CHAPTER II

METHODOLOGY

2.1 Office Preparation

Individually, the estuarine surveying operation may be categorized in a number of ways. Here they are grouped in a manner appropriate to the presently recognized disciplines, namely, hydrology, geology, and oceanography. Before these operations are launched it must be subjected to the forethought and deliberations common to any surveying propose. These can be listed as :

(a) man power,

(b) instrumentation and method of execution,

(c) formulation of work programme,

(d) office preparation,

(e) field reconnaissance,

(f) field investigation, and

(g) evaluation.

This study began with a little background information which are as follows :

(1) "Detailed reconnaissance soil map of southern central plain area" by Soil Survey Division, Department of Land Development in 1972.

(2) "Climatological data of Thailand 15-year period (1951-1965)

and 25-year period (1951-1975)" from Meteorological Department.

(3) A bathymetric chart of Tha Chin river (unpublished), scale 1:10,000 from Port Authority of Thailand.

(4) A 1:25,000 nautical chart, no.222, 4th ed. 1974 prepared by Hydrographic Department, Royal Thai Navy.

(5) Topographic maps nos. 5035 I, 5035 IV, 5036 II, 5036 III (1969), scale 1:50,000 prepared by Army Topographic Map Department, Royal Thai Army.

(6) Mean daily gage height and discharge data of 5 irrigation canals which joined Suphan river (northern section of Tha Chin river) in Suphanburi Province during 1968-1971 from Hydrology Section, Survey Division, Royal Irrigation Department.

(7) Aerial photographs scale 1:16,000 of Tha Chin river mouth from Royal Thai Air force. These photographs were taking at the end of 1977 from the altitude of 8,000 feet.

It is against this background information, the boundary of the studied area was set up and the studied area was first classified into various depositional environment using aerial photographs. Second, the work plan was then be considered, depending on the climate of the studied area and discharge of Tha Chin river. However, the scope of the present work is limited to a certain extent which is primarily due to the shortage of man-power assistance during the field investigation, inadequate financial support and restricted time available.

Besides, it was intended to use the in situ measurement methods for every possible oceanographic parameters by means of electronic equipment. Therefore, additional office preparation regarding the understanding of characteristics of each equipment including calibration techniques concerned were carried out. Oceanographic parameters, equipment and calibration techniques are summarized as follows :

(a) Current Direct-reading current velocity and direction meter from Toho Dentan, model CM-2 (Figure 2.1.1) was used in current measurement. This meter consists of the sensory unit, the indicator unit and the cable connecting these two units. The measuring range lies between 0.08-3 m/sec (accuracy ± 3%) for current velocity and 0°-360° (accuracy ± 3%) for current direction (magnetic bearing). The method of calibration and measurement are refered to the manufacturer's manual.

(b) Salinity and Temperature The electrodeless induction salinometer from Beckman, model RS5-3 (Figure 2.1.2) was used to measure in situ salinity and temperature. The operation of this instrument is based upon the direct proportionality between the magnitude of an induced electric current and the electrical conductivity of the medium in which it is induced. Temperature is measured by a DC Wheatstone Bridge which uses aged and stabilized thermistors as the temperature sensing element. The measuring range lies between 0°-40°c (accuracy ± 0.50°c direct reading) for temperature and 0-40%.(accuracy ± 0.5% direct reading) for salinity. This instrument was calibrated by known salinity method (Beckman's manual, 1976).

