CHAPTER 2

Instrumentation and Data

2 - 1 Introduction.

The chromosphere is a layer of the sun'satmosphere which emits line spectra instead of continuous spectra. At present spectroheliograms of the chromospheric disk taken through the CaII and several hydrogen lines are available. Furthermore, spectroheliograms taken through the light at different positions across the H_α- profiles are also obtained by using spectroheliographs of high rosolution power and narrow slits. Although the spectroheliographs is a flexible instrument for the study of the chromosphere, it cannot however, be used in solar cinematorgraphy. Using the first design of Lyot (1944) and later developed by many investigators, good birefringent filters of band pass in range of $\frac{1}{8}$ Å to $\frac{3}{4}$ Å, centered at H_α have been constructed and are now in operation at many observatories.

With the narrow band-pass birefringent filters, attached to the solar telescopes both at Sydney and Capri, chromospheric data have been obtained by Dr. Rawi Bhavilai. Parts of the data are used in this project.

2 - 2 The C.S.I.R.O. Chromospheric Telescope,

Optical System. The chromospheric telescope belongs to the C.S.I.R.O. Division of Solar Physics Observatory, located in flate country at an altitude of 200 feet. The arrangement of the optical system used by R. Bhavilai to obtain the data for reductions in Chapters 3 and 4 is shown in Fig. 2 - 1. The objective of 129.8 mm. in diameter and 1776 mm. focal length produces a 16.6 mm. solar image at the diaphram D. The selected portion of the solar image is magnified by the lens L_1 of focal length

