

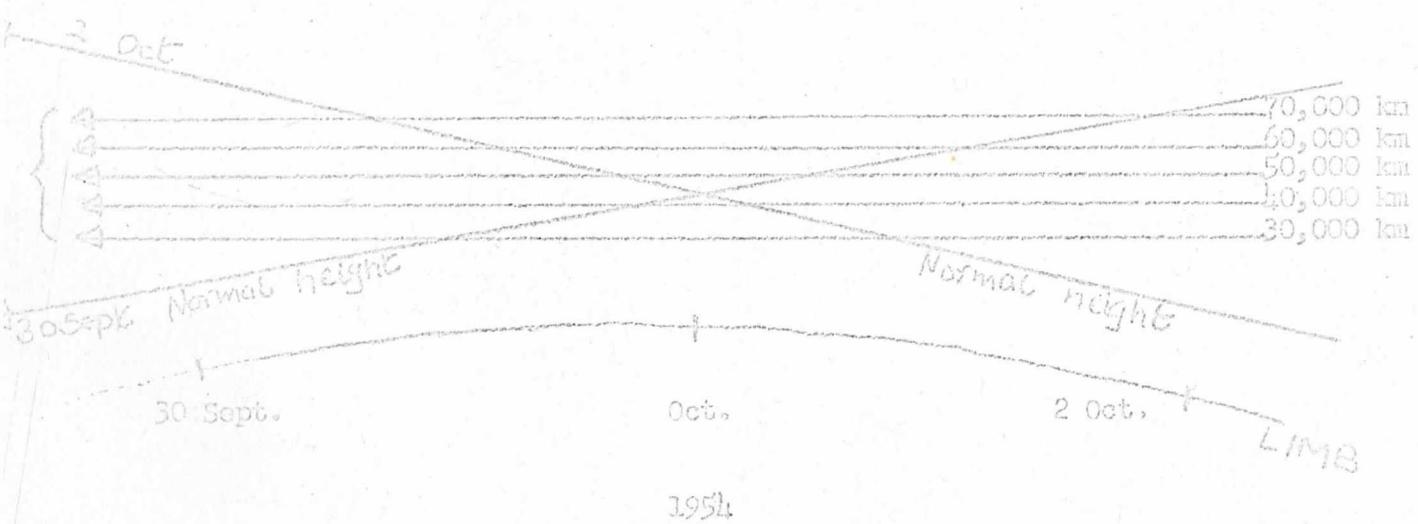
METHOD OF ANALYSIS

A. Construction of three-dimensional emission model.

We constructed, by trial and error, a three-dimensional model of the coronal region, with emission densities (i.e. emission per unit volume per unit time) in each of the two wave-lengths, $\lambda 5303$ and $\lambda 6374$, distributed in the model in such a way that the integral of these densities along the line of sight would be equal to the actual observed line intensities. The three-dimensional model is the composite of three two-dimensional models, corresponding to 50° , 55° , and 60° heliocentric angles.

Figure I

Line of Sight Diagram



It is possible that the model we found is not unique. The rather detailed observations, however, consisting of normal height observations on the days preceding and succeeding the day that the center of the region was on the limb together with spectra at 5000 km. intervals when the center of the region was on the limb, strongly limit the possible number of models.

