AES NIPHER SHIELDS FOR RECORDING PRECIPITATION GAUGES: AN ASSESSMENT

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Previous field tests (Goodison, 1978a) and wind tunnel flow visualization experiments (Turner and Goodison, 1977) have indicated that the MSC Nipher shielded snow gauge has a superior catch efficiency for measuring snowfall water equivalent compared to standard Alter-shielded recording gauges. However, in low snowfall regions, such as the Arctic and Prairies, the MSC Nipher gauge has been found to be less efficient because retention losses and trace amounts were not being accumulated (Goodison, 1978b). A recording gauge would be more desirable for operation in such regions. In order to improve the performance of Alter-shielded recording gauges and to avoid the errors associated with the standard non-recording Nipher gauge, it was proposed that a larger Nipher-type shield should be constructed, scaled to fit the 20.7 cm (8 inch) diameter recording gauges. The aim was to obtain measurements from a recording gauge which would be comparable to the official MSC Nipher snow gauge measurements.

The "scaled-up" version of the MSC Nipher shield was designed by the Atmospheric Instruments Branch of AES. The shield was made of fiberglass. An elongated tube of galvanized sheet metal (diameter 20.7 cm) was affixed to the gauge to extend its orifice even with the top of the shield. Gauges were mounted at 2 m above the ground. Two prototype shields were installed on Fischer and Porter and Universal Belfort recording gauges at the Toronto Meteorological Research Station in January 1979 (Figure 1). Measurements obtained during the snow season are summarized by event in Table 1. The recording gauges with the new Nipher shield recorded a substantially higher catch than Alter-shielded, unshielded, or Wyoming shielded gauges, but the catch was still 7-15% less than the standard MSC Nipher gauge at the station.

Additional shields were built and installed for testing on gauges located in different snowfall environments during the 1979-80 winter season. Either Fischer and Porter or Universal gauges were installed at: Resolute, N.W.T.; Bad Lake, Saskatchewan; Regina, Saskatchewan; Monticello, Ontario; Dorset, Ontario; and Peterborough, Ontario. Different climatic regimes and a variety of local siting conditions were specifically chosen. Unfortunately, low snowfall and higher than normal rainfall were characteristic of many of the stations, particularly those in Ontario.

Data from Saskatchewan for the 1979-80 winter confirmed the higher catch efficiency for recording gauges using the Nipher type shield. At Bad Lake, a Nipher shielded Fischer and Porter caught 96% of the standard MSC Nipher compared to only 37% for an Alter-shielded Fischer and Porter (see Table 2). This latter catch is in line with the long term average monthly catch of 35% reported by Gray et al. (1979). At Regina, the modified Fischer and Porter gauge caught 94% of the MSC Nipher. At both stations only snow events were recorded. Very few trace amounts of precipitation were recorded at either station during the winter.

At Monticello, Ontario, paired Nipher and Alter shielded gauges were placed in both open and sheltered bush locations to assess the effect of siting on the large shield. For the period of operation, the two Nipher shielded gauges accumulated about 20% more than the MSC Nipher gauge. Reasons for this are not known at this time, but because of the size of the shield, snow may have rested on it during periods of light wind and have been blown in later. At this site (as well as at Muskoka and Peterborough) it was observed that during freezing rain events, precipitation was often recorded after the actual time of the event, presumably because of freezing on the orifice extension. Wet snow could also stick to the extension and it would only be recorded later after melting or falling into the catch bucket. Occasional undercatch by the Nipher shielded recording gauges during rain events was observed at some stations. The efficiency of this gauge configuration for measuring rainfall will be tested during the summer months.

Initial results indicate that further testing of this type of shielding is warranted. At this stage there are still problems in design which limit easy operational use of the shield. Its physical size alone makes servicing of both the Fischer and Porter and Universal gauges awkward and difficult. It is hoped that further wind tunnel tests will allow the shield to be shortened to provide a more compact operational unit.