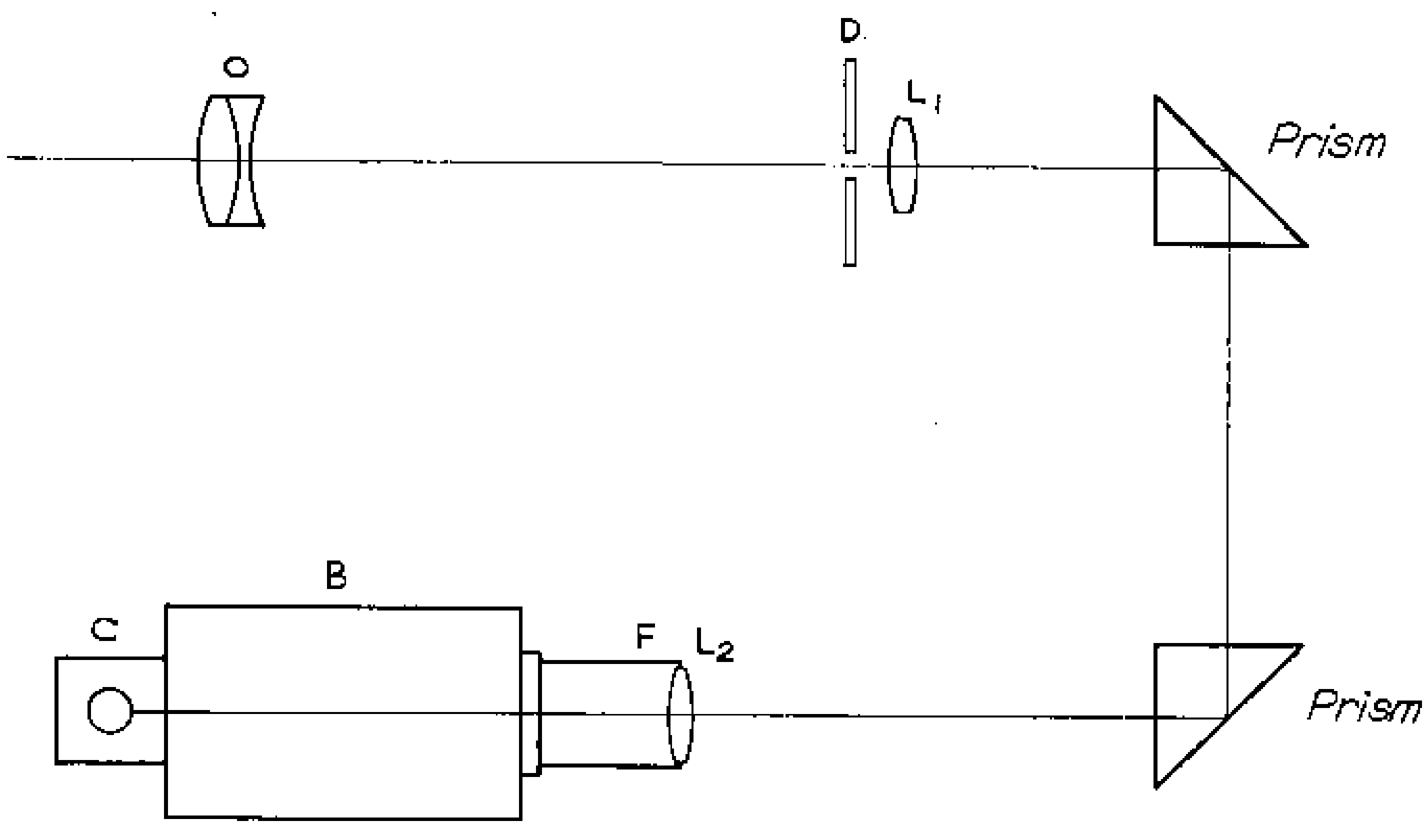

Figure 2-1 THE C.S.I.R.O. CHROMOSPHERIC TELESCOPE WITH $\frac{1}{8}$ Å TUNABLE BIREFRINGENT FILTER AND CINECAMERA

34.5 mm. To shorten the length of the telescope while high magnification is still obtained, two right angle prisms situated in the optical path after lens L_1 are used to turn the light beam. The light beam then passes through the lens L_2 into an auxilliary interference filter F and the C.S.I.R.O. tunable birefringent filter B, and finally enters a 35 mm. cinecamera C. The net magnification of the enlarging system is such that 1 mm. corresponds to 20."0 of arc on the sun.

Data. The 35 mm. Debric cinecamera uses magazines carrying 100 feet length of Kodak IV - E film per full loading. An optical system projects a clock image onto one corner of each frame simultaneously with an exposure to provide a record of time. Before processing, a 15- step sensitometric pattern was printed on one end of the roll. Each roll was then developed 5 minutes in full strength D-19 in a tank at 20 C, giving a gamma around 3.2 to 3.6 (Bhavilai, 1964)

The good time-lapse cinematographic data of 3.4.64, obtained through this instrument in the light of H_α+ 0.75 are used for reduction (Chapters 3 and 4). Although, this observation lasted for about three hours, frames of good quality have been obtained. This result is dues to the performance of an air suction device (Loughhead and Burgess 1958) which removed the heated air formed at surfaces exposed to the sun and replaced it with air at the ambient temperature. The spaces between frames however, are not uniform because of the use of a solar seeing monitor (Bray, Loughhead and Norton 1959) which triggers the shutter automatically at a moment of good seeing. Positive prints from this roll are sometimes scanned to study the changes of the chromospheric features with time.

