

## CHAPTER 13

### OPERATIONAL FORMULATIONS OF CONCEPTS FOR EXPERIMENTAL PROCEDURES

*The most important criterion for a closed system is probably the presence of a precisely formulated and self-consistent set of axioms governing the concepts and logical relations of the system. To what extent an axiomatic system corresponds to reality can only be decided empirically, and we can only call it a "theory" if it represents large realms of experience.*

W. Heisenberg  
*Physics and Beyond*  
Harper and Row Pub.  
New York (1971), p. 97

#### 13.0 Introduction

In this chapter we construct some useful bridges between the theoretical domain of the preceding chapters and the experimental domain to which the theory is applicable. We shall reformulate the definitions of the principal radiometric concepts, along with those of the inherent and apparent optical properties of natural optical media, so that the concepts have physically realizable equivalent counterparts. Furthermore the reformulations will be guided throughout by the general principles of (unpolarized) radiative transfer theory so as to have the operational definitions and the associated theoretical concepts interrelated in a consistent manner, and so that the results of either theoretical or experimental activities in the discipline of hydrologic optics can be usefully applied to the advancement of the other.

#### 13.1 Operational Definitions of the Principal Radiometric Concepts

The mode of development of the chapter on radiometry in the present work (Chapter 2) was designed to emphasize at the outset the operational aspects of the definitions of the radiometric concepts used in radiative transfer theory, and in hydrologic optics in particular. Therefore we need not undertake an extensive reformulation of these concepts for the purposes of the present chapter. Instead, we shall take the opportunity to collect the principal definitions of the radiometric concepts together in a relatively compact summary form