(c) Dissolved Oxygen KAHLSICO model TDO-2 dissolved oxygen meter

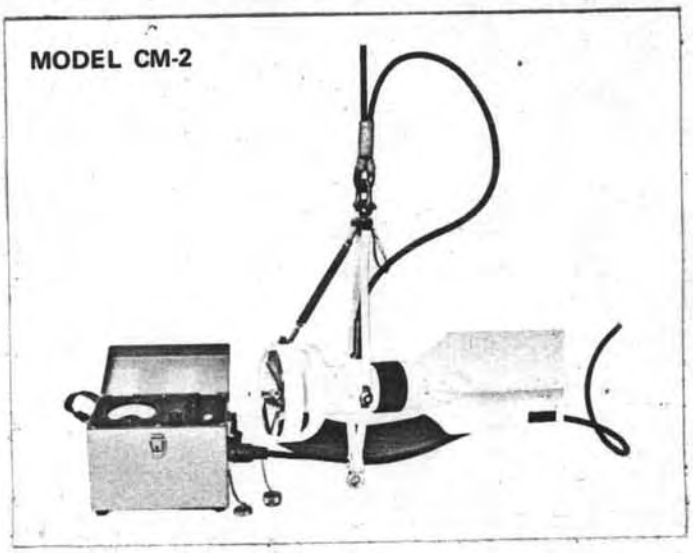

Figure 2.1.1 Direct-reading current velocity and direction meter from Toho Dentan, model CM-2.

Figure 2.1.2 The electrodeless induction salinometer from Beckman, RS 5-3.

(Figure 2.1.3) was used to measure in situ dissolved oxygen. This instrument is equipped with automatic temperature compensator to allow D.O. direct readout. This system consists of surface unit, instrument cable, submersible stirrer and temperature-compensated polarographic probe. The overall accuracy for meter reading lies between ± 2%. The Winkler calibration method (KAHLSICO's manual., 1977) was used to calibrate the instrument for direct reading in percent saturation of dissolved oxygen.

(d) pH and water samples Water samples were collected by 3 litre metal-free transparent water sampler, Van Dorn type (Figure 2.1.4). After water samples were collected, pH of each water sample were measured immediately by using portable digital pH meter (Figure 2.1.5).

(e) Sediment Local made Peterson-type dredge was used for bottom sediment collection (Figure 2.1.6).

(f) Depth Depth were measured by two methods. First was lead and line method and second was performed by Raytheon model DE-719B (Figure 2.1.7) recorder fathometer depth sounder. This fathometer is designed to measure water depth between 2 and 410 feet and provides high resolution with narrow transducer beam width. The accuracy lies between ± 0.5% of ± 1" of indicated depth.

2.2 The Field Investigation Programme.

At the beginning of the study of the physical estuarine environment of Tha Chin river, it was decided that the field investigation must be carried out during two monsoon seasons and their transitional period.

Figure 2.1.3 The dissolved oxygen meter from KAHLSICO, model TDO-2.

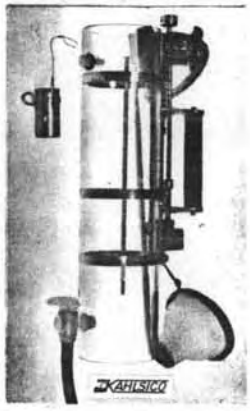

Figure 2.1.4 The Van Dorn water sampler.

Figure 2.1.5 The portable digital pH meter from KAHLSICO.

