The consumer-oriented electronics industry has developed extremely rapidly over the past decade and has provided many beneficial side-effects for experimental scientists. A development of particular interest to environmental researchers is the advent of a new generation of relatively inexpensive solid-state data-loggers. This type of apparatus, which uses the same technology as that of the popular digital microprocessor industry, makes continuous monitoring of environmental parameters at remote sites feasible for even modestly funded studies. The analogue sensors needed to provide the logging device with input information, however, do not usually arise from similar high-volume production lines, and very often constitute the most costly part of any data monitoring system. This article intends to illustrate the idea that inexpensive, laboratory-constructed transducers can play an important role in optimizing the potential benefits of modern data-logging equipment.

During 1985, an experimental study plot was established in an area of natural mountain fynbos at an altitude of 375 m in the Highlands State Forest Reserve in the south-western Cape, on a site which had been cleared by burning in February of that year. Since the wind, especially the forceful summer 'south-easter', is a dominant feature of the regional climate, and one to which the vegetation is probably adapted in many respects (see Boucher 1972), it was decided to dedicate one channel of an on-site logger to measuring wind-speed at the site. The most economical and convenient means of achieving this was to construct a three-cup anemometer similar to that described by Unwin (1980), but using a small 3 VDC electric motor as a voltage generator in place of an electronic pulse counter. Investment in the instrument comprised less than R15,00 in component parts and approximately one working-day for assembly and calibration, whereas the cost of an imported commercial anemometer of similar design (Didcot DWR/201G) was cited as more than R2 000,00 at the time of writing.

The cup wheel was constructed from half table tennis balls, 2 mm brazing rod, microjet irrigation fittings, and epoxy resin (see Figure 4). Output from this generator was adjusted via a half-bridge resistance circuit to provide the logger with a signal in the correct range of 0 to 2 000 mVDC. Although it is reported (Woodward & Sheehy 1983) that anemometers using this principle of signal generation have a relatively high detection threshold (up to 2 m.s^{-1}), this shortcoming was not considered a hindrance to the measurement of maxima, and the approximation of mean windspeeds for the expected seasonal windy conditions. The length of the arm (47 mm) relative to the cup radius (17 mm) was close to the ratio of 2,5 recognized as a reasonable compromise between sensitivity and linear response (see Grace 1977). In the field, the device was mounted with the cups 1,5 m above the ground.

