8.501111	8.601111
1 CH42/214	30164 1710H	ST614	3-100M				
6.801010	7.751100	4.701100	6.300100	9.001000	6.701000	5.151000	8.100000
6.800000	5.550000	4.900000	4.450000	4.050000	4.000000	4.050000	4.100000
4.200000	4.400000	4.850000	5.400000	6.300000	7.700000	8.551111	8.551111
1 CH42/215	30164 2015H	ST615	32 55.6N 65	53.1W	PIPE S		
5.350110	6.201010	7.651100	5.151100	7.400100	5.350100	8.101000	6.451000
5.251000	4.351000	7.450000	6.650000	6.100000	5.800000	5.600000	5.800000
5.800000	6.300000	6.650000	7.500000	8.700000	5.151000	8.401111	8.381111
1 CH42/216	30164 2050H	ST615	1-SURFACE				
5.600110	6.351010	7.801100	5.201100	7.400100	5.350100	8.501000	6.501000
5.301000	8.700000	7.850000	7.100000	6.550000	6.050000	6.050000	6.150000
6.300000	6.650000	7.450000	8.650000	5.051000	6.301000	8.351111	8.451111
1 CH42/217	30164 2110H	ST615	2-60M				
6.451010	6.901100	8.750100	5.850100	8.051000	6.001000	9.500000	7.250000
5.750000	4.900000	4.200000	3.800000	3.550000	3.550000	3.500000	3.650000
3.800000	3.900000	4.320000	5.000000	5.810000	7.200000	8.431111	8.401111
1 CH42/218	30164 2120H	ST615	10-1000M				
5.801010	6.701100	4.351100	5.900100	8.401000	6.351000	5.051000	8.500000
7.450000	6.250000	5.550000	5.300000	4.850000	4.700000	4.850000	4.900000
5.150000	5.250000	5.750000	6.400000	7.400000	8.750000	8.351111	8.321111
1 CH42/219	30164 2135H	ST615	9-800M				
5.601010	6.601100	8.300100	5.650100	8.001000	6.101000	4.601000	7.450000
6.250000	5.050000	4.500000	4.050000	3.850000	3.650000	3.800000	3.900000
4.000000	4.100000	4.400000	4.850000	5.700000	6.850000	8.481111	8.481111
1 CH42/220	30164 2150H	ST615	3-100M				
6.851010	7.851100	4.851100	6.400100	4.600100	6.701000	5.201000	8.300000
6.600000	5.400000	4.650000	4.200000	3.850000	3.750000	3.800000	3.900000
4.150000	4.200000	4.600000	5.200000	6.150000	7.600000	8.501111	8.471111
1 CH42/221	30164 2205H	ST615	8-600M				
5.201010	5.901100	7.500100	5.000100	7.201000	5.251000	8.250000	6.450000
5.500000	4.450000	3.900000	3.600000	3.300000	3.250000	3.400000	3.400000
3.600000	3.700000	4.000000	4.500000	5.200000	6.450000	8.501111	8.351111
1 CH42/222	30164 2220H	ST615	4-210M				
5.750110	6.401010	8.101100	5.251100	7.900100	5.450100	8.401000	6.351000
5.101000	8.750000	7.100000	6.350000	5.850000	5.550000	5.600000	5.550000
5.750000	5.900000	6.400000	7.250000	8.400000	5.051000	8.501111	8.451111
1 CH42/223	30164	ST615	7-500M				
7.401010	8.751100	5.451100	7.400100	5.200100	7.801000	5.751000	4.601000
7.800000	6.500000	5.550000	5.100000	4.600000	4.350000	4.350000	4.400000
4.550000	4.700000	5.100000	5.700000	6.650000	8.200000	8.431111	8.421111

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1	CH42/224	30164	2255H	ST615	5-300M								
	5.001010	5.751100	7.300100	4.800100	6.801000	5.301000	8.000000	6.300000					
	5.100000	4.350000	3.800000	3.350000	3.250000	3.300000	3.350000	3.350000					
	3.550000	3.600000	3.900000	4.350000	5.000000	6.150000	8.391111	8.421111					
1	CH42/225	30164	2310H	ST615	6-400M								
	5.401010	6.001100	7.600100	5.200100	7.301000	5.101000	8.100000	6.450000					
	5.300000	4.700000	4.100000	3.800000	3.600000	3.530000	3.670000	3.850000					
	4.100000	4.350000	4.900000	5.600000	6.650000	8.500000	8.401111	8.351111					
1	CH42/226	31164	0630H	ST61633	59.7N 66	34.1W	PIPE	SURFACE					
	9.101010	5.201010	6.251100	8.550100	6.200100	9.201000	6.801000	5.451000					
	8.750000	7.300000	6.300000	5.650000	5.300000	5.000000	5.000000	5.050000					
	5.200000	5.280000	5.750000	6.400000	7.200000	8.700000	8.601111	8.421111					
1	CH42/227	31164	0725H	ST616	1-SURFACE								
	7.601010	8.801100	5.401100	7.600100	5.350100	7.451000	6.001000	4.701000					
	7.500000	6.450000	5.400000	5.000000	4.450000	4.300000	4.350000	4.300000					
	4.500000	4.600000	5.050000	5.700000	6.450000	7.750000	8.401111	8.551111					
1	CH42/228	31164	/MK/H	ST 616	10-1000M								
	5.101010	5.001100	6.500100	4.500100	6.501000	4.751000	8.000000	6.400000					
	5.500000	4.800000	4.350000	4.150000	4.050000	4.000000	4.150000	4.250000					
	4.350000	4.500000	5.050000	5.700000	6.700000	8.000000	8.451111	8.451111					
1	CH42/229	31164	0810H	ST616	9-800M								
	5.201100	6.050100	8.001000	5.451000	7.850000	6.200000	4.700000	3.950000					
	3.400000	2.800000	2.600000	2.500000	2.350000	2.300000	2.550000	2.600000					
	2.700000	2.800000	3.000000	3.350000	3.900000	4.600000	8.451111	8.401111					
1	CH42/230	31164	0825H	ST616	8-600M								
	6.801100	8.050100	5.300100	6.651000	5.051000	7.900000	6.450000	4.900000					
	4.050000	3.600000	3.200000	3.050000	2.850000	2.850000	2.950000	3.100000					
	3.200000	3.250000	3.650000	4.200000	4.900000	6.050000	8.301111	8.551111					
1	CH42/231	31164	0840H	ST616	7-500M								
	6.551010	7.651100	4.801100	6.700100	4.700100	6.901000	5.251000	8.600000					
	7.000000	5.750000	5.000000	4.500000	4.200000	4.000000	4.000000	4.050000					
	4.130000	4.210000	4.700000	5.150000	5.900000	7.200000	8.441111	8.501111					
1	CH42/232	31164	0910H	ST616	6-400M								
	5.301100	6.200100	8.201000	5.551000	8.200000	6.100000	4.900000	4.100000					
	3.500000	2.900000	2.700000	2.650000	2.600000	2.400000	2.650000	2.750000					
	3.000000	3.000000	3.250000	3.650000	4.200000	5.200000	8.401111	8.501111					
1	CH42/233	31164	0930H	ST616	5-300M								
	7.151100	8.200100	5.200100	7.001000	4.801000	8.000000	6.000000	4.750000					
	3.900000	3.400000	2.900000	2.750000	2.600000	2.600000	2.700000	2.750000					
	2.950000	3.050000	3.250000	3.750000	4.300000	5.250000	8.401111	8.351111					
1	CH42/234	31164	0945H	ST616	4-210M								
	5.251010	6.101100	7.800100	5.350100	7.401000	5.781000	4.451000	7.200000					
	6.200000	5.400000	4.900000	4.600000	4.450000	4.250000	4.350000	4.400000					
	4.650000	5.050000	5.700000	6.450000	7.350000	9.200000	8.151111	8.201111					
1	CH42/235	31164	1005H	ST616	3-100M								
	8.201010	4.831010	6.101100	8.500100	5.950100	8.701000	6.801000	5.201000					
	8.500000	7.000000	6.100000	5.500000	4.850000	4.650000	4.600000	4.650000					
	4.800000	5.000000	5.300000	6.100000	7.000000	8.500000	8.491111	8.601111					
1	CH42/236	31164	1025H	ST616	2-60M								
	7.701010	8.701100	5.351100	7.400100	5.050100	7.601000	5.801000	9.250000					
	7.500000	6.150000	5.200000	4.650000	4.350000	4.200000	4.150000	4.200000					
	4.350000	4.500000	4.750000	5.400000	6.300000	7.650000	8.471111	8.501111					
1	CH42/237	31164	1040H	ST616	10-1000M REPEAT								
	6.101100	7.500100	4.750100	6.501000	4.801000	7.400000	5.950000	4.900000					
	4.250000	3.500000	3.150000	2.900000	2.850000	2.800000	2.900000	3.100000					
	3.200000	3.300000	3.600000	4.200000	4.700000	5.700000	8.521111	8.581111					
1	CH42/238	31164	1410H	ST617	34 57.5N 67	4.2W	PIPE						