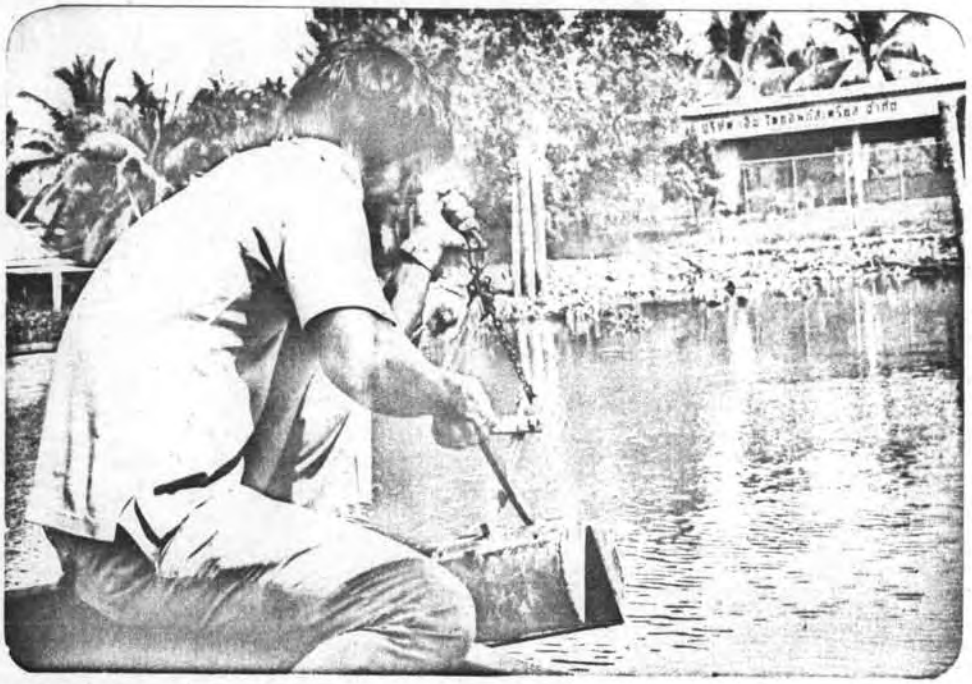

Figure 2.1.6 The Peterson-type dredge.

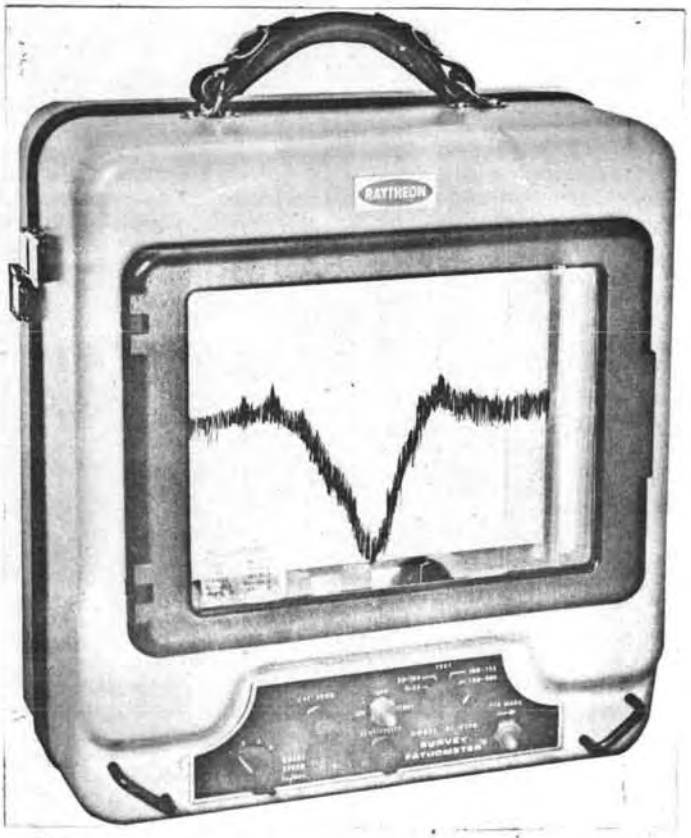

Figure 2.1.7 The recorder fathometer depth sounder from Raytheon, model DE-719 B.

However, the insufficient funds and limited time partly affected the programme. As a result, the field investigations were carried out only during northeast and southwest monsoon seasons.

The basis of the sampling programme was a series of monsoonal sampling cruises to each station in each of the traverses (cross-section of the river). Each sampling cruise normally required three or four days to complete and was conducted during the flood and the ebb period. Tha Chin estuary has what is known as a mixed type; that is, the greatest tidal range occurs in summer and winter with a more or less diurnal character and in the intermediate months the tidal ranges are relatively smaller with many more semidiurnal character (NEDECO, 1965).

Three sampling stations were established in each of the six traverses along Tha Chin estuary. At each station the water samples were collected at 1 meter below the surface, mid-depth, and 1 meter above the bottom. Besides the current speed and direction, salinity, dissolved oxygen were measured in situ using electronic instruments at each point of collections. The bottom sediments were also collected at each station.