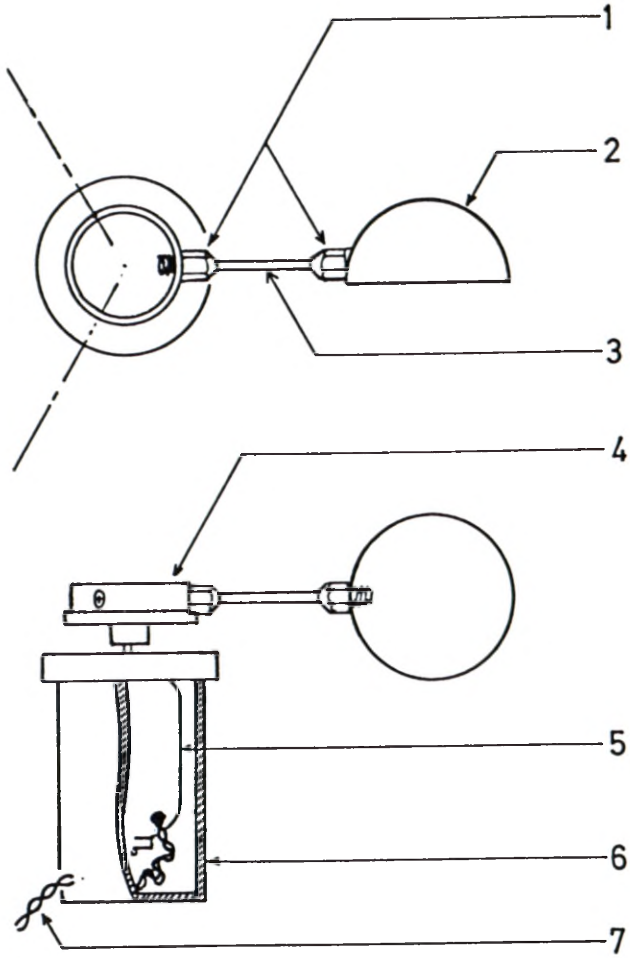

FIGURE 4.—Construction of the D.C. generator anemometer. Component parts were assembled as indicated in the above sketch, with slow-setting epoxy resin as a joining and sealing medium. The parts labelled are: 1, microjet irrigation couplers; 2, half table tennis ball; 3, brazing rod; 4, plastic vial lid; 5, electric motor; 6, plastic film cannister; and 7, electric leads to monitoring circuitry. Scale is provided by the table tennis ball which has a diameter of 34 mm.

The instrument was calibrated on a windless day by mounting it 0,5 m above the roof of a car, and driving at constant speeds between 20 and 80 $km.h^{-1}$ (5,6 and 22,2 $m.s^{-1}$) while measuring the output on a digital voltmeter (Fluke, model 73). Accuracy (± 5 %) of the car's speedometer was checked within the calibration range by timing displacement over measured distances. Further comparisons were made *in situ* in the field with an adjacently mounted totalizing anemometer (S.I.A.P., model 1220) over 30-minute periods on a windy day (Figure 5). This latter set of measurements implied a reliable detection threshold of approximately 2 $m.s^{-1}$.

During the measurement period (November 15, 1985 to March 13, 1986), output from the anemometer was measured once per minute, and processed by inbuilt data-logger software to provide a mean windspeed value for every three-hour interval, as well as the maximum single value recorded during each day. Information is summarized in Figures 6 & 7 for the full period, a time of year when the south-east wind is common. From Figure 6 it can be seen that on only one day during the trial period did air movement remain below the reliable detection threshold for the full 24-hour period, while an overall maximum windspeed of 16,1 $m.s^{-1}$ was recorded on November 18. The three-hour mean values have been combined for the whole measurement period, and plotted in Figure 7 to indicate the diurnal pattern of air movement. The site may not be subject to the full force of the south-easter, as it is approximately 75 to 125 m lower than a ridge two kilometres distant to the south and south-east. Records of windspeed at D. F. Malan Airport indicate that gusts of 28 $m.s^{-1}$ may be experienced on the Cape Flats between November and March (Weather Bureau 1960).

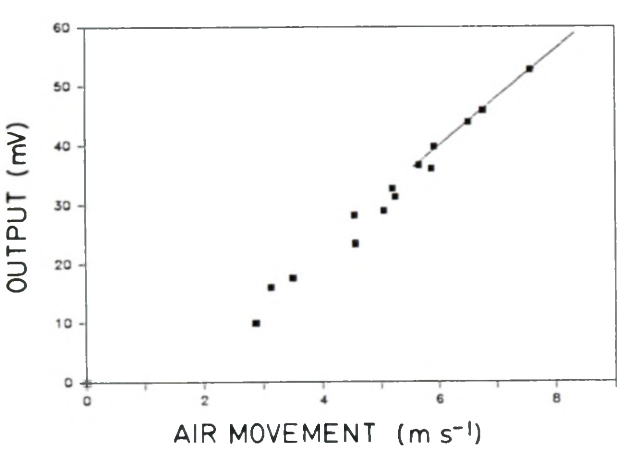

FIGURE 5.—Calibration of the D.C. generator anemometer. The solid line ($Y = 8.121X - 8.895$; $r^2 = 0.9997$) represents in part the calibration of the device against a car speedometer for five values between 5,6 and 22,2 $m.s^{-1}$ (values beyond 8 $m.s^{-1}$ are not shown). Solid points compare mean output to mean windspeed as measured at the study site by an adjacently mounted totalizing anemometer over 30-minute periods.

