NAVIGATION			
FIGURE:	3.12	3.12	3.7B
* Above waterline. ** A 12 m long fabric tube, 40 cm in diameter, suspended below a subsurface float at –3 m, which was in turn connected to the surface float using an elastic tether to isolate the drogue from surface wave motion. *** Nominal operating service life between refurbishment/replacement visits.			

4. Radiometric field measurement methods designed to minimize platform shading and reflection artifacts are needed for autonomous measurements on buoys. The more successful methods used for shading avoidance in operator attended measurements from ships, *i.e.* free-fall profiling (Volume III, Chapter 2), are not readily applied to radiometric measurements on moorings and drifters. The unusual MOBY platform (Volume VI, Chapter 2) is an example of a buoy and instrument configuration designed specifically to address this problem, but it would be neither affordable, nor practical, to replicate such a configuration in the vast majority of projects where bio-optical buoys are appropriately deployed (Section 3.2 above).

5. Unattended instruments on buoys are either immersed in water, or exposed to the atmosphere, continuously for periods of weeks to months without opportunity to clean optical windows, or other exposed sensor surfaces. In this situation, the performance of buoy instrumentation is subject to progressive degradation due to marine organism growth on sensors in water (biofouling), or salt, dust and/or bird dung deposition in air.

The remainder of this section describes methods for acquiring reliable measurements under the constraining conditions described above (see also the related methods in Vol. VI, Chapter 2, as applied to the more specialized MOBY observatory). The discussion emphasizes the mounting and integration of radiometric, optical, fluorescence, meteorological, CTD, and other sensors under the control of an on-board microcomputer, pre-processing and storage of the data measured by those sensors, and near-real-time transmission of selected data values to ships, or laboratories ashore. Essential characteristics of instrument arrays are summarized in Tables 3.3 and 3.4, respectively, for moored and drifting buoy examples. Specific commercial[4] and custom instruments listed by model, or name, in Tables 3.3 and 3.4 are briefly described below.

Instrument Control and Data Acquisition

A critical aspect of any mooring or drifter platform is its instrument controller and its ability to perform in harsh environments. The system controller must be configured to communicate with instruments, operate electromechanical devices (*e.g.* shutter mechanisms), store measured data and metadata (*e.g.* GPS time, latitude and longitude), preprocess measurements and transmit the resulting parameters to a ship or laboratory. Generically, a system controller consists of a microcomputer interfaced to an array of instruments, the buoy's power source (batteries and/or solar cells), and sometimes a telecommunications link. Many of the instruments used on buoys have some sort of internal microcomputer, operate semi-autonomously to acquire data scans, store the data internally, perhaps average scans over a specified time interval, and transmit digital data to the controller; the instrument controller interfaces to these digital-format instruments using either multiple single channel interfaces (*e.g.* serial RS232), or a network protocol interface (*e.g.* serial RS485 or parallel IEEE-488). Other instruments may produce an analog output, in which event the controller's microcomputer must also be interfaced to one or more analog-to-digital (A-to-D) converters; for most such applications, it is necessary to calibrate the A-to-D converter by recording it's digital responses to known voltage inputs. In other controller-instrument configurations, analog devices may be connected to A-to-D ports of a digital instrument, *e.g.* a CTD, and communicated to the controller as part of its data frame.

Recent development of smaller Ethernet devices has allowed the creation of Local Area Network on moorings, which can provide easy communications between both individual system controllers and serial output from instruments. For example a controller may be physically separated from instruments connected to an Ethernet RS-

[4] Certain commercial equipment, instruments, or materials are identified in this document to foster understanding. Such identification does not imply recommendation or endorsement by the National Aeronautics and Space Administration, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.