The surveys were carried out three times over studied period (during March-December 1979). These 3 surveys were executed as follows :

(1) the first survey, 19^{th} - 21^{st} March 1979,

(2) the second survey, 25^{th} - 27^{th} August 1979, and

(3) the third survey, 18^{th} - 21^{st} December 1979.

2.3 Sampling and Position Fixing

In this work six channel traverses were established along Tha Chin estuary upstream from the river mouth (Figure 2.3.1). They are as follows :

(1) Channel Traverse No.1 (T1) is between two minor fixed mark of the triangular network of the Port Authority of Thailand at the river mouth. The traverse direction is N 089°E (see Note 1, page 32). The traverse length is approximately 1.3 kilometers.

(2) Channel Traverse No.2 (T2) lies between an extraordinary big tree on left bank and Wat Kampra (see Note 2, page 32). The traverse direction is N 066°E and the traverse length is approximately 625 meters.

(3) Channel Traverse No.3 (T3) is between Wat Chong Lom and a green painted house on the other bank (see Note 2, page 32). The traverse direction is N 096.5°E and the traverse length is approximately 345 meters.

(4) Channel Traverse No.4 (T4) lies at the downstream point where Klong Mahachai joins Tha Chin river between a big house with a tall-form water tank and Wat Toukmahachayaram. The traverse direction is N 053.4°E and the traverse length is approximately 265 meters.

(5) Channel Traverse No.5 (T5) lies in the direction N 062°E between Wat Hlang San Prasit and a solitary big rhizophora tree, right downstream where Klong Sunak Hon joins Tha Chin river (see Note 2, page 32). The traverse length is approximately 300 meters.