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8.301010	4.701010	5.901100	8.050100	5.600100	8.151000	6.251000	4.851000
8.100000	6.700000	5.700000	5.030000	4.600000	4.400000	4.400000	4.600000
4.700000	4.800000	5.150000	5.650000	6.550000	8.050000	8.231111	8.271111
1 CH42/239	31164 1450H	ST617	1-SURFACE				
7.901010	4.451010	5.801100	7.800100	5.450100	7.901000	6.101000	4.751000
7.700000	6.500000	5.400000	5.150000	4.750000	4.600000	4.500000	4.800000
4.800000	4.950000	5.350000	6.150000	6.900000	8.850000	8.201111	8.151111
1 CH42/240	31164 1505H	ST617	5-300M				
6.051010	6.901100	8.950100	5.900100	8.551000	6.301000	4.651000	7.200000
6.400000	5.500000	4.650000	4.100000	4.000000	3.850000	3.800000	3.850000
3.850000	4.050000	4.700000	5.100000	5.700000	7.100000	8.001111	8.051111
1 CH42/241	31164 1525H	ST617	7-500M				
5.501100	6.600100	8.301000	5.701000	8.500000	6.450000	5.150000	4.150000
3.500000	2.850000	2.600000	2.450000	2.250000	2.350000	2.400000	2.550000
2.650000	2.650000	2.950000	3.250000	3.700000	4.550000	8.201111	8.151111
1 CH42/242	31164 1535H	ST617	6-400M				
8.801010	5.101010	6.501100	8.800100	6.000100	9.001000	6.801000	5.301000
8.800000	7.400000	6.100000	5.400000	5.050000	4.700000	4.850000	4.800000
5.000000	5.000000	5.450000	6.100000	7.100000	8.650000	8.221111	8.301111
1 CH42/243	31164	ST617	4-210M	1550H			
9.601100	5.801100	7.050100	5.200100	6.801000	5.201000	8.200000	6.400000
5.050000	4.500000	4.050000	3.600000	3.550000	3.850000	3.750000	3.600000
3.750000	3.950000	4.600000	5.200000	5.900000	7.200000	8.151111	8.281111
1 CH42/245	31164 1610H	ST617	8-600M				
7.601010	8.701100	5.501100	7.650100	5.150100	8.001000	5.851000	4.651000
7.800000	6.700000	5.600000	5.300000	4.750000	4.600000	4.700000	4.700000
4.700000	4.850000	5.200000	5.900000	6.750000	8.000000	8.251111	8.221111
1 CH42/245	31164 1620H	ST617	3-100M				
7.000110	8.301010	5.301010	6.701100	4.751100	7.150100	5.300100	8.351000
6.601000	5.601000	9.800000	8.700000	8.000000	7.250000	7.100000	7.100000
7.400000	7.750000	8.300000	4.451000	5.101000	6.151000	8.201111	8.371111
1 CH42/246	31164 1635H	ST617	9-800M				
9.001100	5.151100	6.900100	9.251000	6.701000	5.301000	8.200000	6.600000
5.400000	4.800000	4.350000	4.000000	3.800000	3.850000	3.950000	4.000000
4.200000	4.500000	4.850000	5.450000	6.150000	7.400000	8.351111	8.351111
1 CH42/247	31164	ST617	2-60M	1650H			
9.201100	5.201100	7.100100	9.401000	6.701000	4.851000	8.200000	6.400000
5.150000	4.500000	3.850000	3.600000	3.400000	3.320000	3.450000	3.550000
3.700000	3.800000	4.200000	4.800000	5.420000	6.450000	8.351111	8.401111
1 CH42/248	31164 1700H	ST617	10-1000M				
5.701010	6.351100	8.200100	5.700100	8.351000	6.401000	5.151000	8.450000
7.000000	6.300000	5.700000	5.550000	5.250000	5.150000	5.300000	5.300000
5.450000	6.000000	6.600000	7.400000	8.600000	9.900000	8.301111	8.251111
1 CH42/249	31164 2110H	ST618	36 3N 67 39W	PIPE SURFACE			
7.401010	8.401100	5.151100	6.900100	4.700100	7.001000	5.201000	8.500000
7.000000	5.800000	5.050000	4.500000	4.250000	4.150000	4.150000	4.250000
4.400000	4.600000	5.100000	5.600000	6.400000	7.750000	8.701111	8.601111
1 CH42/250	31164 2150H	ST618	1-SURFACE				
6.451010	7.401100	9.600100	6.250100	8.951000	6.551000	4.951000	8.350000
6.600000	5.400000	4.800000	4.400000	4.000000	3.850000	3.950000	4.000000
4.100000	4.250000	4.650000	5.200000	6.150000	7.500000	8.551111	8.801111
1 CH42/251	31164 2210H	ST618	2-2000M				
5.701010	6.601100	8.550100	5.750100	8.301000	6.101000	4.601000	7.500000
6.100000	5.150000	4.250000	4.000000	3.700000	3.550000	3.750000	3.800000
3.900000	4.000000	4.300000	4.850000	5.750000	6.700000	8.651111	8.601111
1 CH42/252	31164 2225H	ST618	10-1000M				
6.301010	6.901100	4.451100	6.050100	8.801000	7.001000	5.301000	8.750000

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7.300000	6.320000	5.550000	5.200000	5.050000	4.900000	5.050000	5.100000
5.200000	5.500000	5.950000	6.550000	7.450000	8.700000	8.651111	8.651111
1 CH42/253	31164 ST618	9-800M					
6.901100	8.400100	5.300100	7.201000	5.051000	3.901000	6.000000	4.900000
4.100000	3.650000	3.050000	2.800000	2.600000	2.550000	2.700000	2.850000
2.900000	3.150000	3.400000	3.800000	4.350000	5.200000	8.651111	8.701111
1 CH42/254	31164 2255H ST618	8-600M					
5.401100	6.350100	8.251000	5.651000	8.500000	6.250000	4.950000	4.000000
3.300000	2.850000	2.600000	2.400000	2.350000	2.380000	2.450000	2.600000
2.750000	2.800000	3.100000	3.350000	3.900000	4.700000	8.721111	8.701111
1 CH42/255	31164 2315H ST618	7-500M					
4.901010	5.501100	7.200100	4.900100	7.101000	5.101000	8.400000	6.400000
5.200000	4.700000	4.250000	3.850000	3.800000	3.650000	3.750000	3.850000
4.050000	4.100000	4.500000	5.050000	5.900000	7.050000	8.701111	8.751111
1 CH42/256	31164 2335H ST618	6-400M					
6.301010	7.251100	4.701100	5.900100	8.701000	6.301000	4.701000	7.550000
6.200000	5.100000	4.400000	4.050000	3.850000	3.600000	3.700000	3.750000
3.900000	4.100000	4.300000	4.850000	5.650000	6.900000	8.681111	8.651111
1 CH42/257	31164 2350H ST618	5-300M					
8.551010	4.801010	6.201100	8.300100	5.700100	8.201000	6.601000	5.151000
8.400000	7.250000	6.200000	5.550000	5.300000	5.000000	4.850000	4.850000
5.000000	5.300000	5.800000	6.500000	7.700000	9.500000	8.651111	8.581111
1 CH42/258	11164 0010H ST618	J-210M					
6.001010	6.901100	8.650100	6.000100	4.200100	6.251000	4.751000	7.800000
6.300000	5.250000	4.600000	4.000000	3.800000	3.650000	3.600000	3.900000
3.950000	3.950000	4.300000	4.900000	5.600000	6.900000	8.651111	8.701111
1 CH42/254	11164 0035H ST618	3-100M					
6.300110	7.301010	9.101100	6.001100	8.500100	6.050100	4.600100	7.101000
5.701000	9.650000	8.300000	7.200000	6.450000	6.150000	6.000000	6.100000
6.250000	6.350000	6.850000	7.650000	8.900000	5.301000	8.651111	8.681111
1 CH42/260	11164 0055H ST618	2-2000M REPEAT					
8.801100	4.951100	6.900100	4.550100	6.701000	5.201000	7.750000	6.200000
5.150000	4.300000	3.850000	3.650000	3.400000	3.400000	3.500000	3.650000
3.800000	4.000000	4.500000	5.300000	6.250000	7.900000	8.551111	8.471111
1 CH42/261	11164 0615H ST619	37 39N 68 38W PIPE GS					
6.151010	6.751100	8.600100	5.150100	7.351000	5.101000	8.000000	6.200000
5.050000	4.300000	3.900000	3.450000	3.250000	3.150000	3.330000	3.450000
3.500000	3.600000	3.880000	4.450000	5.200000	6.550000	8.701111	8.701111
1 CH42/262	11164 0700H ST619	U SURFACE					
8.051010	9.051100	5.451100	7.500100	5.200100	7.601000	6.101000	4.701000
7.650000	6.650000	5.900000	5.400000	5.200000	4.950000	4.950000	5.050000
5.150000	5.450000	6.100000	7.100000	8.250000	5.001000	8.651111	8.651111
1 CH42/263	11164 0720H ST 619	2-600M					
6.151010	6.951100	8.700100	5.700100	8.001000	5.851000	4.351000	7.200000
5.900000	5.050000	4.250000	3.750000	3.500000	3.350000	3.450000	3.450000
3.650000	3.800000	4.050000	4.700000	5.400000	6.650000	8.651111	8.451111
1 CH42/264	11164 0735H ST619	8-600M					
5.401100	6.200100	8.001000	5.401000	7.800000	5.700000	4.550000	3.800000
3.100000	2.700000	2.450000	2.300000	2.150000	2.150000	2.400000	2.550000
2.700000	2.750000	3.050000	3.550000	4.200000	5.400000	8.451111	8.501111
1 CH42/265	11164 0805H ST619	5-300M					
8.901100	4.701100	6.200100	7.851000	5.601000	8.500000	6.700000	5.200000
4.250000	3.750000	3.150000	2.950000	2.800000	2.850000	2.950000	3.100000
3.250000	3.500000	3.920000	4.700000	5.800000	7.850000	8.351111	8.351111
1 CH42/266	11164 0825H ST619	10-1000M					
3.601010	4.051100	5.300100	7.151000	4.951000	7.700000	6.150000	4.700000
3.900000	3.450000	3.000000	2.900000	2.850000	2.800000	2.850000	3.050000

