COMPARISON OF SOVIET AND CANADIAN SNOW GAUGES

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The standard snow gauge in Canada is the Nipher and in the Soviet Union is the Tret'yakov. Between them, these two instruments provide snowfall data which represents most of the north polar regions of the world. Figures 1 and 2 bring out the principal characteristics of each of these instruments.

It would appear that simplicity of design, low manufacturing costs, simple operation and ease of installation have been important considerations in the development of the Tret'yakov Gauge. When the two instruments are juxtaposed, as in Figure 1, the Nipher appears as the Rolls Royce and the Tret'yakov as the Model 'T'. This analogy in no way reflects on the efficiency of the instruments under severe conditions nor on their utility for organizations responsible for snowfall measurement over large areas of the earth's surface including some very remote areas which are very difficult of access. With regard to this last comment it is worthy of note that shipment of the Tret'yakov involves a relatively small, light, easy to handle package. The instrument is essentially assembled in the field. The shield can be put together quickly using paper clip-like pieces of wire and the instrument is designed so that it can be mounted on a wooden post which can vary considerably in diameter and shape. By contrast, shipping and installing the Nipher is a fairly major undertaking. The instrument is heavy and bulky as is the threaded steel pipe required for mounting. As the instrument is heavy, a very solid foundation is required for it.

The Nipher Shield is solid spun alloy, a very substantial, well finished, virtually indestructable, piece of work. The Tret'yakov Shield is sheet steel and wire, all of the slats are identical. The Nipher cylinder is a simple cylinder except for a machined lip. It is constructed of heavy copper and brass. By contrast the cylinder for the Soviet gauge is relatively light, it is constructed of 0.8 mm galvanized steel, has a sloping interior collar, a pouring spout and its design allows for a carrying lid (Fig. 2). This spout is a useful extra as it does reduce splashing, the interior collar increases the value of the spout but affects snow catch (see below). In principle, the carrying lid (which has a handle) is a good idea but the lids used are not water tight. The plastic shields, which are sometimes used for this purpose in Canada, also have their limitations as they become brittle and ill-fitting at low temperatures. A lid of some sort should become a standard accessory for snow gauges of this general type.

Comments on Measurements with the Gauges

In 1975, courtesy Atmospheric Environment Service of Canada, a Tret'yakov gauge was obtained and was installed within 10 m of a Canadian Nipher in a 60 m diameter "Clearing" in a wooded area at the Trent University Field Station, Peterborough, Ontario, Canada (44°21'N, 78°17'W, 220 m a.s.l.). The surrounding trees were approximately 12 m in height. This clearing is within 200 m of the official Trent University Weather Station where snowfall measurements are made routinely with a Canadian Nipher. In 1979, three replicas of the Tret'yakov were constructed and were located, with Niphers, at the Weather Station at a sheltered site within an area of cedar bush and in an area of sumac bush. Thus comparative data are available from one pair of gauges for the period 1975/78 and from four pairs

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located in a variety of exposure situations, but within a few hundred m of each other, for 1979/81.

The purpose of this program of measurement was to provide the basis for a practical assessment of these important types of snow gauge. It is a well established fact that both shielded and unshielded snow gauges tend to under-measure during periods with wind (see, for example, Goodison 1977 and references). Bogdanova (1965) has shown that the Tret'yakov under-registers solid precipitation on average 30-50% with extreme errors at wind speeds of 10-12 m/sec^{-1} of 70-80%. Goodison (1977) has shown that the Canadian Nipher outcatches most standard gauges under a wide range of weather conditions. In this case, it was notable that the Nipher did indeed outcatch the Tret'yakov in virtually all situations. However, the difference, although persistent, was generally slight being in the order of only 4% in the 5-year Clearing records. The seasonal receipts of the pairs of gauges were also similar in statistical terms with t-tests showing significant differences only in the 1976/77 (Clearing) and in the 1979/80 (Weather Station) cases. It will be noted that these are the most exposed of the four sites.

Comments on Detailed Performance of the Gauges (see Fig. 3)

Although, on a season-long basis, the performance of these two gauges appears to be quite similar, distinct different catches were obtained under particular weather conditions. An examination of some of the points farthest from the x=y line of the 1976/78 plot is instructive in this regard. The high Nipher/Tret'yakov ratios of 6 December 1977 and 27 January 1978 occurred on days of fairly high snowfall during relatively calm conditions. On both days, the Tret'yakov overflowed as a result of the accumulation of low density snow above the inner rim--which effectively reduces the cylinder's capacity under such conditions. This rim also limits the possibility of measuring snow depth in the cylinder which is encouraged in some observing programs in Canada.

Two other days on which the Nipher measured appreciably greater amounts were January 10th, 1977 and 14th March 1978. Both of these were days of gusting winds, the former was one of the windiest days on record. These points presumably reflect the relative efficiency of the Nipher Shield under windy conditions.

On 7 December 1976, 12 December 1977 and 26 January 1978, the Tret'yakov recorded more precipitation than the Nipher. On all three of these days, bridging occurred on the sides of the solid Nipher Shield. The open Tret'yakov Shield is not affected by this. The phenomenon of bridging is a well documented feature of the Nipher Gauge (see, for example, Goodison, 1977 and Guelph, 1975).

Concluding Remarks

The preliminary data presented here and at the Conference tend to confirm the fact that the Canadian Nipher outcatches the Tret'yakov. However, in the longer term, the differences between the two appear to be slight. They are certainly slight relative to the degree of under-catch which is reported for both of the gauges in literature. In detail, differences in performance appear to be most marked in windy situations when the effectiveness of the Nipher Shield appears most obvious and in situtations which promote bridging (calm, moist conditions) when the Tret'yakov's Shield has an advantage. All of the sites represented here are within a few hundred m of each other. Preliminary inspection of the data sets presented suggests that differences of site may be of much greater significance than differences of gauge design in determining efficiency of catch.