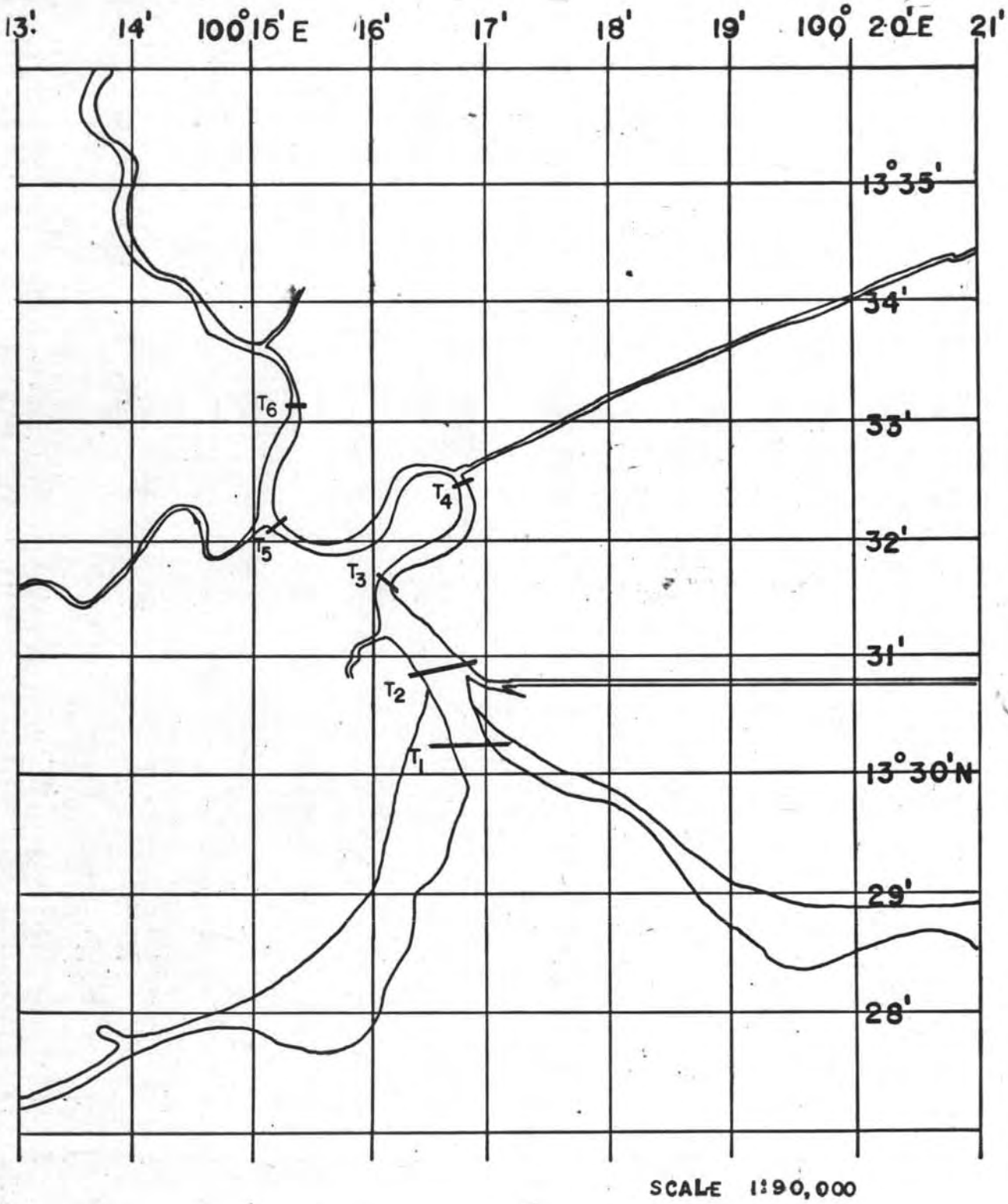

Figure 2.3.1 Index map illustrating the six surveying channel traverses.

(6) Channel Traverse No.6 (T6) lies in the direction N 088°E between Wat Tha Psi School and M. Thai Industrial Gas Company. This traverse, north of Phutalerdlharnapalai Bridge, is the most going upstream and about 10.6kilometers farther upstream from T1 along the river channel. The traverse length is approximately 330 meters.

Note 1 The left and right banks of the river are identified by an observer facing upstream.

Note 2 Within the vicinity of this study area, a part of Chao Phraya River basin, is characterized by a large flood plain with exceptionary a few permanent nataural landmarks. Therefore many man made structures, trees, etc. are employed for position fixing of channel traverses during the survey programme.

Three sampling stations were established in each traverse and the numbering system is set up as follows :

- Station near the left bank was called Station 1 (Tx-1).
- Station at the mid river channel was called Station 2 (Tx-2).
- Station near the right bank was called Station 3 (Tx-3).

When samplings were taken at different depth, the subscript L_0, L_1, L_2 were used to indicate the depth of 1 meter from the water surface, mid-depth and 1 meter above the bottom respectively, i.e. Tx-y La, etc.

(F) and (E) were also labelled to distinguish between samples which were collected during the flood tide and the ebb tide, i.e. Tx-y La (F), Tx-y La (E). Date of collection was also labelled and recorded.

The basic requirement for an estuarine study is map with appropriate scale. In this study three kinds of map and chart were used; topographic maps scale 1:50,000 Nos. 5035 I, 5035 IV, 5036 II, 5036 III prepared by Army Topographic Map Department in 1969, a nautical chart scale 1:25,000 No.222 (4th ed.) prepared by Hydrographic Department, Royal Thai Navy in 1974 and a bathymetric chart (unpublished) scale 1:10,000 prepared by Port Authority of Thailand in 1977. Local landmarks mentioned in Note 2 were located in all the maps and charts employed in this study. Every position fixing was made after the boat had been anchored by a combination of sounding devices and bearings. Sampling stations were easily located by this method.