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3.200000	3.300000	3.700000	4.250000	4.850000	6.050000	8.501111	8.381111
1 CH42/267	11164 0845H	ST619	4-210M				
6.351010	7.501100	9.500100	6.350100	4.500100	6.351000	4.851000	7.900000
6.400000	5.150000	4.600000	4.000000	3.850000	3.600000	3.650000	3.800000
3.900000	4.000000	4.350000	5.100000	5.900000	7.300000	8.451111	8.401111
1 CH42/268	11164 0905H	ST619	3-100M				
5.601010	6.651100	8.500100	5.700100	8.101000	5.801000	4.401000	7.350000
5.850000	5.000000	4.300000	3.900000	3.650000	3.600000	3.750000	3.750000
4.000000	4.100000	4.350000	5.150000	6.100000	7.800000	8.301111	8.401111
1 CH42/269	11164 0920H	ST619	7-500M				
8.151100	4.451100	5.850100	8.051000	5.551000	8.500000	6.500000	5.100000
4.300000	3.600000	3.150000	2.950000	2.870000	2.850000	2.970000	3.100000
3.200000	3.250000	3.650000	4.150000	4.750000	5.800000	8.351111	8.351111
1 CH42/270	11164 0950H	ST619	6-400M				
5.050110	5.801010	7.151100	4.601100	6.700100	4.950100	7.201000	5.701000
4.651000	8.000000	6.700000	6.100000	5.600000	5.500000	5.450000	5.450000
5.700000	5.800000	6.350000	7.200000	8.400000	5.101000	8.451111	8.451111
1 CH42/271	11164 1015H	ST619	9-800M				
5.801010	6.701100	8.700100	5.850100	8.151000	5.801000	4.601000	7.500000
6.200000	5.200000	4.600000	4.050000	3.800000	3.650000	3.800000	3.950000
4.050000	4.300000	4.700000	5.100000	5.900000	7.200000	8.451111	8.451111
1 CH42/272	11164 1415H	ST620	38 58N 69 53W	PIPE SURF			
5.550110	6.001010	7.501100	4.801100	6.350100	9.201000	6.701000	5.351000
8.350000	6.700000	5.750000	5.300000	4.600000	4.450000	4.550000	4.450000
4.630000	4.900000	5.350000	6.050000	7.100000	8.950000	8.551111	8.551111
1 CH42/273	11164 1435H	ST620	1-SURFACE				
5.800110	6.601010	8.001100	5.001100	7.200100	4.800100	7.001000	5.201000
8.800000	7.300000	6.000000	5.300000	4.800000	4.600000	4.600000	4.600000
4.750000	4.900000	5.500000	6.250000	7.350000	9.600000	8.651111	8.451111
1 CH42/274	11164 1455H	ST620	3-100M				
7.601010	8.851100	5.651100	7.500100	5.450100	7.901000	5.751000	9.550000
7.300000	6.100000	5.250000	4.750000	4.450000	4.150000	4.150000	4.150000
4.300000	4.450000	4.850000	5.400000	6.550000	7.950000	8.551111	8.551111
1 CH42/275	11164 1510H	ST620	9-800M				
3.500110	7.251100	4.501100	6.600100	4.400100	6.551000	5.251000	8.000000
6.600000	5.750000	4.850000	4.500000	4.200000	4.050000	4.150000	4.200000
4.250000	4.650000	4.800000	5.450000	6.350000	7.500000	8.481111	8.401111
1 CH42/276	11164 1520H	ST620	2-60M				
8.901010	4.951010	6.251100	8.700100	6.200100	8.901000	6.701000	5.201000
9.200000	7.150000	6.050000	5.400000	5.250000	4.750000	4.750000	4.700000
5.000000	5.200000	5.700000	6.400000	7.500000	8.750000	8.351111	8.351111
1 CH42/277	11164 1535H	ST620	5-300M				
8.251010	5.301010	5.301100	7.700100	5.100100	7.251000	5.901000	8.400000
7.100000	6.300000	5.100000	4.550000	4.250000	4.100000	4.100000	4.200000
4.250000	4.350000	4.750000	5.500000	6.300000	7.700000	8.251111	8.451111
1 CH42/278	11164 1550H	ST 620	4-210M				
9.301010	5.251010	6.501100	4.301100	6.200100	4.600100	6.701000	5.401000
4.301000	7.350000	6.200000	5.400000	5.050000	4.900000	4.850000	4.950000
5.100000	5.350000	5.600000	6.350000	7.400000	9.100000	8.501111	8.501111
1 CH42/279	11164 1605H	ST620	6-400M				
6.301100	7.500100	5.200100	6.601000	4.801000	8.000000	5.900000	4.900000
3.750000	3.350000	2.950000	2.650000	2.550000	2.500000	2.700000	2.700000
2.800000	3.000000	3.200000	3.550000	4.100000	5.100000	8.301111	8.301111
1 CH42/280	11164 1620H	ST620	7-500M				
4.201010	4.801100	6.250100	4.250100	6.101000	9.300000	7.400000	5.600000
4.600000	4.200000	3.450000	3.200000	3.000000	2.950000	3.100000	3.200000
3.200000	3.400000	3.650000	4.150000	4.750000	5.700000	8.401111	8.301111

14

1 CH42/281	11164	1645H	ST620	8-600M					
2.650110	6.051100	7.750100	5.250100	7.051000	5.301000	8.000000	6.450000		
5.000000	4.200000	3.800000	3.400000	3.200000	3.150000	3.300000	3.400000		
3.650000	3.650000	4.000000	4.600000	5.200000	6.350000	8.301111	8.351111		
1 CH42/282	11164	1700H	ST620	10-1000M					
5.351010	6.401100	8.300100	5.300100	8.101000	5.751000	4.501000	7.300000		
6.100000	5.200000	4.400000	4.150000	3.750000	3.600000	3.600000	3.750000		
3.850000	4.050000	4.350000	4.750000	5.700000	6.900000	8.401111	8.401111		
							808		
						TOTAL	808*		

Table of data pertinent to each sample

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CRL01/1	18Nov1963	2000	41°18'	70°52'	pump	11.5	*
2	"	2100	41°11'	70°50'	"	12.0	*
3	"	2215	41°01'	70°41'	"	*	32.371
4	19Nov1963	0000	40°46'	70°28'	"	*	32.217
5	"	0300	40°18'	70°07'	"	*	32.771
6	"	0600	39°51'	69°49'	"	11.4	32.665
7	"	0720	39°41'	69°44'	"	12.0	*
8	"	0830	39°30'	69°35'	"	18.0	35.641
9	"	0930	39°20'	69°29'	"	17.9	35.566
10	"	1040	39°08'	69°20'	"	18.8	35.754
11	"	1130	39°00'	69°14'	"	18.7	35.742
12	"	1330	38°39'	69°01'	"	18.6	35.506
13	"	1410	38°34'	68°57'	"	18.7	35.616
14	"	1510	38°23'	68°50'	"	18.5	35.552
15	"	1605	38°14'	68°42'	"	20.4	35.815
16	"	1630	38°10'	68°38'	"	20.8	35.812
17	"	1710	38°02'	68°31'	"	21.8	35.811
18	"	1740	37°57'	68°25'	"	21.3	35.761
19	"	1810	35°53'	68°21'	"	22.1	36.294
20	"	1840	37°48'	68°14'	"	24.4	36.399
21	"	1930	37°41'	68°07'	"	24.3	36.405
22	"	2045	37°29'	68°00'	"	*	36.485
23	"	2200	37°17'	67°46'	"	21.9	36.493
24	"	2300	37°07'	67°37'	"	22.2	36.427
25	"	2350	36°59'	67°31'	"	21.8	36.555

