

sheet of fire. The noise is incredible. Suddenly, 5 km seems uncomfortably close. I cannot think; I could not shout. Much nearer the launch complex and this "white noise" would literally tear me apart.

Up in the sky, *Columbia* and her propellant cluster roll over one-half a turn. It is a move of ponderous grace, like the broaching of a whale. She will stay this way, upside-down with earth above her, till she prepares to land.

Loudspeakers at the viewing site chant height, speed, and downrange distance. At two minutes, travelling about 10 000 km/h, *Columbia* has dwindled to a bright speck. "SRB separation," say the loudspeakers. I see a white puff as her spent solid rocket boosters are blown away, riding parachutes down to their recovery ships. *Columbia* is 100 km above the Atlantic Ocean. She will burn her main engines for six minutes longer, jettison

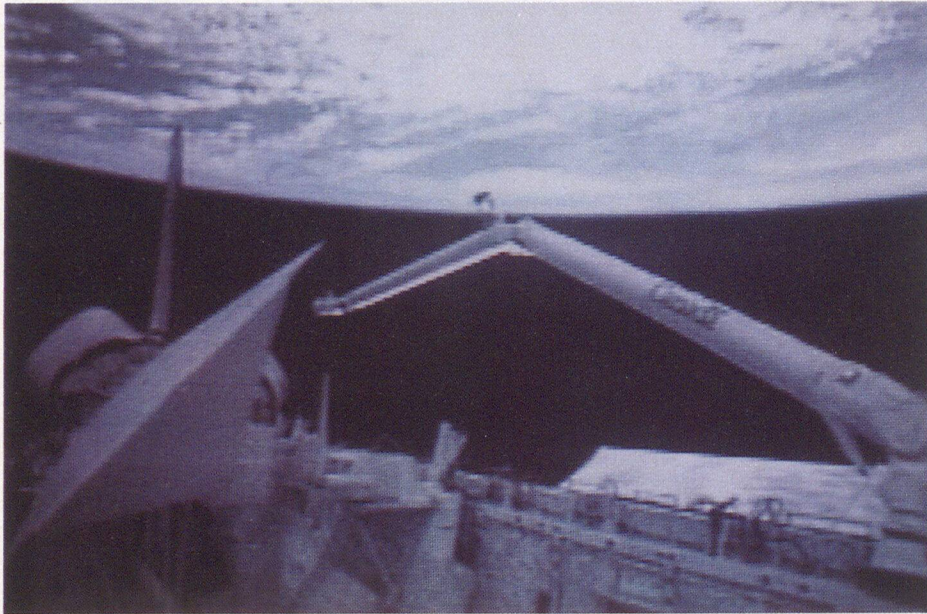
her external tank — now scorched, no longer unstained — and fire her secondary propulsion system to achieve her intended orbit. She will then become the world's first spacecraft to have done so more than once. God help the woodpeckers.

As the white column disappears high into the morning sky, there is time to consider the background of this unique craft, and the significance of the remote manipulator arm securely clipped inside her cargo bay. *Columbia*, though clothed in the most advanced materials, is, after all, basically an idea: a boxcar with wings. The Space Transportation System, as the name implies, means that travel beyond the earth has progressed from exploration to exploitation: NASA soon will treat the void above our atmosphere as a commercial resource. The Space Shuttle is thus not just a bigger, better rocket, but something wholly new — the first true spaceship. Only its external tank gets tossed, tumbling down to break up in the Indian Ocean. The solid-fuel boosters parachute to earth for repeated service, while the orbiter herself is re-usable up to a hundred times.

Initially, *Columbia* and her three sister orbiters will ferry up satellites pre-built by NASA's clients, placing them in precise orbits for a lower sum per kilogram than NASA has yet been able to charge. By the turn of the century, the Shuttle fleet may be constructing solar-power stations several kilometres to a side, or assembling manned Space Operations Centers from thousands of components orbited one load at a time. Each orbiter is the size of a DC-9 and is engineered to haul 30 t of cargo into low earth orbit again and again.

Long-distance haulage, however, is not the same as stevedoring. A boxcar *Columbia* may be; but once in space, she also needs to handle her 30 t of cargo. This is the task of the Shuttle Remote Manipulator System, which the National Research Council has christened Canadarm. When her engines switch off and the Shuttle coasts into orbit, her men and women astronauts won't be suiting up to take spacewalks in order to stow satellites in, or unstow them from, the cargo bay. Instead, the astronauts and mission specialists will turn to a control station at the rear of the orbiter's cabin. Their commands will open the doors of the cargo bay to a harsh space environment, and then the astronauts will grasp hand controls and put Canadarm to use. Still in the shirtsleeve environment of their cabin, spacemen will become workmen — all thanks to the Canadian arm.

Canadarm will release the satellites it



Bending its elbow, the arm undergoes its first test in space; the Earth provides a backdrop above.

Le bras subit son premier essai en pliant le coude avec, au-dessus de lui, la Terre comme toile de fond.



(NASA)

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