

SOME ADVANTAGES AND DISADVANTAGES OF A PHOTOGRAPHIC ZENITH  
TUBE

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ABSTRACT

The theory and instrumentation of a photographic zenith tube (PZT) have been described by various authors (Torao, 1959; Markowitz, 1960; Thomas, 1964; Schuler, 1968; Takagi, 1974). Analysis of the more recent results of the PZT's of the U. S. Naval Observatory at Washington, D. C. and Richmond, Florida, permit the determination of precision and accuracy estimates which may be expected from the daily operation of a PZT. This analysis shows precisions of  $\pm 0''.03$  in latitude and  $\pm 0^s.003$  in time, determined from the internal error of one sight. Accuracies estimated from the external error of a sight were found to be  $\pm 0''.08$  in latitude and  $\pm 0^s.006$  in time.

In comparison to other techniques available for the measurement of Earth rotation parameters, the PZT has many advantages. Among these are its rigid construction, elimination of levelling errors, minimization of refraction errors, low cost, and ease of operation. This instrument also observes stars whose positions may be related to a visual fundamental reference frame. Conversely the observations may be used for improvement of this reference frame. The use of PZT's in established chains eliminates the need for the development of more star catalogs and minimizes the effect of systematic catalog errors in the determination of polar motion.

Among the disadvantages of a PZT are its limited field of view and possible systematic errors in the positions and proper motions of the internal star catalog. Also the observations are limited to clear skies and by systematic atmospheric refraction effects.

These advantages and disadvantages along with the well-established estimates of the instrument's accuracy must be considered in the development of future instrumentation for the study of the rotation of the Earth.

## REFERENCES

- Markowitz, Wm.: 1960, "Stars and Stellar Systems", vol. 1, p. 88.
- Schuler, W.: 1977, "Etude Theorique et Experimentale de la Lunette Zenithale Photographique (PZT) de Neuchatel", Edition Medicine & Hygiene, Geneva.
- Takagi, S.: 1974, Pub. Int. Latitude Obs. of Mizusawa 9, p. 259.
- Thomas, D. V.: 1964, Royal Obs. Bulletins No. 81.
- Torao, M.: 1959, Ann. Tokyo Astron. Obs. Second Series 6, p. 103.

## DISCUSSION

- S. Debarbat: You have mentioned the 65-cm PZT of the U. S. Naval Observatory in your talk; can you say something about it?
- D. D. McCarthy: Analysis of the preliminary observational results of the 65-cm PZT indicates that at least a 25% improvement in precision may be expected. We are currently working on the elimination of a systematic temperature effect in the rotation angle and the improvement of the environmental control. The original instrumental design has been changed to incorporate improvements in the plate drive mechanism and computer control of the instrument. When the 65-cm PZT becomes fully operational (hopefully in the latter part of 1978) it will be used to observe all of the stars which have been observed by the Washington and Mizusawa PZTs in the past along with a supplemental list of stars numbering approximately one thousand.