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Figure 2a

Emission Density Model for Region 54-T

λ 6374 Heliocentric angle 60°

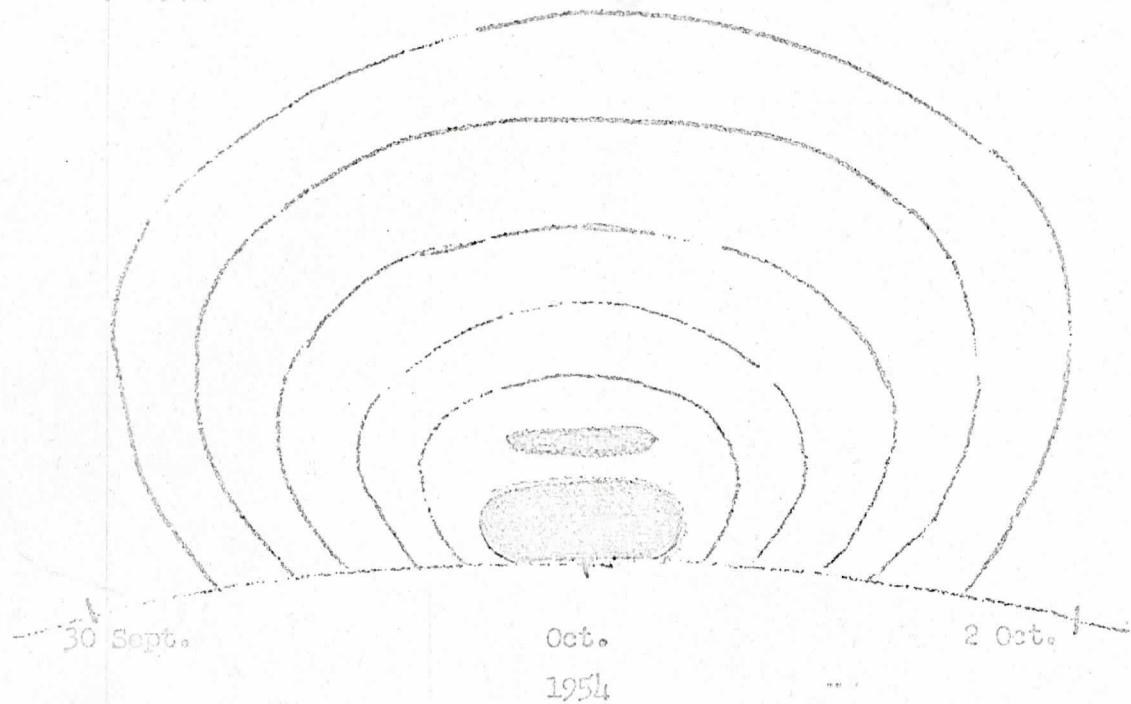
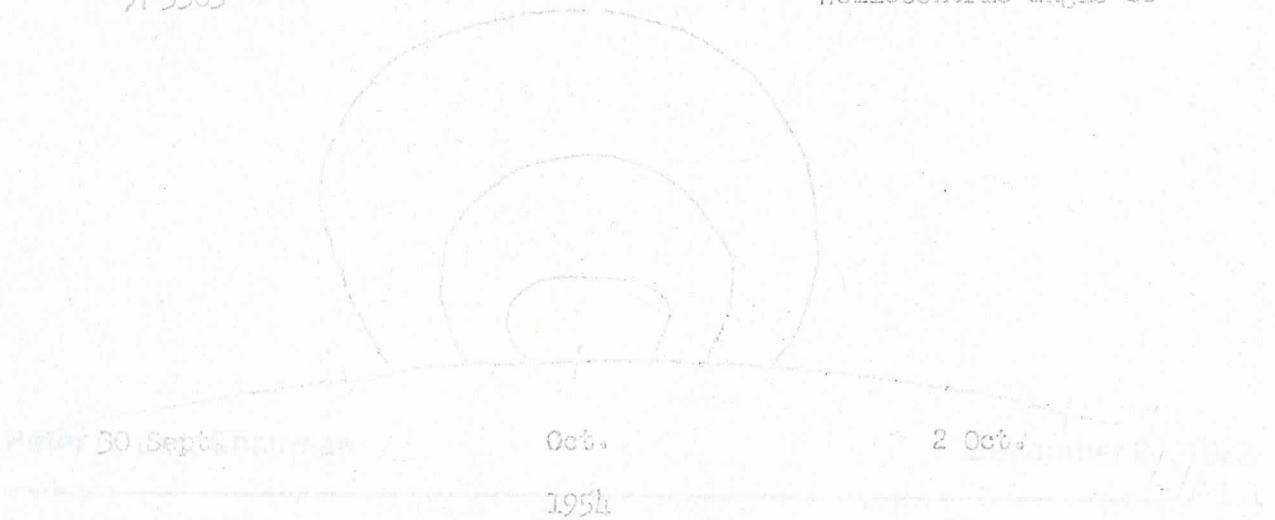