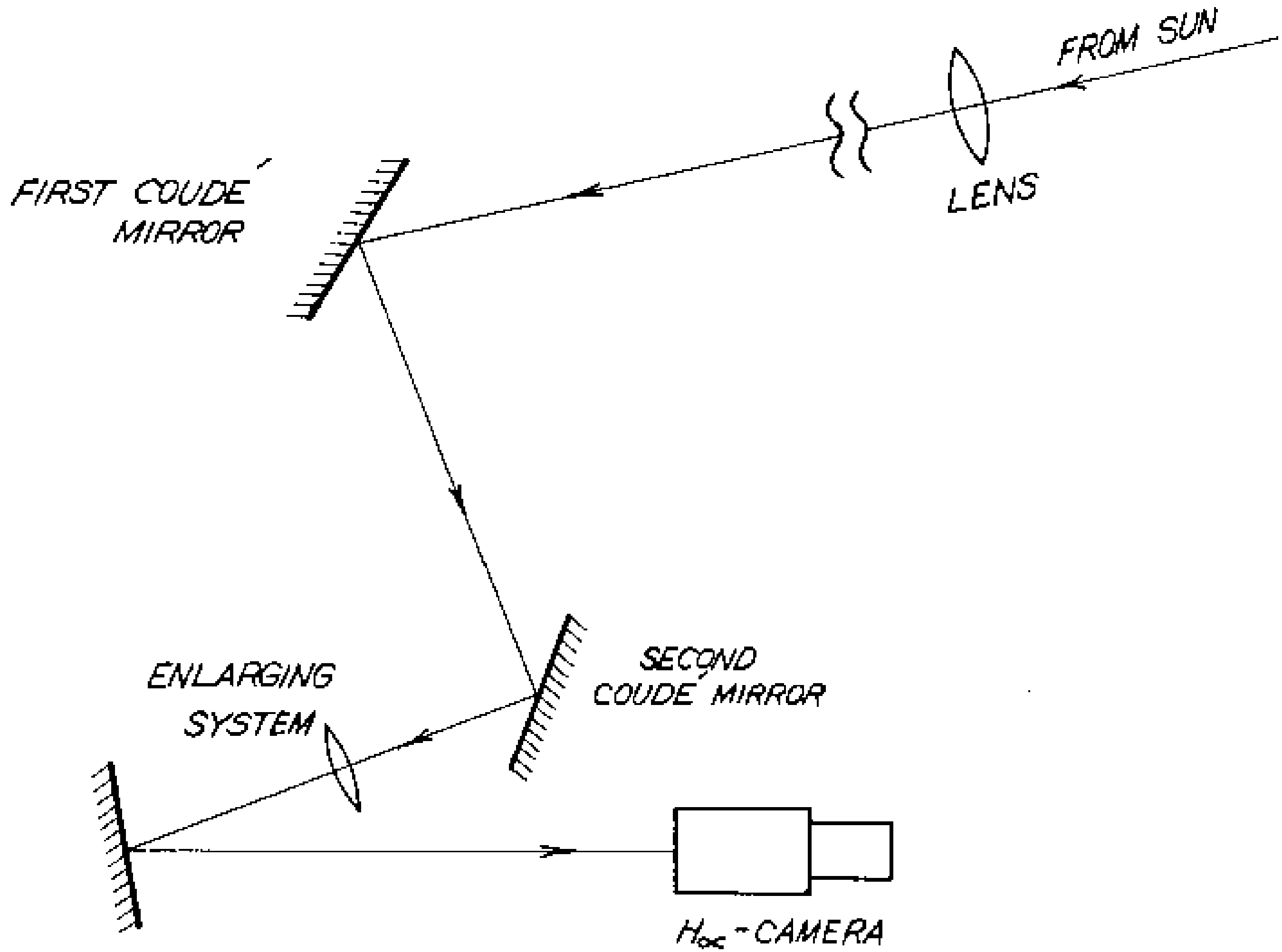

Figure 2-2 DIAGRAM OF OPTICAL SYSTEM OF DOMELESS COUDÉ REFRACTOR

2 - 3 Domeless Coudé Refractor.

Optical system. The data used for reduction in Chapter 5 were obtained through this new telescope by R. Bhavilai on 15.8.67. The instrument was built as a Coudé-type refractor at the Carl Zeiss Works. It was installed in 1965 at Capri Observatory in Italy, operated by the Fraunhofer Institute of Freiburg, West Germany. The observatory stands 150 metres above sea level.

Fig. 2 - 2 shows the arrangement of the optical system used to obtain the data. The objective O is 35 cm. in diameter and has a focal length of 4.45 metres. The solar beam is reflected by the first and second Coudé-mirrors (A, and B) such that the light beam finally is sent at right angles to the polar axis into the laboratory. The diameter of the solar image is increased by an enlarging system from 4.3 cm. to 15.0 cm. That is, 1.8 mm. corresponds to 20 sec. of arc on the sun. On the optical path to the laboratory, the solar beam is reflected by a mirror onto a tunable H_α- filter of a transmission bandwidth of 0.5 Å.

Data. The chromospheric features on the centre of the disk have been taken through the Halle 0.5 H_α- filter tuned for 9 positions along the H_α- line profile on 15.8.67. from 10.00 - 10.05. The spaces between consecutive positions are 0.25 Å. Seven sets of filtergrams are obtained, one of which is selected for reduction in Chapter 5.

2 - 4 Model 22,100 Spetroscanner.