2.4 Laboratory Analyses

2.4.1 Sediment Analyses

A. Colour Indentification

After representative field samples of bottom sediment have been carefully collected, the colour identification was made using the rock colour chart which based on the Munsell system. This system is based on a colour solid or approximately a colour sphere, which has a neutral gray axis grading from white at the top to black at the bottom (Figure 2.4.1). This property of lightness is called value. Around the circumference or equator of the solid are the 10 major hues, each of which is divided into 10 numbered divisions, so that 5 marks the middle of hue and 10 marsk the boundary between one hue and the next. Thus any particular hue can be designated by a number and a letter such as 5 R or 10 YR. Any single

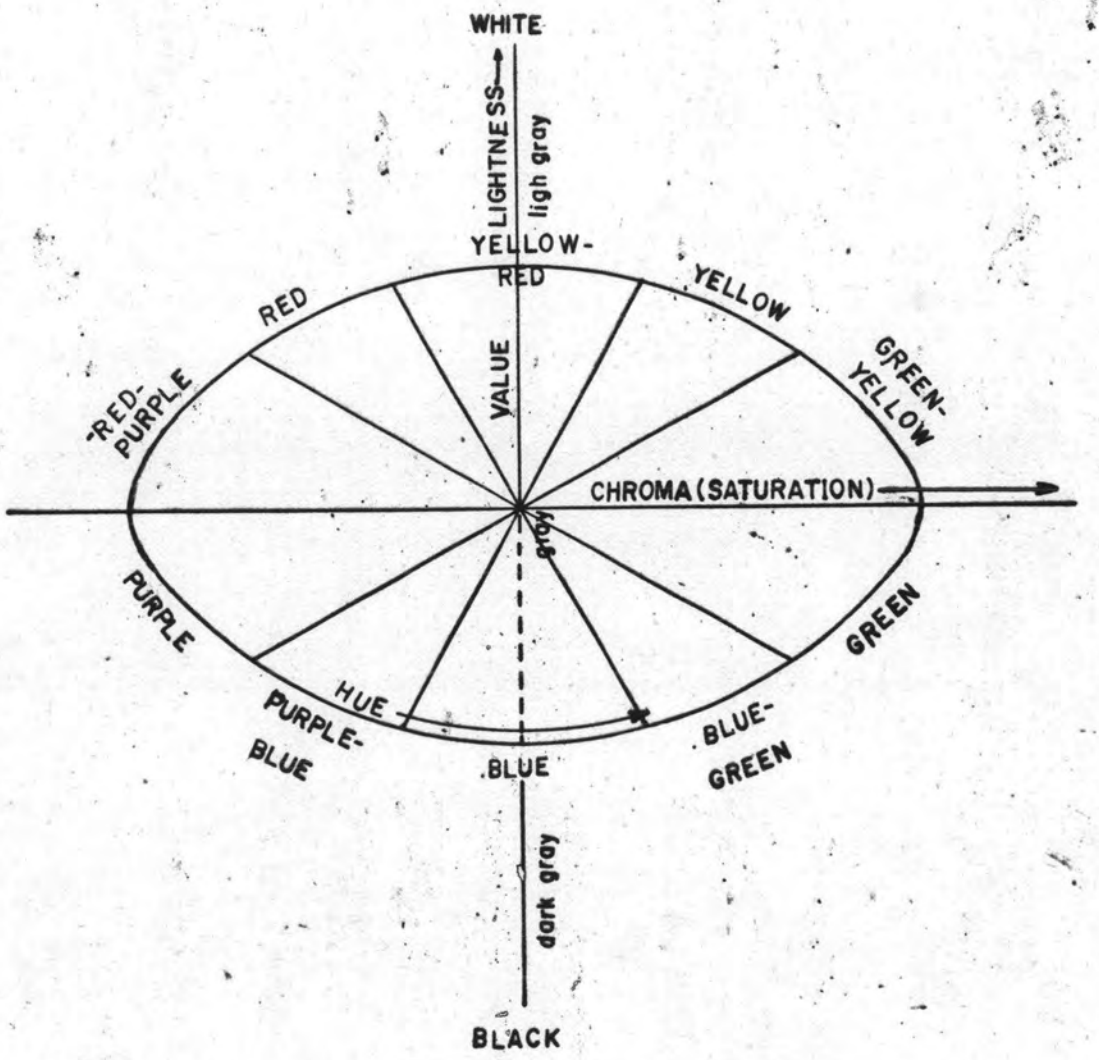

Figure 2.4.1 Dimensions of the colour solid (Munsell system).

vertical section through the neutral gray axis and a particular hue constitutes a colour chart on which the colours grade in value from light at the top to dark at the bottom and in chroma (degree of saturation) from gray at the left to the most vivid colours at the right. Both value and chroma are numbered so any particular colour can be given a numerical designation representing hue, value and chroma.