Figure 2b

Emission Density Model for Region 54-T

λ 5303

Heliocentric angle 60°



B. Computation of Temperatures from the Models.

From the contour diagrams described above, we were able to compute the ratio of green to red emission density at each point in the coronal region. From these ratios we determined the corresponding temperatures, using Waldmeier's table (e. f. Ap. 20, 1/2). The resulting temperature distributions at 55° and at 60° are shown in Figures 3a and 3b.

Figure 3a

Isotherms for the Region T-54 at Heliocentric Angle 55°

(Temperature $\times 10^{-5}$ K)

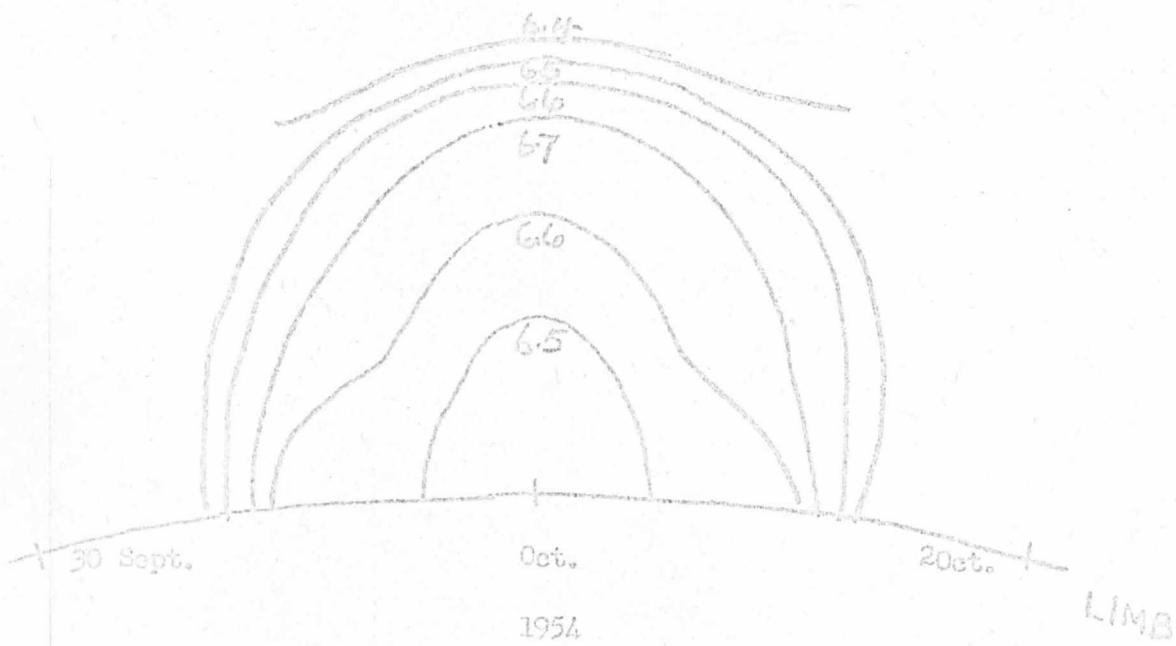
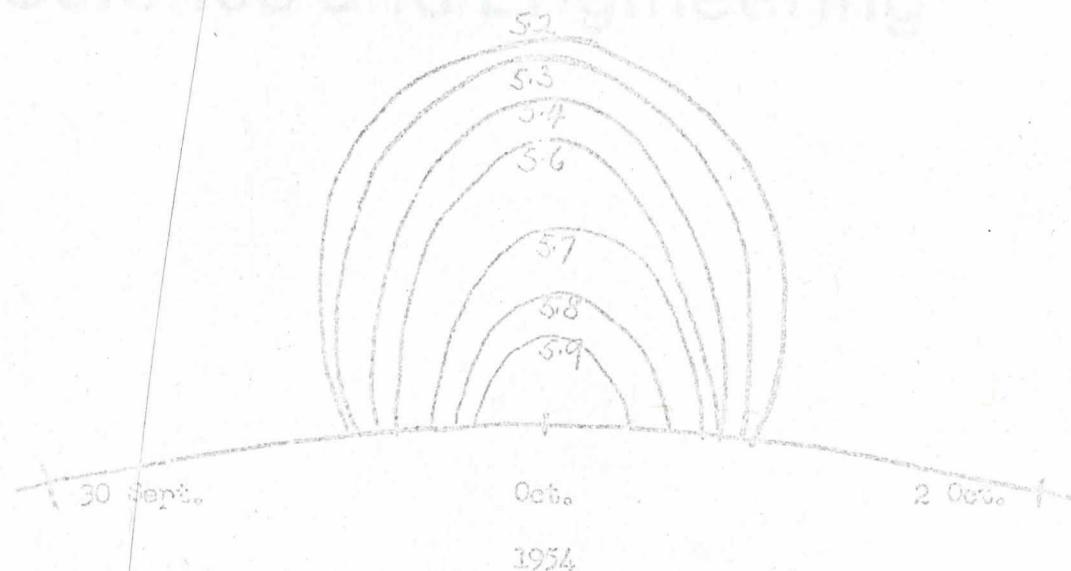