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S<sup>o</sup>/oo</u>
CR101/26	20Nov1963	0045	36°49'	67°24'	pump	21.5	36.642
27	"	0250	36°28'	67°08'	"	21.5	36.558
28	"	0445	36°12'	66°59'	"	21.5	36.567
29	"	0640	35°54'	66°47'	"	21.5	36.557
30	"	0730	35°45'	66°40'	"	21.8	36.567
31	"	0830	35°35'	66°33'	"	21.8	36.564
32	"	1030	35°15'	66°21'	"	21.4	36.569
33	"	1230	34°56'	66°08'	"	21.8	36.526
34	"	1330	34°45'	66°01'	"	21.8	*
35	"	1430	34°36'	65°53'	"	21.8	36.494
36	"	1530	34°26'	65°47'	"	21.5	*
37	"	1630	34°17'	65°41'	"	21.3	36.477
38	"	1730	34°07'	65°36'	"	21.5	*
39	"	1910	33°53'	65°25'	"	*	36.546
40	"	1930	33°47'	65°21'	"	21.6	*
41	"	2030	33°36'	65°14'	"	22.1	36.525
42	"	2130	33°28'	65°07'	"	22.1	*
43	"	2230	33°20'	65°02'	"	22.1	36.530
44	"	2330	33°11'	64°55'	"	22.2	36.529
45	21Nov1963	1940			"	19.7	*
46	3Dec1963	1000			"	*	*
47	"	1035	32°28'	64°38'	"	21.6	*
48	"	1130	32°30'	64°40'	"	21.7	*
49	"	1200	32°36'	64°41'	"	21.7	*
50	"	1300	32°47'	64°50'	"	21.8	36.550



<u>SAMPLE</u>	<u>DATE</u>	<u>TIME</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CR101/51	3Dec1963	1400	32°57'	64°57'	pump	21.8	36.549
52	"	1500	33°05'	65°00'	"	21.8	36.563
53	"	1600	33°18'	65°11'	"	21.6	36.571
54	"	1700	33°26'	65°18'	"	21.6	36.570
55	"	1800	33°39'	65°27'	"	21.6	36.561
56	"	1900	33°49'	65°33'	"	21.5	36.578
57	"	2000	34°00'	65°40'	"	21.1	36.571
58	"	2100	34°13'	65°48'	"	21.1	36.564
59	"	2200	34°22'	65°54'	"	*	36.589
60	"	2300	34°33'	65°00'	"	*	35.560
61	4Dec1963	0100	34°55'	66°16'	"	*	36.546
62	"	0300	35°13'	66°30'	"	*	36.576
63	"	0500	35°25'	66°35'	"	*	36.496
64	"	0800	35°41'	66°57'	"	*	36.454
65	"	1140	36°02'	67°16'	"	22.0	36.507
(1575) 66	"	1315	36°14'	67°23'	"	*	36.495
67	"	1410	"	"	1m	21.85	36.491
68	"	1425	"	"	50m	21.46	36.518
69	"	1440	"	"	100m	21.32	36.570
70	"	1500	"	"	398m	17.98	36.457
71	"	1520	"	"	700m	14.63	35.940
72	"	1535	"	"	995m	8.74	35.106
73	"	1550	"	"	1492m	4.42	34.992
74	"	1610	"	"	1990m	3.81	34.970
75	"	1750	36°44'	67°46'	pump	*	36.533

<u>SAMPLE</u>	<u>DATE</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oe</u>
CR101/76	4dec1963	2310	37°26'	68°13'	pump	22.6	36.468
77	"	2340	37°30'	68°14'	"	22.2	36.497
78	"	2400	37°33'	68°15'	"	22.5	36.483
79	5Dec1963	0020	37°35'	68°16'	"	22.3	36.487
80	"	0040	37°38'	68°18'	"	22.9	36.461
81	"	0100	37°41'	68°19'	"	22.8	36.472
82	"	0130	37°45'	68°22'	"	22.8	36.508
83	"	0200	37°50'	68°24'	"	22.5	36.534
84	"	0230	37°54'	68°26'	"	22.4	36.503
85	"	0300	37°59'	68°28'	"	22.3	36.525
86	"	0330	37°03'	68°28'	"	22.6	36.514
87	"	0400	38°07'	68°29'	"	22.2	36.418
88	"	0430	38°12'	68°31'	"	21.8	36.432
89	"	0500	38°17'	68°33'	"	17.3	35.541
90	"	0530	38°21'	68°36'	"	17.7	35.449
91	"	0600	38°27'	68°39'	"	17.1	35.559
92	"	0700	38°35'	68°47'	"	17.1	35.694
93	"	0800	38°45'	68°55'	"	15.4	35.029
(1576) 94	"	0900	38°55'	69°05'	"	*	34.813
95	"	0945	"	"	1m	14.62	34.834
96	"	1000	"	"	50m	14.58	34.824
97	"	1015	"	"	100m	14.52	35.691
98	"	1030	"	"	381m	7.06	35.060
99	"	1040	"	"	649m	4.66	35.000
100	"	1100	"	"	956m	4.12	34.977

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CR101/101	5Dec1963	1125	38°55'	69°05'	1432m	3.75	34.963
102	"	1140	"	"	1910m	3.43	34.958
(1577) 103	"	1700	39°57'	69°57'	pump	11.3	33.485
104	"	1745	"	"	18m	11.93	33.837
105	"	1805	"	"	60m	14.58	34.821
106	"	1825	"	"	100m	14.79	35.574
107	"	1855	"	"	140m	13.04	35.685
108	"	1915	"	"	180m	12.99	35.450
109	"	1930	"	"	200m	11.84	35.567
(1578) 110	"	2230	40°31'	70°25'	pump	10.4	32.412
111	"	2245	"	"	7m	10.42	32.401
112	"	2300	"	"	17m	10.42	32.404
113	"	2315	"	"	27m	*	32.394
114	"	2330	"	"	37m	10.42	32.400
115	"	2340	"	"	47m	10.45	32.413
116	"	2400	"	"	57m	10.58	32.472
117	6Dec1963	0020	"	"	65m	13.20	33.897
118	"	0900	41°31'	70°40'	pump	*	31.804
119	"	0910	W.H.O.I.	Pier	pump	*	*
CH42/ 1	15Jan1963	1700			"	*	*
2	"	1800			"	*	32.512
3	"	1900			"	*	*
4	"	2000			"	*	*
5	"	2100			"	*	32.791
6	"	2200			"	*	*

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S‰/oo</u>
CH42/7	15Jan1963	2300			pump	13.20	32.791
8	16Jan1963	0800	37°55'	69°59'	"	*	36.344
9	"	0900	37°50'	69°55'	"	*	36.571
10	"	1000	37°45'	69°50'	"	*	36.579
11	"	1100	37°40'	69°50'	"	*	36.589
12	"	1200	37°35'	69°52'	"	(21.1)	(36.599)
13	"	1300	37°25'	69°55'	"	(21.1)	(36.609)
(601)14	"	1530	37°11'	70°00'	"	*	*
15	"	1600	"	"	1m	20.77	36.570
16	"	1620	"	"	90m	19.50	36.624
17	"	1635	"	"	200m	19.22	36.603
18	"	1700	"	"	1934m	3.82	34.965
19	"	1740	"	"	1934m	R	R
20	"	1800	"	"	299m	18.43	36.535
21	"	1835	"	"	398m	*	36.456
22	"	1900	"	"	592m	15.07	35.994
23	"	1920	"	"	784m	9.97	35.276
24	"	1940	"	"	973m	5.78	35.029
25	"	1955	"	"	1451m	4.12	34.967
26	"	2020	"	"	1934m	R	R
27	"	2055	"	"	348m	*	36.493
28	"	2110	"	"	30m	21.19	36.571
(602)29	17Jan1964	0930	34°53'	70°00'	pump	*	*
30	"	1005	"	"	1m	18.34	36.539
31	"	1030	"	"	28m	18.32	36.540

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/32	17Jan1964	1050	34°53'	70°00'	950m	6.22	35.057
33	"	1110	"	"	750m	9.11	35.185
34	"	1125	"	"	556m	12.93	35.660
35	"	1145	"	"	370m	16.46	36.229
36	"	1245	"	"	278m	17.33	36.348
37	"	1305	"	"	185m	18.34	36.546
38	"	1325	"	"	130m	18.35	36.547
39	"	1345	"	"	85m	18.32	36.542
40	"	1410	"	"	950m	R	R
41	"	1430	"	"	750m	R	R
42	"	1450	"	"	1m	R	R
(603) 43	"	2245	32°47'	70°00'	pump	*	*
44	"	2315	"	"	1m	19.05	36.596
45	"	2340	"	"	971m	7.63	35.101
46	"	2355	"	"	97m	19.03	36.605
47	18Jan1964	0015	"	"	213m	19.03	36.603
48	"	0030	"	"	301m	18.33	36.528
49	"	0050	"	"	388m	17.85	36.466
50	"	0105	"	"	485m	17.27	36.383
51	"	0125	"	"	582m	15.86	36.158
52	"	0145	"	"	679m	14.07	35.829
53	"	0200	"	"	776m	11.90	35.529
54	"	0220	"	"	971m	R	R
(604) 55	"	2235	30°21'	69°32'	pump	*	*
56	"	2300	"	"	100m	19.94	36.610

