Chapter Three

Photometric Observations of Satellites

Early in the history of satellite tracking, the problem of detection capabilities was realized and possible solutions were investigated. Russian scientists were among the first to explore alternatives to photographic tracking, as long ago as 1960.[7]

The only difference in the tracking hardware for photometric as opposed to photographic systems is the recording medium which consists of a photon counter coupled to a computer. Such devices are comparable to those used in astronomical research for investigations into distant objects such as quasars. Unlike photographic stations, however, photometric systems require more versatile tracking mechanisms because of the small area of the photocathode. This is important for tracking objects of magnitude less than m=11.

Canada's involvement intensified when the Satellite Identification and Tracking Unit (SITU) was officially opened at the St. Margaret's Canadian Forces Station near Moncton, New Brunswick, on November 9, 1976. Its chief feature is an f/16, 61-cm Cassegrain telescope mounted on a modified Baker-Nunn triaxial support. This installation was intended to replace a Baker-Nunn photographic system at Cold Lake, Alberta, and followed an exhaustive ten years of testing at the USAF Avionics Laboratory on Wright-Patterson AFB. The light from an object is relayed through the telescope's optics to the photocathode which converts the incident photons to electrons. These electronic pulses are then recorded on paper or magnetic tape for further processing; they can also be sent to NORAD over telephone lines for analysis.[8]

With an increasing number of satellites in orbit, the necessity of an additional tracking unit such as the St. Margaret's station was obvious. The St. Margaret's station was also heralded for its "semi-automatic" features. In addition to the photometric system at St. Margaret's, there is a Baker-Nunn camera on loan from the SAO site at Alisfantsfontaine, South Africa. The camera can hold 1,000 linear feet of film which can be processed at SITU at a rate of 5½ feet per minute. The photographic system is described as being able to detect a "basketball at a distance of about 20,000 miles".[9]

The interpretation of photometric measurements of satellites has provided a wealth of data to scientists. This has come about through revelations concerning the density of the Earth's atmosphere and its actual composition. But scientific information about the satellites themselves is also easily discerned from the data. It is possible to determine the rate of rotation of a satellite, its shape, size, and the reflective properties of its surface. Fluctuations in brightness were first noted by observers of booster rockets, making it simple to speculate upon their altitude and lifetime.

There have been a large number of studies of orbiting satellites based on various observations, resulting in detailed calculations of their orbits. For example, between May 1971 and June 1972, over 1,500 optical and radar observations were compiled for Cosmos 387. Included were observations from Hewitt cameras (a variation of the Baker-Nunn system), kinetheodolites, MOONWATCH stations and radar installations. Only through the combination of all these observations was it

7 The great Russian astronomer, I.S. Shklovskii, described photometric tracking in "Optical Methods for the Observation of Artificial Earth Satellites", *Artificial Earth Satellites*, V. 1, 1960, pp. 55-63.

8 Kissell, K.E. and Mavko, G.E., *The Canadian Forces/ NORAD Satellite Identification Sensor at St. Margaret's*, USAF Avionics Lab., Wright-Patterson AFB, Ohio, AFAL TR-77-189.

9 Wooding, B. and Spruston, T.A. "The Canadian Armed Forces and the Space Mission", *Canadian Defence Quarterly*, V. 5, no. 2, Winter, 1975, pp. 15-20.