Figure 3b

Isochronals for the Region 54-T at Heliocentric Angle 60°



The average temperature at 55° is 6.7×10^5 °K, and that at 60° , 5.5×10^5 °K.

C. Determination of Temperatures from Line Widths.

We made line profile tracings of the coronal emission lines on the same spectrograms as those used in building the model of the coronal region. From these tracings we determined the half-widths of the lines, eliminating the instrumental profile by the method used by Pecker, Billings, and Roberts (1954). We then computed the temperatures from the half-width measurements by the following standard formula:

$$\tau = \frac{b^2}{\lambda^2} \cdot \frac{M}{(7.07 \times 10^{17})^2}$$

where M is the weight of the emitting ion

λ is the wavelength in Angstroms

b is the reduced half-width in Angstroms

$$T_G = (3.88 \times 10^6) \times b^2$$

$$T_R = (2.69 \times 10^6) \times b^2$$

The green coronal line, because of its nearness to Fraunhofer line needed special treatment in the line profile analysis. First we carefully plotted the line profiles on a scale of intensity versus wave length. We then replaced the wing adjacent to the absorption line by the image of the wing away from the absorption line, reflected on the wave length of maximum intensity, and determined the half-width of the resulting profile. Next, because the microphotometer recorder introduces a slight asymmetry into the line profiles we averaged the half-widths obtained as described above with those similarly obtained from tracings made in the opposite direction. Emission was sufficiently intense for good quality line profiles quite close to the limb only. Consequently we could not obtain a distribution of temperature with height, only values of temperature at each position angle. Also, the green line was of sufficient intensity for temperature determination only at 55° . The results of line width temperature measurements are:

By half-width of	Temperature at	
	55°	60°
$\lambda 5303$	2.6×10^6	
$\lambda 6374$	2.5×10^6	1.9×10^6

CONCLUSIONS

As expected, the results of the temperature calculations by the two methods described yield different results; however, both methods show the temperature at 55° to be greater than at 60° . The ratio of temperature by the two methods is 3.7 for 55° , and 3.5 for 60° . The fact that these ratios are not vastly different, indicates that the two methods are basically measuring the same physical quantity, temperature.

In computing the tables which we used to determine temperature from the ratio of green to red line intensity, certain theoretical constants are used that are not well determined. This may be one of the chief sources of discrepancy between the two methods. The constants used in the line broadening method are well known, but the theory of this method assumes that the temperature refers to purely thermal motion.

Our next step in this program will be to study several other coronal regions in which the red line and green line maxima are at different latitudes, to determine whether the temperatures found by the two methods are always in the same ratio. If so, we will investigate the possibility of using this result for a more accurate determination of the atomic constants involved.

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