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/57	18Jan1964	2320	30°21'	69°32'	400m	17.78	36.451
58	"	2340	"	"	1000m	6.67	35.071
59	19Jan1964	0005	"	"	1000m	R	R
60	"	0025	"	"	1000m	R	R
61	"	0035	"	"	pump	R	R
62	"	0055	"	"	100m	R	R
63	"	0110	"	"	400m	R	R
64	"	0135	"	"	1000m	R	R
65	"	0200	"	"	pump	R	R
66	"	0220	"	"	100m	R	R
67	"	0235	"	"	400m	R	R
68	"	0250	"	"	1000m	R	R
69	"	1245	"	"	pump	R	R
70	"	1310	"	"	100m	R	R
71	"	1335	"	"	400m	R	R
72	"	1355	"	"	1000m	R	R
73	"	1510	"	"	pump (22.3)		(36.713)
74	"	1525	"	"	pump (22.3)		(36.713)
(605) 75	"	2235	26°32'	69°30'	pump	*	*
76	"	2330	"	"	1m	23.72	36.714
77	"	2340	"	"	100m	21.47	36.712
78	20Jan1964	0005	"	"	220m	18.79	36.550
79	"	0020	"	"	310m	18.05	36.522
80	"	0040	"	"	400m	17.38	36.399
81	"	0055	"	"	500m	16.03	36.168

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/82	20Jan1964	0110	26°32'	69°30'	600m	13.86	35.828
83	"	0130	"	"	700m	11.81	35.461
84	"	0150	"	"	800m	9.45	35.261
85	"	0235	"	"	1000m	6.55	35.035
86	"	0335	"	"	1000m	R	R
(606) 87	"	2155	27°15'	69°52'	pump	*	*
88	"	2225	"	"	1000m	6.52	35.080
89	"	2245	"	"	800m	9.90	35.307
90	"	2305	"	"	700m	12.35	35.609
91	"	2325	"	"	600m	14.53	35.926
92	"	2340	"	"	500m	16.51	36.246
93	21Jan1964	0005	"	"	400m	17.57	36.425
94	"	0035	"	"	310m	18.13	36.493
95	"	0100	"	"	220m	18.72	36.543
96	"	0130	"	"	100m	21.54	36.713
97	"	0150	"	"	1m	21.63	36.723
98	22Jan1964	1140	26°01'	71°45'	pump	23.5	36.718
99	"	1245	26°11'	71°51'	pump	23.0	36.733
100	"	1345	26°26'	71°55'	pump	23.0	36.720
101	"	1515	26°32'	71°52'	pump	23.0	36.731
102	"	1615	26°44'	71°41'	pump	21.6	36.695
103	"	1815	26°40'	72°03'	pump	23.4	36.720
104	"	1915	26°53'	72°08'	pump	23.1	36.716
105	23Jan1964	0010	27°41'	71°54'	pump	21.4	36.765
106	"	1330	27°14'	72°50'	pump	23.8	36.715

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/‰</u>
CH42/107	23Jan1964	1430	27°24'	72°44'	pump	23.5	36.732
108	"	1525	27°28'	72°40'	pump	23.0	36.759
109	"	1620	27°33'	72°31'	pump	22.8	36.748
(607) 110	"	2200	28°03'	71°47'	pump	*	*
111	"	2240	"	"	1m	22.17	36.841
112	"	2300	"	"	89m	21.53	36.730
113	"	2315	"	"	208m	18.88	36.556
114	24Jan1964	0015	"	"	990m	7.05	35.046
115	"	0035	"	"	792m	11.41	35.492
116	"	0045	"	"	693m	13.43	35.757
117	"	0100	"	"	594m	15.51	36.086
118	"	0115	"	"	495m	17.05	36.344
119	"	0130	"	"	396m	17.80	36.457
120	"	0140	"	"	297m	*	36.521
121	"	1930	27°05'	69°20'	pump	21.0	36.688
(608) 122	"	2100	27°10'	69°17'	pump	*	*
123	"	2115	"	"	1m	21.19	36.769
124	"	2130	"	"	89m	21.13	36.714
125	"	2140	"	"	208m	18.87	36.581
126	"	2215	"	"	297m	*	36.536
127	"	2255	"	"	396m	17.53	36.420
128	"	2320	"	"	495m	16.69	36.284
129	"	2340	"	"	595m	14.56	35.942
130	25Jan1964	0005	"	"	695m	12.29	35.605
131	"	0025	"	"	795m	9.83	35.301



<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/132	25Jan1964	0045	27°10'	59°17'	995m	6.42	35.061
133	"	1005	26°46'	68°23'	pump	21.6	36.727
134	"	1020	26°46'	68°24'	pump	21.6	36.701
135	"	1030	26°45'	68°25'	pump	21.6	(36.705)
136	"	1045	26°44'	68°25'	pump	21.6	(36.720)
137	"	1100	26°43'	68°26'	pump	22.8	36.745
138	"	1115	26°42'	68°27'	pump	23.2	36.741
139	"	1130	26°41'	68°27'	pump	23.3	36.727
140	"	1145	26°40'	68°28'	pump	23.4	36.725
141	"	1230	26°35'	68°27'	pump	23.5	36.720
142	"	1245	26°34'	68°28'	pump	23.5	36.717
143	"	1315	26°32'	68°29'	pump	23.5	36.730
144	"	1500	26°22'	68°22'	pump	23.8	36.703
145	"	1530	26°22'	68°19'	pump	23.4	*
(609) 146	"	2340	26°28'	67°35'	pump	*	*
147	26Jan1964	0005	"	"	1m	23.44	36.709
148	"	0200	"	"	20m	23.43	36.697
149	"	0035	"	"	120m	21.44	36.680
150	"	0050	"	"	100m	*	36.688
151	"	0105	"	"	60m	22.63	36.752
152	"	0120	"	"	40m	23.41	36.699
153	"	0135	"	"	80m	21.72	36.691
154	"	0150	"	"	200m	18.85	36.560
155	"	0140	"	"	140m	20.84	36.667
156	"	0215	"	"	160m	19.87	36.622

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S‰/‰</u>
CH42/157	26Jan1964	0330	26°52'	67°45'	pump	*	*
158	"	0355	"	"	1m	21.38	36.727
159	"	0415	"	"	20m	21.14	36.717
160	"	0430	"	"	40m	21.30	36.717
161	"	0445	"	"	60m	20.32	36.625
162	"	0500	"	"	80m	19.94	36.614
163	"	0510	"	"	100m	*	36.587
164	"	0525	"	"	120m	19.13	36.567
165	"	0540	"	"	140m	18.91	36.553
166	"	0555	"	"	160m	18.76	36.542
167	"	0610	"	"	200m	18.55	36.535
168	27Jan1964	2335	28°51'	66°37'	pump	21.0	36.728
169	28Jan1964	0030	28°50'	66°27'	pump	21.3	36.727
170	"	0130	28°34'	66°20'	pump	22.3	36.766
171	"	0235	28°29'	66°13'	pump	23.3	36.807
172	"	0330	28°34'	66°07'	pump	22.8	36.793
(611) 173	29Jan1964	1230	28°51'	63°07'	pump	*	*
174	"	1255	"	"	1m	22.37	36.845
175	"	1315	"	"	60m	21.55	36.839
176	"	1330	"	"	100m	21.34	36.735
177	"	1350	"	"	210m	18.63	36.542
178	"	1400	"	"	300m	18.10	36.500
179	"	1415	"	"	400m	17.43	36.408
180	"	1435	"	"	500m	*	36.278
181	"	1455	"	"	699m	12.63	35.686

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/182	29Jan1964	1515	28°51'	63°07'	992m	7.03	35.071
(512) 183	"	2320	29°57'	64°04'	pump	*	*
184	"	2350	"	"	1m	*	36.780
185	30Jan1964	0005	"	"	56m	21.66	35.759
186	"	0025	"	"	93m	21.53	36.739
187	"	0045	"	"	193m	18.74	36.554
188	"	0100	"	"	361m	17.60	36.439
189	"	0115	"	"	641m	13.83	35.815
190	"	0130	"	"	273m	18.03	36.486
191	"	0145	"	"	940m	7.95	35.133
192	"	0200	"	"	541m	15.51	36.063
(613) 193	"	0740	31°03'	64°47'	pump	*	*
194	"	0815	"	"	1m	19.95	36.628
195	"	0835	"	"	59m	19.91	36.644
196	"	0805	"	"	98m	19.91	36.644
197	"	0910	"	"	205m	*	36.644
198	"	0925	"	"	985m	6.70	35.073
199	"	0945	"	"	293m	18.26	36.507
200	"	1000	"	"	490m	16.90	36.313
201	"	1015	"	"	787m	10.90	35.394
202	"	1035	"	"	391m	17.69	36.443
203	"	1050	"	"	590m	15.43	36.061
(614) 204	"	1410	32°05'	65°20'	pump	*	*
205	"	1445	"	"	1m	19.47	36.633
206	"	1500	"	"	60m	19.72	36.637