Further analysis will focus on the effects of temperature, wind and precipitation type as well as on the effects of gauge site.

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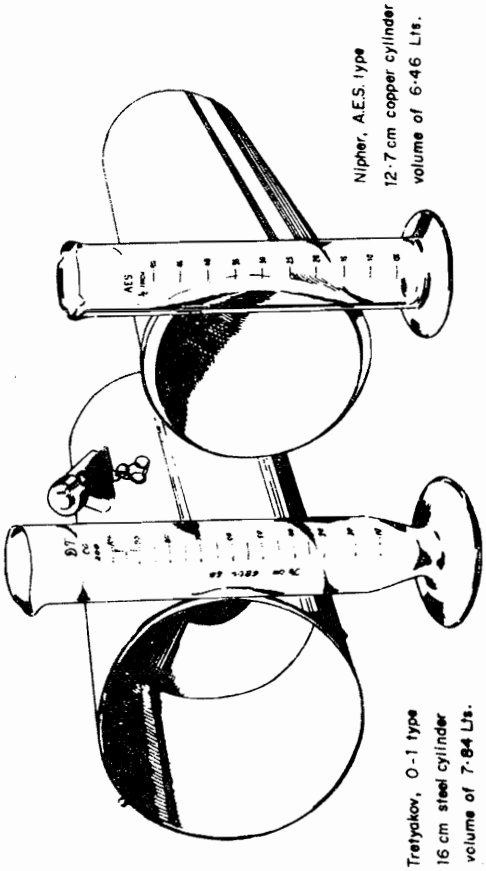

Fig. 2. Measuring cylinders and graduates

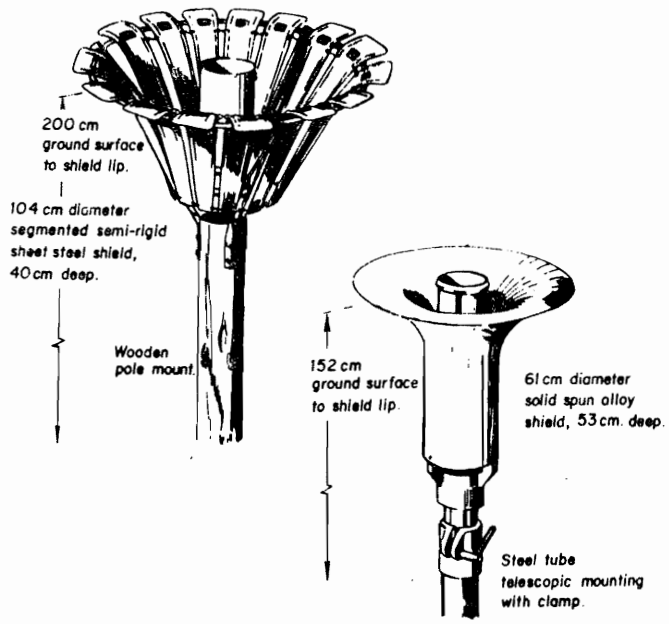

Fig. 1. Tret'yakov (left) and Nipher Snow Gauges.

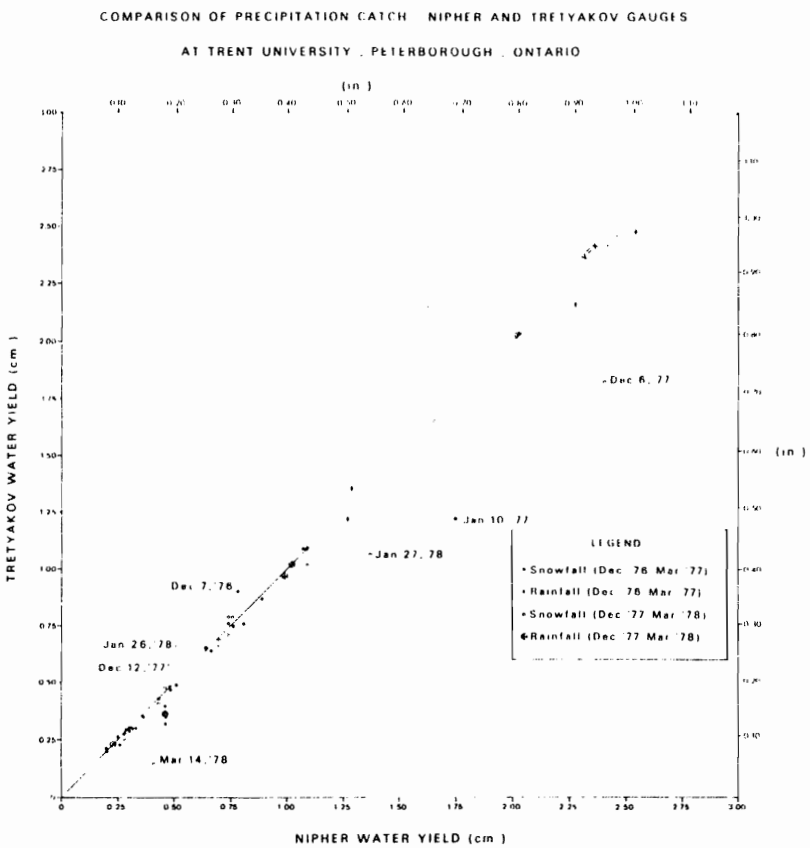

Fig. 3.

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