Up, up and away -
To the stratosphere and back

Modern versions of an old standby, the helium balloon, are adding new wrinkles to the field of atmospheric science. A series of balloon-borne probes into the stratosphere were recently flown from Yorkton, Saskatchewan, using Canada's new mobile launch facility.

Unhampered by vibrating or polluting engines, the free balloon is in many ways an ideal laboratory for studying the subtleties of the atmosphere.

A mobile balloon launch facility, recently established at Yorkton, Saskatchewan, has become Canada's link in the growing international network of scientific support services. During the month of August, a series of large scientific balloons were launched from the site in support of Canadian scientists from the Atmospheric Environment Service of Environment Canada, the Universities of Calgary and York as well as a number of scientists from the United States. The eight-week program was organized by NRC's Space Research Facilities Branch.

Why Yorkton? "For many reasons," explains Project Manager Ron Charko. "High altitude winds for example. They're critical for a successful balloon flight. Also, the balloons drift hundreds of miles in the air before they land, so the long stretches of open country west of Yorkton offer many areas in which to bring them down. Add to that the low density of air traffic in the region and the series of radar tracking stations already in place along the balloon flight corridor and you come up with an excellent launch site.

"Don't forget," he adds, "there's also a built-in advantage for scientists working in northern latitudes where geophysical conditions are ideal for their studies."

In recent years, balloon technology has progressed to such a point that a scientific launch facility can provide support for experiments not only in atmospheric sciences but also in the fields of astronomy and other space sciences.

The development in the United States of a plastic film which could be easily sealed and would withstand the harsh environment was a major breakthrough in balloon design and manufacture. Although remarkably resilient, the skin of a modern balloon bubble measures less than one thousandth of an inch in thickness, about three times thinner than the material in a common plastic garbage bag.

The largest of the balloons flown from Yorkton fills a volume of 15 million cubic feet and can float instrument payloads weighing some 3,500 lb. (1 600 kg), the equivalent of a small car, to altitudes exceeding 100,000 feet (30 000 m). When deflated and spread out on the ground, its mammoth plastic skin can comfortably cover the area of a football field.

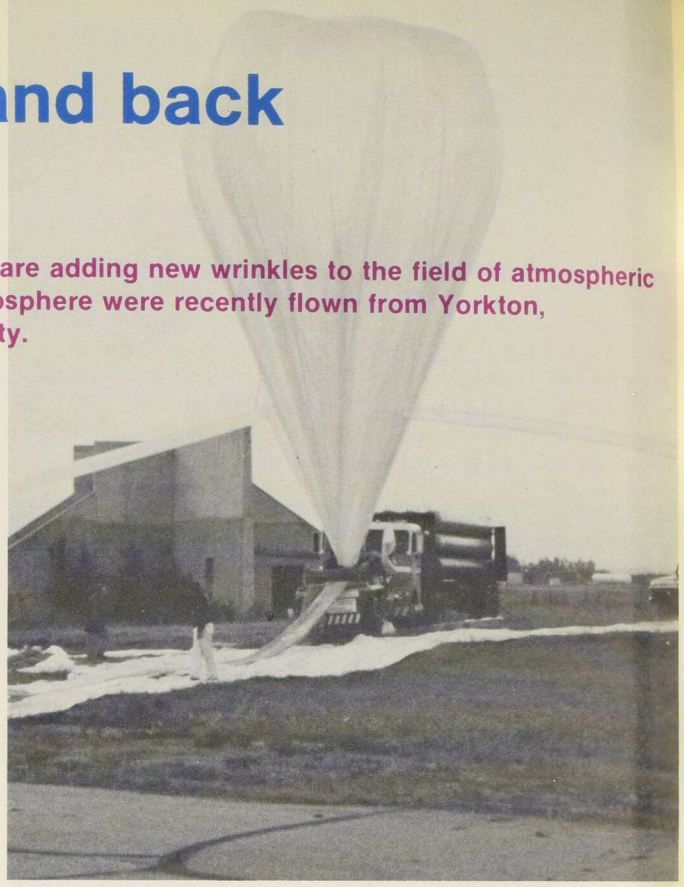
The size of these balloons, in fact, determines the size and complexity of a suitable launching facility. Small balloons, up to 250,000 cubic feet (7 000 m^3), require no special heavy ground equipment and can therefore be launched by a small scientific group with little or no outside assistance. With larger balloons, however, launching is a complex task which requires the coordination of numerous technicians with specially designed machines and electronics.

At the outset, weather patterns play a vital role in any scientific balloon launch. At the mercy of fickle winds and changing weather, flight crews may wait for days until conditions are optimal. Only then can the operation begin.

In preparation, wind profiles are recorded up to altitudes of 60,000 feet (18 000 m). Near the ground, surface winds must be slow enough to ensure a safe, effective take-off. Higher up, boundary layer winds must be measured for the proper direction and speed since turbulent shear winds could easily rupture a balloon during ascent. Finally, measurements are made on the strength and direction of high altitude winds which determine the flight path of a large balloon; the eventual distance travelled can vary from 250 miles (400 km) to as much as 1,000 miles (1 600 km) from the launch site.

At length, the expected moment arrives. The winds are just right. The skies are clear. The nearest thunderstorm is many miles and towns away on the distant prairie. Transport Canada personnel at Yorkton airport confirm that a balloon flight won't interfere with air traffic. Count-down begins.

The most common technique for launching balloons is the dynamic launch, executed with a mobile vehicle which supports the payload. This flexible approach lets the launch crew compensate for changes in surface wind direction which might otherwise give the balloon an awk-ward or misdirected lift-off. First, the prostrate balloon is filled slowly with helium gas while it is held down by a large spool attached to a weighted trailer. Next, as the inflated bubble is released, a launch vehicle manoeuvres the payload so it stays directly under the ascending balloon. When the balloon train is fully extended, the payload is finally set free by the launch vehicle, and the experiment soars skyward.



Space Research Facilities Branch/Direction des installations de recherche spatiale

A balloon bubble taking shape. Helium gas flows in through the long, extended sleeves on either side. The spool in front of the helium trailer restrains the balloon until lift-off.

Ballon en cours de gonflage. L'hélium pénètre dans l'enveloppe en empruntant les longues manches placées de chaque côté. Le treuil monté à l'avant du camion avitailleur retient le ballon jusqu'au lancement.