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/207	30Jan1964	1520	32°05'	65°20'	600m	14.87	35.968
208	"	1535	"	"	500m	16.30	36.206
209	"	1550	"	"	400m	17.39	36.399
210	"	1605	"	"	800m	10.21	35.380
211	"	1620	"	"	1000m	6.52	35.072
212	"	1635	"	"	300m	18.19	36.495
213	"	1650	"	"	210m	18.46	36.539
214	"	1710	"	"	100m	19.52	36.635
(615) 215	"	2015	32°56'	65°57'	pump	*	*
216	"	2050	"	"	1m	18.78	36.586
217	"	2110	"	"	54m	18.80	36.586
218	"	2120	"	"	917m	7.64	35.104
219	"	2135	"	"	734m	11.82	35.511
220	"	2150	"	"	90m	18.82	36.585
221	"	2205	"	"	550m	15.57	36.083
222	"	2220	"	"	190m	18.83	36.585
223	"	2235	"	"	456m	17.05	36.321
224	"	2255	"	"	271m	18.27	36.507
225	"	2310	"	"	361m	17.76	36.445
(616) 226	31Jan1964	0630	34°05'	66°38'	pump	*	*
227	"	0725	"	"	1m	18.76	36.585
228	"	0750	"	"	980m	7.37	35.014
229	"	0810	"	"	784m	11.64	35.498
230	"	0825	"	"	588m	15.72	36.102
231	"	0840	"	"	490m	17.05	36.341

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/232	31Jan1964	0910	34°05'	66°38'	392m	17.75	36.456
233	"	0930	"	"	294m	18.38	36.525
234	"	0945	"	"	206m	18.73	36.603
235	"	1005	"	"	98m	18.77	36.590
236	"	1025	"	"	59m	18.75	36.603
237	"	1040	"	"	980m	R	R
(617) 238	"	1410	34°58'	67°04'	pump	*	*
239	"	1450	"	"	1m	*	36.577
240	"	1505	"	"	300m	18.50	36.582
241	"	1525	"	"	500m	17.50	36.334
242	"	1535	"	"	400m	18.38	36.552
243	"	1550	"	"	210m	18.49	36.574
244	"	1610	"	"	600m	16.51	36.242
245	"	1620	"	"	100m	18.45	36.585
246	"	1635	"	"	800m	12.10	35.543
247	"	1650	"	"	60m	18.47	36.574
248	"	1700	"	"	1000m	7.56	35.086
(618) 249	"	2100	36°03'	67°39'	pump	*	*
250	"	2150	"	"	1m	18.54	36.546
251	"	2210	"	"	1940m	3.68	34.962
252	"	2225	"	"	970m	5.75	35.032
253	"	2240	"	"	776m	8.84	35.149
254	"	2255	"	"	582m	13.09	35.748
255	"	2315	"	"	485m	14.77	35.930
256	"	2335	"	"	388m	16.75	36.252

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T<sup>o</sup>C</u>	<u>S<sup>o</sup>/oo</u>
CH42/257	31Jan1964	2350	36 <sup>o</sup> 03'	67 <sup>o</sup> 39'	291m	18.52	36.558
258	1Feb1964	0100	"	"	204m	18.53	36.555
259	"	0035	"	"	97m	18.54	36.551
260	"	0055	"	"	1940m	R	R
(619) 261	"	0615	37 <sup>o</sup> 39'	68 <sup>o</sup> 38'	pump	*	*
262	"	0700	"	"	1m	21.67	36.571
263	"	0720	"	"	59m	21.63	36.560
264	"	0735	"	"	588m	15.38	36.054
265	"	0805	"	"	294m	18.56	36.589
266	"	0825	"	"	971m	6.35	35.042
267	"	0845	"	"	206m	18.96	36.593
268	"	0905	"	"	98m	20.86	36.638
269	"	0920	"	"	490m	16.97	36.309
270	"	0950	"	"	392m	18.10	36.497
271	"	1015	"	"	782m	11.22	35.433
(620) 272	"	1415	38 <sup>o</sup> 58'	69 <sup>o</sup> 32'	pump	*	*
273	"	1435	"	"	1m	5.07	32.698
274	"	1455	"	"	100m	13.65	35.701
275	"	1510	"	"	800m	4.05	34.979
276	"	1520	"	"	60m	13.81	35.614
277	"	1535	"	"	300m	7.78	35.101
278	"	1550	"	"	210m	9.72	35.225
279	"	1605	"	"	400m	5.70	35.032
280	"	1620	"	"	500m	4.86	35.008
281	"	1645	"	"	600m	4.72	35.024

<u>Sample</u>	<u>Date</u>	<u>Time</u>	<u>N.Lat.</u>	<u>W.Long.</u>	<u>Depth</u>	<u>T°C</u>	<u>S°/oo</u>
CH42/282	1Feb1964	1700	38°58'	69°32'	1000m	3.94	34.046

\* not recorded

R rerun, data given at first run.

Salinity and temperature values in parenthesis are interpolated.

APPENDIX B

FORTRAN PROGRAM

The following pages are a copy of the FORTRAN program employed in the data reduction.



C	SCATTERING CALCULATIONS	
	READ 5000, M	A
5000	FORMAT (I5)	B
	DIMENSION AMP(30),I1(30),I2(30),I3(30),I4(30),RNORM(37),THETA(37)	500
	DIMENSION X(37) , RTHETA(37), RNOLN(37), SLOLN(37), RTHLN(37)	
	DIMENSION SLOPE(37), RATIO(37), RAPAR(37), SLO2(37), RINT(37)	
	DO 340 N=1,M	
	READ 3900	
3900	FORMAT (54H	)
C	CORRECTIVE ROUTINE	
	OREAD 4000, AMP(7), I1(7), I2(7), I3(7), I4(7),	501
	1AMP(8), I1(8), I2(8), I3(8), I4(8),	502
	2AMP(9), I1(9), I2(9), I3(9), I4(9),	503
	3AMP(10), I1(10), I2(10), I3(10), I4(10),	504
	4AMP(11), I1(11), I2(11), I3(11), I4(11),	505
	5AMP(12), I1(12), I2(12), I3(12), I4(12),	506
	6AMP(13), I1(13), I2(13), I3(13), I4(13),	507
	7AMP(14), I1(14), I2(14), I3(14), I4(14)	508
	OREAD 4000, AMP(15), I1(15), I2(15), I3(15), I4(15),	509
	1AMP(16), I1(16), I2(16), I3(16), I4(16),	510
	2AMP(17), I1(17), I2(17), I3(17), I4(17),	511
	3AMP(18), I1(18), I2(18), I3(18), I4(18),	512
	4AMP(19), I1(19), I2(19), I3(19), I4(19),	513
	5AMP(20), I1(20), I2(20), I3(20), I4(20),	514
	6AMP(21), I1(21), I2(21), I3(21), I4(21),	515
	7AMP(22), I1(22), I2(22), I3(22), I4(22)	516
	OREAD 4000, AMP(23), I1(23), I2(23), I3(23), I4(23),	517
	1AMP(24), I1(24), I2(24), I3(24), I4(24),	518
	2AMP(25), I1(25), I2(25), I3(25), I4(25),	519
	3AMP(26), I1(26), I2(26), I3(26), I4(26),	520
	4AMP(27), I1(27), I2(27), I3(27), I4(27),	521
	5AMP(28), I1(28), I2(28), I3(28), I4(28),	522
	6DIRECT, I1D, I2D, I3D, I4D,	
	7DIR2, I12, I22, I32, I42	
40000	FORMAT (F5.2,4I1,F6.2,4I1,F6.2,4I1,F6.2,4I1,F6.2,4I1,F6.2,4I1,	530
	IF6.2,4I1,F6.2,4I1)	531
	A1 = .490	
	A2 = .245	
	A3 = .122	
	A4 = .0611	
	DO 310 J=7,28	550
	IF(I1(J)-1) 301,302,1	560
301	AMP(J)=AMP(J) * A1	
302	IF(I2(J)-1) 303,304,1	580
303	AMP(J)=AMP(J) * A2	
304	IF(I3(J)-1) 305,306,1	600
305	AMP(J)=AMP(J) * A3	610
306	IF(I4(J)-1) 307,310,1	620
307	AMP(J)=AMP(J) * A4	630
310	CONTINUE	640
	IF(I1D-1) 311,312,1	650
311	DIRECT =DIRECT * A1	660
312	IF (I2D-1) 313,314,1	
313	DIRECT =DIRECT * A2	680
314	IF(I3D-1) 315,316,1	690
315	DIRECT = DIRECT * A3	
316	IF(I4D-1) 317,318,1	710
317	DIRECT =DIRECT * A4	720
318	IF(I12 - 1) 321,322,1	