With the spectroscanner of the Department of Science, Ministry of Industry, Bangkok, the original negative of the extreme limb obtained on 3.4.64. was traced, from which the isophotal contour map of low

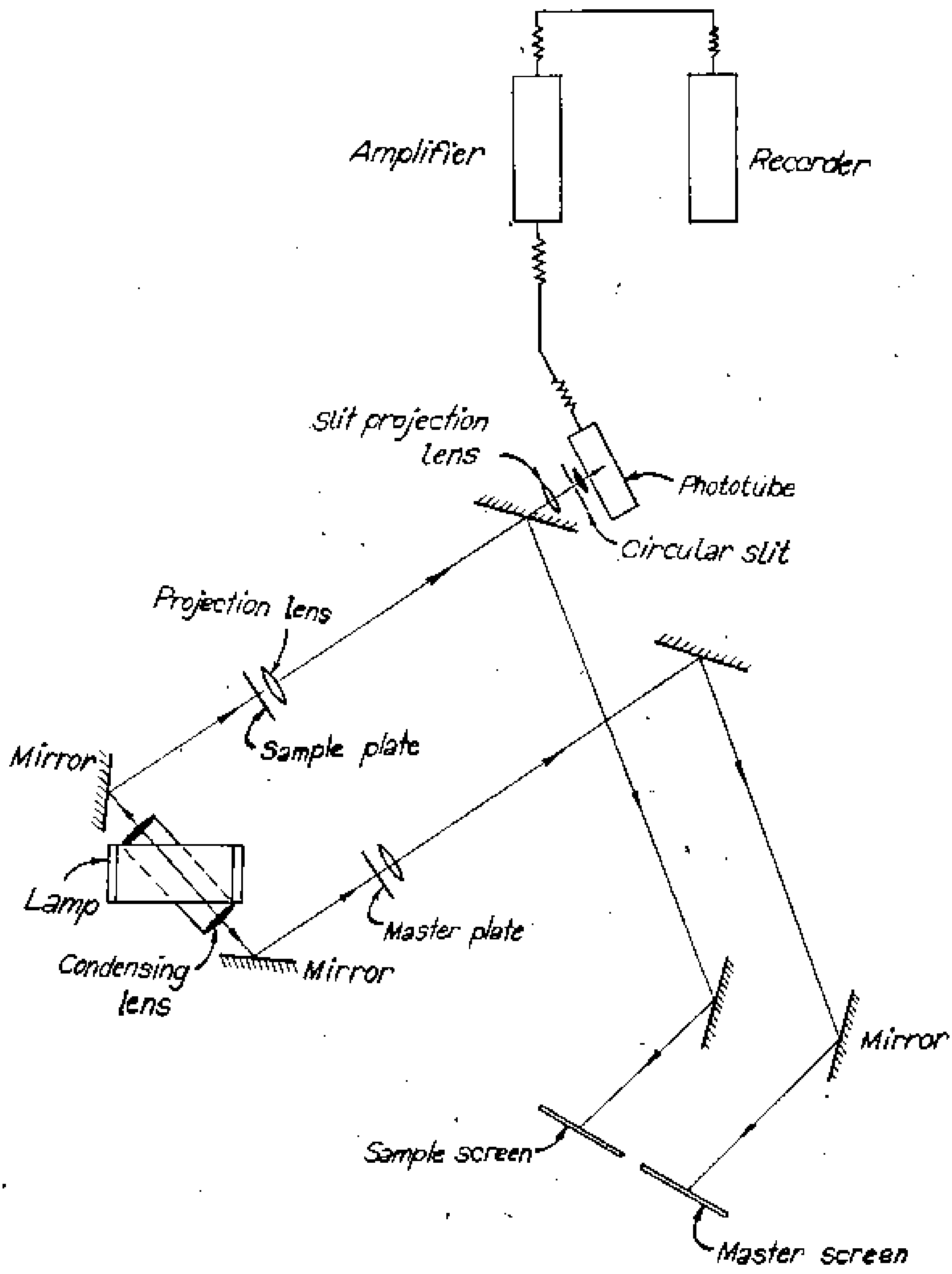

Figure 2-3 OPTICAL SYSTEM OF THE SPECTROSCANNER

chromosphere has been drawn (Chapter 4). Its optical system is shown in Fig 2 - 3. The slit lens in conjunction with the sample projection lens magnifies and focuses on the slit the portion of the image which passes through a $\frac{1}{16}$ inch diameter hole in the sample beam mirror. The magnification of this lens system is 5 times. Images with a magnification of about 14.6 are also projected on the screen by the sample and master projected lenses.

Since the instrument was originally designed for use in the study of line spectra, its rectangular slit of size 75 x 1000 μ is not suitable for this project and has been replaced by a circular slit of about 75 μ diameter which still provides optimum resolution and sensitivity. On the sample screen, the regions to be scanned are selected and the same regions are easily identified in each scanning by using the reference line on the master screen.