CHAPTER 9
SUMMARY

Owing to the expected complexity of the spectral structure of the actinide oxides, very little has been reported in the literature about their spectra. The shortcomings and anomalies observed in the work of earlier investigators prompted us to undertake a detailed investigation of as many bands as possible of the many bands of ThO that have so far eluded assignment to any of the known electronic systems. The findings of this investigation are incorporated in the Thesis.

(1) One of the prerequisites for such a study, is the availability of a high resolution instrument. Construction of a 10.6 meter concave grating spectrograph, therefore, was undertaken, the various units required for this purpose were designed and fabricated in the laboratory. Details about these and their assembling has been described in the Thesis. The procedures adopted for the setting and calibration of the spectrograph have been described. A systematic analysis of the errors likely to occur in the measurement of wavelength has been carried out and reported in the Thesis.

(2) The techniques adopted for the excitation of the bands and their spectral characteristics have been described.
(3) Vibrational analysis of the 4115 Å system has been carried out. The procedure has been described. The values of the vibrational and other constants found are:

\[ \omega_e' = 301.47 \text{ cm}^{-1} \quad \omega_e'' = 882.21 \text{ cm}^{-1} \]
\[ \omega_e' x_e' = 4.47 \text{ cm}^{-1} \quad \omega_e' x_e'' = 3.64 \text{ cm}^{-1} \]
\[ \Delta T_e = 24331.76 \text{ cm}^{-1} \quad D_e' = 4.40 \text{ ev.} \]
\[ D_e'' = 6.57 \text{ ev.} \]

It has been shown that the lower state of the system lies between \( X^1Σ \) and \( H^3Δ \) state found by Edvinsson.

(4) Rotational analysis of the 4115 Å band has been carried out. The wavenumbers of the \( P, Q, R \) branches were fed to the computer and the combination relations were obtained. The values of the rotational constants obtained from the corresponding plots are

\[ B_0' = 0.3228 \text{ (cm}^{-1} \text{)} \quad B_0'' = 0.3291 \text{ (cm}^{-1} \text{)} \]
\[ r_0' = 1.8655 \text{ Å} \quad r_0'' = 1.8475 \text{ Å} \]
\[ \gamma_0 = 24274.00 \text{ cm}^{-1} \]

As a mutual check on the vibrational and rotational analysis, values of \( \omega_e', \omega_e'' \) were calculated from the rotational constants on the basis of Morse potential. These were found to be fairly in good agreement with those obtained from the vibrational analysis.
(5) Explanation has been given to show that the lower level lies close to but slightly below H $^3\Delta$ level found by Edvinsson. Arguments have been given in support of the conclusions that the system belongs to $^3\Pi - ^3\Delta$ transition.

(6) Rotational analysis of the 4024 Å band is carried out. The relevant branches were picked up and combination relations were obtained. It has been shown that the bands belong to $^1\Sigma - X ^1\Sigma$ transition.

(7) 3340 Å system in the U.V. being reported for the first time. Observations on the relative positions of the bands and their spacings are reported. On the basis of the vibrational and rotational structure, the bands have been tentatively $^3\Delta - ^3\Delta$ transition.

(8) General features of 4670 Å system are discussed.