1

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321 DIR2 = DIR2 * A1
322 IF(I22 - 1) 323,324,1
323 DIR2 = DIR2 * A2
324 IF(I32 - 1)325,326,1
325 DIR2 = DIR2 * A3
326 IF(I42 - 1) 327,328,1
327 DIR2 = DIR2 * A4
328 DO 319 J =7,28
319 AMP(J) = AMP(J) / (DIRECT - ((DIRECT-DIR2)/22.) * FLOATF(J-7) )
DO 320 J=10,28
L=38-J
320 AMP(L) = AMP(L) - 0.078 * AMP(J)
DO 333 J=1,37
335 THETA(J) = FLOATF((J-1)*5)
333 RTHETA(J) = THETA(J) * 3.1416 / 180.
DO 331 J=7,9
331 AMP(J) = AMP(J) - 0.078 * AMP(28) * SIN(RTHETA(10)) /
1SIN(RTHETA(J))
DO 330 J=7,28
330 RNORM(J) = AMP(J) * SIN(RTHETA(J)) * 1.42
DO 341 J=7,28
341 RNOLN(J) = LOGF(RNORM(J))
DO 342 J=2,37
342 RTHLN(J) = LOGF(RTHETA(J))
RTHLN(1) = -6.35
C EXTRAPOLATION ROUTINE
E = 2.303
G = 5.
X1 = 0.
X2 = 0.
X3 = 0.
X4 = 0.
Y = 0.
XY = 0.
X2Y = 0.
DO 400 J=7,11
X(J) = LOGF(RNORM(J)) / E
X1 = X1 + THETA(J)
X2 = X2 + THETA(J)**2
X3 = X3 + THETA(J)**3
X4 = X4 + THETA(J)**4
Y = Y + X(J)
XY = XY + THETA(J) * X(J)
400 X2Y = X2Y + THETA(J)**2 * X(J)
D = G * X2 * X4 + 2. * X2 * X1 * X3 - X2**3 - G * X3**2 - X1**2 * X4
A = (Y * X2 * X4 + X1 * X3 * X2Y + X2 * XY * X3 - X2**2 * X2Y - Y * X3**2 - X1 * XY * X4) / D
B = (G * XY * X4 + Y * X3 * X2 + X2 * X1 * X2Y - X2**2 * XY - G * X3 * X2Y - Y * X1 * X4) / D
C = (G * X2 * X2Y + X1 * XY * X2 + Y * X1 * X3 - Y * X2**2 - G * XY * X3 - X1**2 * X2Y) / D
105 DO 110 J=1,6
X(J) = A + B * THETA(J) + C * THETA(J)**2
RNORM(J) = 10.** X(J)
110 RNOLN(J) = LOGF(RNORM(J))
95 SIGX = 0.
SIGX2 = 0.
SIGY = 0.
SIGXY = 0.
DO 100 J=24,28

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730  
740

760

102

140

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82

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X(J)=LOGF(RNORM(J)) / 2.303
SIGX = SIGX + THETA(J)
SIGX2 = SIGX2 + THETA(J)**2
SIGY = SIGY + X(J)
100 SIGXY = SIGXY + THETA(J) * X(J)
A = (SIGX2*SIGY - SIGX*SIGXY)/(5.* SIGX2 - SIGX**2)
B = (5.* SIGXY - SIGX* SIGY) / (5.* SIGX2 - SIGX**2)
DO 101 J=29,37
X(J) = A+B*THETA(J)
130 RNORM(J)= 10.** X(J)
101 RNOLN(J) = LOGF(RNORM(J))
DO 350 J=1,36
SLOPE(J) = (RNORM(J) - RNORM(J+1)) / (RTHETA(J)- RTHETA( J+1))
350 SLOLN(J) = (RNOLN(J) - RNOLN(J+1)) / (RTHLN(J) - RTHLN(J+1))
SLOLN(37) = 0.0
SLOPE(37) = 0.0
DO 355 J=2,36
355 SLO2(J) = (SLOPE(J) - SLOPE(J-1)) / (RTHETA(J) - RTHETA(J-1))
SLO2(1) = 0.0
SLO2(37) = 0.0
SYM30 = RNORM(7) / RNORM(10)
SYM45 = RNORM(10)/RNORM(28)
C INTEGRATION ROUTINE
DO 205 J=1,37
205 RINT (J) = RNORM(J) * SINF(RTHETA(J))
EVEN= 0.0
ODD= 0.0
DO 200 J=2,36,2
200 EVEN= EVEN + RINT(J)
DO 210 J=3,35,2
210 ODD = ODD+ RINT(J)
SCAT = .183 *(RINT(1) + RINT(37) + 4. * EVEN + 2. * ODD)
ODD= 0.0
EVEN= 0.0
DO 201 J=8,26,2
201 EVEN= EVEN + RINT(J)
DO 211 J =9,25,2
211 ODD = ODD+ RINT(J)
SCAPAR = .183 *(RINT(7) + RINT(27) + 4. * EVEN + 2. * ODD)
DO 401 J=1,37
RATIO(J) = SCAT / RNORM(J)
401 RAPAR(J) = SCAPAR / RNORM(J)
PRINT 3900
90 PRINT 2000
2000FORMAT (112H0THETA SIGMA THETA LN SIGMA THETA LN-LN SLOPE
1 SLOPE 2ND DERIVATIVE SCAT/SIGMA SCAT30-130/SIGMA///)
OPRINT 2010,(THETA(J), RNORM(J), RNOLN(J), SLOLN(J), SLOPE(J) ,
1SLO2(J) , RATIO(J), RAPAR(J) , J = 1,37 )
2010 FORMAT (1X,F4.0,3X,E14.4,E14.4,E14.4,E14.4,E14.4 ,E14.4,E14.4 )
PRINT 3000 , SCAT, SYM30, SYM45 , SCAPAR
3000 FORMAT (6H0SCAT= E14.4,5X,7H 30/45= E14.4,5X,8H 45/135=E14.4 ,5X,
112H SCAT30-130= E14.4)
GO TO 340
1 PRINT 2005
2005 FORMAT (23H1MISPUNCHED DATA CARD///)
340 CONTINUE
CALL EXIT

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88  
9  
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94  
96  
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120  
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880  
810  
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840  
840  
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920

## APPENDIX C

## REDUCED DATA

The reduced data appear on the following pages. Nine sets of data appear on each page and the heading above each set identifies the sample from which it was derived. The columns give, in order:  $\theta$ ,  $\sigma(\theta)$ ,  $\ln \sigma(\theta)$ , the  $\ln$ - $\ln$  slope between  $\theta$  and  $\theta+5^\circ$ , the second derivative at  $\theta$ ,  $s/\sigma(\theta)$ , and  $s(30-130)/\sigma(\theta)$ . The bottom line contains  $s$ ,  $\sigma(30^\circ)/\sigma(45^\circ)$ ,  $\sigma(45^\circ)/\sigma(135^\circ)$ , and  $s(30-130)$ . The two digit numbers are the exponents of the base ten by which all numbers must be multiplied to place them in the correct order of magnitude.















RECAPITULACION DEL INGRESO - 1964

PERIODO: JULIO 1963 - JUNIO 1964

ACTIVO	1963	1964	1963	1964
1. APORTAS DEL ESTADO	1,200,000,000	1,500,000,000	500,000,000	600,000,000
2. APORTAS DE ENTIDADES	800,000,000	1,000,000,000	300,000,000	400,000,000
3. APORTAS DE EMPRESAS	600,000,000	800,000,000	200,000,000	300,000,000
4. APORTAS DE ORGANISMOS	400,000,000	500,000,000	150,000,000	200,000,000
5. APORTAS DE INDIVIDUOS	200,000,000	300,000,000	100,000,000	150,000,000
6. APORTAS DE OTROS	100,000,000	150,000,000	50,000,000	75,000,000
TOTAL	3,300,000,000	4,250,000,000	1,250,000,000	1,725,000,000

RECAPITULACION DEL INGRESO - 1964

PERIODO: JULIO 1964 - JUNIO 1965

ACTIVO	1964	1965	1964	1965
1. APORTAS DEL ESTADO	1,500,000,000	1,800,000,000	600,000,000	750,000,000
2. APORTAS DE ENTIDADES	1,000,000,000	1,200,000,000	400,000,000	500,000,000
3. APORTAS DE EMPRESAS	800,000,000	1,100,000,000	300,000,000	400,000,000
4. APORTAS DE ORGANISMOS	500,000,000	600,000,000	200,000,000	250,000,000
5. APORTAS DE INDIVIDUOS	300,000,000	400,000,000	150,000,000	200,000,000
6. APORTAS DE OTROS	150,000,000	200,000,000	75,000,000	100,000,000
TOTAL	4,250,000,000	5,300,000,000	1,725,000,000	2,200,000,000

RECAPITULACION DEL INGRESO - 1965

PERIODO: JULIO 1965 - JUNIO 1966

ACTIVO	1965	1966	1965	1966
1. APORTAS DEL ESTADO	1,800,000,000	2,100,000,000	750,000,000	900,000,000
2. APORTAS DE ENTIDADES	1,200,000,000	1,400,000,000	500,000,000	600,000,000
3. APORTAS DE EMPRESAS	1,100,000,000	1,300,000,000	400,000,000	500,000,000
4. APORTAS DE ORGANISMOS	600,000,000	700,000,000	250,000,000	300,000,000
5. APORTAS DE INDIVIDUOS	400,000,000	500,000,000	200,000,000	250,000,000
6. APORTAS DE OTROS	200,000,000	250,000,000	100,000,000	125,000,000
TOTAL	5,300,000,000	6,250,000,000	2,200,000,000	2,675,000,000