The sediment samples were then air-dried at room temperature, and hand-crush if necessary, and ground to -200 mesh for further analyses. Usually 20 to 50 grams will permit a replicate sample analysis. After sieving, samples are normally stored dry in labelled vials. Samples should be well mixed and subsamples dried at 110°c for at least 4 hours just prior to analysis. The appropriate standard samples must be analyzed in the same way as the samples being studied. The analysis of standards will permit immediate detection and correction of difficulties in the analytical procedure. The standards used are Analar grade Glucose and $CaCO_3$ for total organic carbon and carbonate-carbon determinations respectively.

B. Total Organic Carbon Content

Total organic carbon content by ignition loss at 550°c is employed in this study. Ignition loss technique tends to be less accurate than H_2O_2 oxidation technique because of many interfering reactions, i.e., partial decomposition of carbonates or partial dehydration of minerals, such as clays that contain H_2O or OH. However the ignition loss technique is simple, rapid, minimal equipment required and useful for groups of samples with uniform mineral composition that have less

than 10% $CaCO_3$ (Gross, 1971).

Procedure (APHA, 1965)

(1) Transfer a weighed sample (approximately 1 gram) of ground sediment that has been dried at 110°c for 8 hours or more and place in crucible.

(2) Place crucible in electric muffle furnance and heat at 550°c for 1 to 2 hours.

(3) Cool partially in air and then transfer to dessicator for cooling to room temperature.

(4) Remove from dessicator and reweigh; calculate weight loss as percentage of initial weight of sample.

(5) Report as ignition loss (550°c).

C. Carbonate Carbon Content.

Carbonate-carbon by weight loss after acidification: The carbonate content of a sediment can be simply and rapidly determined, with fair precision (reproducibility), by determining the weight loss after treating the sample with dilute acid to drive off CO_2 from carbonates. Heating for 1 to 5 minutes is necessary to break down the less soluble carbonates. However, the technique does not work well in sediment where dolomite is the dominant carbonate and sulfide-bearing sediment but it is good for calcareous materials (Gross, 1971).

Procedure (Black and et al.,1965)

(1) For sediment containing less than 1% $CaCO_3$ of ground sediment dried at 110°c, transfer approximately 2 grams to a preweighed tallform 250 ml beaker; cover with watch glass or inverted petri dish. For sediment with more than 1% $CaCO_3$, smaller samples may be used.

(2) Add 10 ml of distilled water and 5 ml of 0.1 NHCL and stir to promote reaction. After initial reaction has ceased, add additional 2 ml 0.1 NHCL and continue to add acid until no further reaction is observed or until the solution is strongly acid to pH indicator paper.

(3) Decant excess acid and carefully wash sample in distilled water to remove $CaCl_2$.

(4) Evaporate to dryness and heat to 110°c before transferring to dessicator to cool.

(5) Reweigh and calculate weight loss.

(6) Results may be calculated and reported as follows :

$$\text{percentage carbonate-carbon} = \frac{100 \text{ X weight loss X } 0.12}{\text{intial dry weight of sample}}$$

assuming that all the carbonate occurred as $CaCO_3$.

2.4.2 Suspended Sediment Analysis

The filter method is used for the determination of suspended sediment in water. This method involves the filtration by suction of a known volume of skaken sample through a preweighed sintered

glass crucible no.4, which is then dried at 100-105°c. With higher concentrations where filtration is tedious, evaporation may be employed, although a correction is necessary for dissolved matter in the residue. Results are expressed in milligrams per litre (mg/l) which defined as one million times the ratio of the dry weight of sediment in grams to the volume of the water/sediment mixture in cubic centimeters. In some cases weight per weight units have been used (parts per million or ppm), although these are no longer recommended.