# Chapter 11

# THE THERMAL RADIATION BALANCE EXPERIMENT ON BOARD EXPLORER VII

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## SECTION I. INTRODUCTION

The value of the sun's radiant energy at the mean distance of the earth's orbit is 2.00 calories per square cm per minute. Since the earth intercepts the sun's radiation as a disk and reradiates it as a sphere, were the earth a perfect absorber the average loss per square cm at equilibrium would be one fourth the solar constant or 0.5 calories per cm squared per minute. The earth's surface is not a perfect absorber and in addition it is covered with an atmosphere. Part of the solar energy is reflected by Raleigh scattering in the atmosphere. We see this as the blue sky. Clouds exercise the most important variable control on the amount of sunshine the earth absorbs for they act as highly reflecting shutters. A small part of the sunlight is absorbed by the gases in the atmosphere, principally water vapor and ozone. Still another small fraction is absorbed by clouds, dust and smoke. By and large, however, most of that which is not reflected passes through the atmosphere to the earth's surface. The amount absorbed per unit area of the earth's surface depends on the sun's zenith angle and the surface properties. The oceans, for example, absorb most of it, about 95%, while polar snow fields absorb much less, about 10%. There are land surfaces which range between these extreme values. Reflected solar radiation is lost to space and never enters into the global thermodynamic system. The remaining solar energy is absorbed mainly at the earth's surface so it acts like the boiler lining of the giant heat engine which drives the atmosphere. The solar input to each unit area of the earth's surface depends on the latitude, time of year, and state of the atmosphere above. The effects of latitude and season on the incoming solar energy are well known; however, the effects of the atmosphere, especially over large parts of the earth where weather observations are unavailable, are only estimates.

Our understanding of the global distribution of long wave energy lost to space is even less well-known. Water vapor, carbon dioxide, ozone and other minor gases in the atmosphere selectively absorb the long wave energy radiated from the earth's surface and other layers of