RECAPITULACION DEL INGRESO - 1966

PERIODO: JULIO 1966 - JUNIO 1967

ACTIVO	1966	1967	1966	1967
1. APORTAS DEL ESTADO	2,100,000,000	2,400,000,000	900,000,000	1,050,000,000
2. APORTAS DE ENTIDADES	1,400,000,000	1,600,000,000	600,000,000	700,000,000
3. APORTAS DE EMPRESAS	1,300,000,000	1,500,000,000	500,000,000	600,000,000
4. APORTAS DE ORGANISMOS	700,000,000	800,000,000	300,000,000	350,000,000
5. APORTAS DE INDIVIDUOS	500,000,000	600,000,000	250,000,000	300,000,000
6. APORTAS DE OTROS	250,000,000	300,000,000	125,000,000	150,000,000
TOTAL	6,250,000,000	7,200,000,000	2,675,000,000	3,150,000,000

RECAPITULACION DEL INGRESO - 1967

PERIODO: JULIO 1967 - JUNIO 1968

ACTIVO	1967	1968	1967	1968
1. APORTAS DEL ESTADO	2,400,000,000	2,700,000,000	1,050,000,000	1,200,000,000
2. APORTAS DE ENTIDADES	1,600,000,000	1,800,000,000	700,000,000	800,000,000
3. APORTAS DE EMPRESAS	1,500,000,000	1,700,000,000	600,000,000	700,000,000
4. APORTAS DE ORGANISMOS	800,000,000	900,000,000	350,000,000	400,000,000
5. APORTAS DE INDIVIDUOS	600,000,000	700,000,000	300,000,000	350,000,000
6. APORTAS DE OTROS	300,000,000	350,000,000	150,000,000	175,000,000
TOTAL	7,200,000,000	8,150,000,000	3,150,000,000	3,675,000,000

RECAPITULACION DEL INGRESO - 1968

PERIODO: JULIO 1968 - JUNIO 1969

ACTIVO	1968	1969	1968	1969
1. APORTAS DEL ESTADO	2,700,000,000	3,000,000,000	1,200,000,000	1,350,000,000
2. APORTAS DE ENTIDADES	1,800,000,000	2,000,000,000	800,000,000	900,000,000
3. APORTAS DE EMPRESAS	1,700,000,000	1,900,000,000	700,000,000	800,000,000
4. APORTAS DE ORGANISMOS	900,000,000	1,000,000,000	400,000,000	450,000,000
5. APORTAS DE INDIVIDUOS	700,000,000	800,000,000	350,000,000	400,000,000
6. APORTAS DE OTROS	350,000,000	400,000,000	175,000,000	200,000,000
TOTAL	8,150,000,000	9,100,000,000	3,675,000,000	4,200,000,000

RECAPITULACION DEL INGRESO - 1969

PERIODO: JULIO 1969 - JUNIO 1970

ACTIVO	1969	1970	1969	1970
1. APORTAS DEL ESTADO	3,000,000,000	3,300,000,000	1,350,000,000	1,500,000,000
2. APORTAS DE ENTIDADES	2,000,000,000	2,200,000,000	900,000,000	1,000,000,000
3. APORTAS DE EMPRESAS	1,900,000,000	2,100,000,000	800,000,000	900,000,000
4. APORTAS DE ORGANISMOS	1,000,000,000	1,100,000,000	450,000,000	500,000,000
5. APORTAS DE INDIVIDUOS	800,000,000	900,000,000	400,000,000	450,000,000
6. APORTAS DE OTROS	400,000,000	450,000,000	200,000,000	225,000,000
TOTAL	9,100,000,000	10,050,000,000	4,200,000,000	4,675,000,000

RECAPITULACION DEL INGRESO - 1970

PERIODO: JULIO 1970 - JUNIO 1971

ACTIVO	1970	1971	1970	1971
1. APORTAS DEL ESTADO	3,300,000,000	3,600,000,000	1,500,000,000	1,650,000,000
2. APORTAS DE ENTIDADES	2,200,000,000	2,400,000,000	1,000,000,000	1,100,000,000
3. APORTAS DE EMPRESAS	2,100,000,000	2,300,000,000	900,000,000	1,000,000,000
4. APORTAS DE ORGANISMOS	1,100,000,000	1,200,000,000	500,000,000	550,000,000
5. APORTAS DE INDIVIDUOS	900,000,000	1,000,000,000	450,000,000	500,000,000
6. APORTAS DE OTROS	450,000,000	500,000,000	225,000,000	250,000,000
TOTAL	10,050,000,000	10,950,000,000	4,675,000,000	5,225,000,000

RECAPITULACION DEL INGRESO - 1971

PERIODO: JULIO 1971 - JUNIO 1972

ACTIVO	1971	1972	1971	1972
1. APORTAS DEL ESTADO	3,600,000,000	3,900,000,000	1,650,000,000	1,800,000,000
2. APORTAS DE ENTIDADES	2,400,000,000	2,600,000,000	1,100,000,000	1,200,000,000
3. APORTAS DE EMPRESAS	2,300,000,000	2,500,000,000	1,000,000,000	1,100,000,000
4. APORTAS DE ORGANISMOS	1,200,000,000	1,300,000,000	550,000,000	600,000,000
5. APORTAS DE INDIVIDUOS	1,000,000,000	1,100,000,000	500,000,000	550,000,000
6. APORTAS DE OTROS	500,000,000	550,000,000	250,000,000	275,000,000
TOTAL	10,950,000,000	11,850,000,000	5,225,000,000	5,775,000,000

















CMZ10 1500M 1818A					CMZ11 1500M 1818A					CMZ12 1500M 1818A					CMZ13 1500M 1818A					CMZ14 1500M 1818A					CMZ15 1500M 1818A																																																																											
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00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	SCAT
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	SCAT
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	SCAT
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	SCAT
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	SCAT





















CMZ/75 2300 2014  
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SCAT+ .2349E-01 10/45\* .1727E-01 45/133\* .3116E-01 SCAT/IMP-1300\* .9318E-02

*Handwritten: 606 - 500*

CMZ/75 2300 2014  
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SCAT+ .2349E-01 10/45\* .1727E-01 45/133\* .3116E-01 SCAT/IMP-1300\* .9318E-02

*Handwritten: 606 - 400*

CMZ/75 2300 2014  
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SCAT+ .2349E-01 10/45\* .1727E-01 45/133\* .3116E-01 SCAT/IMP-1300\* .9318E-02

*Handwritten: 606 - 100*













OMEGA	ETA	ETA DERIVATIVE	ETA SLOPE	ETA SLOPE SLOPE	ETA SLOPE SLOPE SLOPE	ETA SLOPE SLOPE SLOPE SLOPE
1.00	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.05	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.10	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.15	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.20	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.25	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.30	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.35	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.40	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.45	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.50	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.55	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.60	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.65	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.70	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.75	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.80	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.85	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.90	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
1.95	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
2.00	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000

367-604

361-704

DATE	DESCRIPTION	AMOUNT	BALANCE
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610-18

610-18

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CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0

CONVERTED FROM 1200M TO 1IN AS 1IN (1200)

META SIGMA META LN SIGMA META UM/LN SLOPE

2ND DERIVATIVE SCAT/SIGMA SCAT/UM/SLP

SLOPE

45/135

30/45

SCAT

180 175 170 165 160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0



























Table with columns: UTM X, UTM Y, UTM Z, UTM W, UTM S, UTM T, SLOPE, ZND DERIVATIVE, SCAT/SIGNA, SCAT3D-150/SIGNA. Contains numerical data for station CHZ2270.

Table with columns: UTM X, UTM Y, UTM Z, UTM W, UTM S, UTM T, SLOPE, ZND DERIVATIVE, SCAT/SIGNA, SCAT3D-150/SIGNA. Contains numerical data for station CHZ2275.

Table with columns: UTM X, UTM Y, UTM Z, UTM W, UTM S, UTM T, SLOPE, ZND DERIVATIVE, SCAT/SIGNA, SCAT3D-150/SIGNA. Contains numerical data for station CHZ2280.

Table with columns: UTM X, UTM Y, UTM Z, UTM W, UTM S, UTM T, SLOPE, ZND DERIVATIVE, SCAT/SIGNA, SCAT3D-150/SIGNA. Contains numerical data for station CHZ2285.

Table with columns: UTM X, UTM Y, UTM Z, UTM W, UTM S, UTM T, SLOPE, ZND DERIVATIVE, SCAT/SIGNA, SCAT3D-150/SIGNA. Contains numerical data for station CHZ2292.

Table with columns: UTM X, UTM Y, UTM Z, UTM W, UTM S, UTM T, SLOPE, ZND DERIVATIVE, SCAT/SIGNA, SCAT3D-150/SIGNA. Contains numerical data for station CHZ2295.