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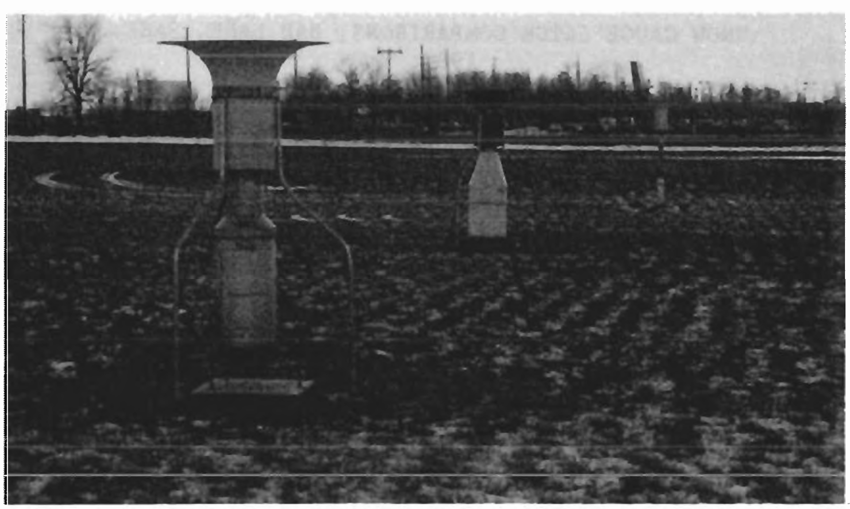

FIGURE 1: NIPHER SHIELDED BELFORT GAUGE, NIPHER SHIELDED FISCHER-PORTER GAUGE AND MSC NIPHER SHIELDED SNOW GAUGE AT TORONTO MET. RESEARCH STATION

TABLE 1

TESTING OF MSC NIPHER SHIELDS FOR RECORDING PRECIPITATION GAUGE
1978-79 SNOW SEASON

PRECIPITATION	WYOMING SHIELDED BELFORT GAUGE (mm)	NIPHER SHIELDED F-P*	NIPHER SHIELDED BELFORT (mm)	ALTER SHIELDED F-P	ALTER SHIELDED BELFORT (mm)	UNSHIELDED BELFORT (mm)	MSC NIPHER (mm)
Jan. 13, 14/79 (snow & rain)	18.3	20.3	21.6	12.7	13.5	11.2	21.8
Jan. 17/79	7.1	7.6	8.9	2.5	4.6	2.5	9.1
Jan. 20,21/79	5.6	5.1	7.1	2.5	3.8	2.0	7.6
Jan. 24,25/79 (snow & rain)	21.8	30.5	36.3	22.9	25.4	24.6	33.0
Feb. 4/79	2.0	2.5	2.5	2.5	2.0	1.5	4.0
Feb. 7,8/79	3.0	2.5	3.6	2.5	2.0	1.0	3.8
Feb. 16/79	1.3	2.5	1.5	Nil	0.8	0.3	1.8
Feb. 21/79 (rain)	1.0	2.5	1.0	2.5	0.8	0.5	1.3
Feb. 23,24/79 (rain)	8.9	7.6	6.9	10.2	10.2	9.9	10.9
Feb. 26/79	3.8	5.1	5.3	2.5	2.3	1.0	8.1
TOTALS	72.8	86.2	94.7	60.8	65.4	54.5	101.4
CATCH TOTAL AS % OF MSC NIPHER	72%	85%	93%	60%	65%	54%	

* F-P FISCHER-PORTER PRECIPITATION GAUGE

TABLE 2

SNOW GAUGE CATCH COMPARISONS, BAD LAKE, SASK.
1980

MONTH	FISCHER-PORTER ALTER SHIELDED	FISCHER-PORTER NIPHER SHIELDED	MSC NIPHER SHIELDED SNOW GAUGE
FEBRUARY	2.5 mm	10.2 mm	12.8 mm
MARCH	5.1 mm	5.1 mm	6.2 mm
APRIL	5.1 mm	17.8 mm	15.6 mm
TOTAL	12.7 mm	33.1 mm	34.6 mm
CATCH TOTAL AS % OF STANDARD NIPHER	37%	96%	