Although a quantitative measurement of accuracy has not been made on the instrument, both the linearity of the calibration and the favourable comparison with a commercial anemometer suggest that the recorded measurements of air movement at the study site are accurate within the limits outlined above. Other more sensitive devices of sophisticated design for windspeed measurement (see Rosenberg 1974) can be constructed for interfacing with a data-logger. Practical designs for transducers to measure other environmental parameters are also readily available from the literature—see Chapter 8 of Woodward & Sheehy (1983) for a useful list of references. Apart from their benefit as instruments of opportunistic data capture, relatively cheap laboratory-constructed transducers can be left unattended with less anxiety at remote stations where pervasive human vandalism is frequently a threat.

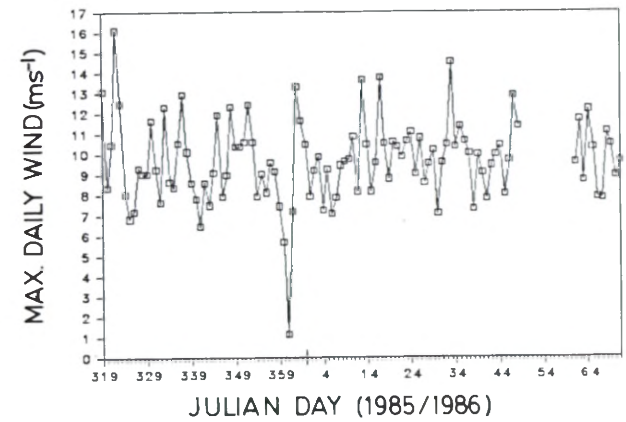

FIGURE 6.—Maximum daily windspeeds measured at the Highlands study-site. The gap starting at day 49 (Feb. 18, 1986) indicates a period of missing data owing to a problem with programmable memory space in the recording device.

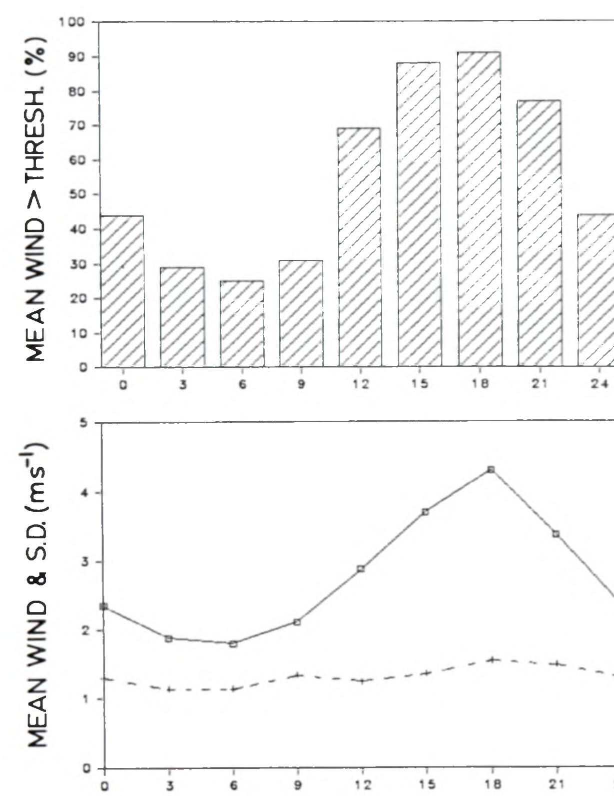

FIGURE 7.—Diurnal pattern of air movement at the Highlands study-site. The histogram above shows the ratio of days in the measurement period when the mean measured wind-speed during the relevant time interval was above 2 $m.s^{-1}$. Below is the overall mean windspeed, including calms, for each time interval (solid line), and the associated standard deviation of each (broken line).

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G. W. DAVIS