sector, this most taciturn of crews yet suddenly became excitedly voluble. Observed Shepard, "This really is a wild place here. It has all the greys, browns, whites, dark craters that everybody's talked about before. The fact that we're climbing away from the surface is very obvious. Of course, that brings more and more of the area in detail." Koosa added: "You're not going to believe this. It looks just like the map."
Some 3hr before spacecraft separation was due Mitchell and Shepard crawled through into Antares to begin the lengthy check-out. As they came round the Moon for the 12th descent orbit the two spacecraft separated. Roosa then took Kitty Hawk up to a 70-mile, 112km circular orbit and Antares prepared for powered descent insertion. But about half an hour before it took place, the final drama occurred. A warning light flashed on in the LM indicating that the automatic abor^ system had been inadvertently activated. This meant that the instant the descent engine was fired by the computer, that same computer would automatically abort the landing.

Immediately controllers at Houston began a fast rewrite of the computer programme. All Mitchell's attempts to correct the fault failed and by the time an override pro-gramme was read up to the astronauts and fed in, PDI was only lOmin away.
At 1005 the descent engine throttled slowly up, taking 26sec to reach full power, and Antares began to let down toward the surface. Distance to target was 240 miles, 387km. But there was one more tribulation to be overcome before the landing pads would rest safely on the surface. At 40,000ft, 12,200m the landing radar was due to begin registering altitude. It did not do so. But tapping the land-ing guidance computer and operating the on-off switch, the traditional layman's repair system, had its effect and at 26,400ft, 8,046m, with 6min to go, the first ground echo was received.

For lOmin following PDI the descent engine braked the spacecraft, allowing it to sink slowly toward the surface of the Moon. A slight excess of height above the flight path at one point was quickly remedied. At 1013 Antares reached its High Gate, at which point it began to turn to a vertical attitude. The spacecraft was then at 7,600ft, 2,316m altitude and had a forward speed of 307 m.p.h., 494km/hr. The last stage of descent was carried out manually by Shepard who held the LM hovering until it seemed inevitable that fuel would run out.

At 1018 GMT was heard Shepard's voice reporting "Contact." Antares had landed. T.W-W.

NASA BUDGET EFFECTS

The remaining Apollo flights have been spread out to last into 1973 as a result of a severe cut in Nasa's budget for 1971. The loss of nearly £200 million means that Apollo 16 will now fly in March next year instead of January and Apollo 17, due for launch in the following July, will now have to wait until early 1973. Apollo 15, however, will still fly next July and Skylab, the Grand Tour and the Viking-Mars Lander programmes remain, as yet, unaffected.
It is in the post-Apollo programme that the cut is being felt most. 1971 spending on development of the shuttle has been nearly halved from £80 million to £42 million. But it is with this £42 million that Nasa has decided to go ahead with initial development of the engines for the shuttle. Consideration on the airframe, the centre of the great transatlantic tug-o-war of priorities, is being post-poned at least until the middle of the year, by which

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time current preliminary design studies will have been completed.
The Nerva nuclear engine programme has also suffered badly, to the extent of having to operate this year on its smallest budget ever. The Nerva engine is being developed to power a manned Mars flight and the pro-gramme will have to wait until the late 1970s before receiving a concentrated share of the resources.

SHUTTLE SHARE CONFIRMED

It was officially confirmed last week that the British Government is to contribute up to half the costs of the British Aircraft Corporation's participation in North American Rockwell's shuttle phase B studies. BAC tenta-tively announced this agreement last September at the same time as declaring a link-up with the US firm.
Both NR and McDonnell Douglas are working on 11-month Nasa contracts for phase B (preliminary design) study of the re-usable space shuttle and the two firms have drawn a number of European companies into their fold for this stage of the project. Each participant is funding its own contribution but BAC's share will be no more than £200,000 (split with the Government). For this BAC has half-a-dozen engineers working at NR, Downey, Calif, on structures, aerodynamics and data handling. McDonnell Douglas, St Louis, has drawn technicians from Hawker Siddeley Aviation, Aerospatiale and Erno.

In the course of these studies, due to be completed next May, the concept of the shuttle has changed radically. It was initially projected as having a 50,0001b, 22,700kg payload capacity plus room for 10 passengers and a crew of two. A stub-winged concept was preferred for both the orbiter and booster stages, producing a low (short) cross-range atmospheric flight. Following the drastic reductions of Nasa's budget, a change of concept was announced last October but not specified until recently. The new con-figuration has a delta-winged orbiter stage for high cross-range capability, a more expensive design but one favoured by the USAF. The design payload has also been halved to 25,0001b, 11,350kg, although the passenger capacity remains the same.

Further difficulties may arise, however, following the new cutbacks reported above. The present tie-up agree-ments call for a review of arrangements at the end of the phase B period. If NR wins a development contract any continued contribution by BAC will almost certainly be on a subcontract basis. On the other hand, Nasa is now even more in need of an independently financed European contribution. If the European schism of last autumn is going to heal, it may take some time. With a number of European companies already working on the shuttle airframe, and Europe's original interest, the tug, given a very low priority—tantamount to cancellation—it is now more possible that any European interest could favour contributing to the shuttle. This may well be one reason why Nasa has deferred financial emphasis on the shuttle airframe. It certainly gives Europe more time to sort itself out, while Nasa goes ahead with the propulsion unit, an area in which Europe would not be so willing or able to participate.

SECOND NATO COMSAT LAUNCHED

The second communications satellite for use by members of the North Atlantic Treaty Organisation was successfully launched on February 2. The satellite, Nato-B (now Nato-2) was launched by the US Air Force atop a Delta booster.

Nato-2 is the second of two satellites built by Philco Ford for Nato under a £21 million programme which includes advanced terminals in each of the 12 Nato countries. Similar to the British military comsat, Skynet, it is drum-shaped and mechanically de-spun, measuring 54in, 137cm in diameter, 32in, 81cm in drum-height or 63in, 185cm overall {Flight, April 9, 1970). The satellite has an orbital mass of 2851b, 129kg and is being positioned over the Atlantic to serve as a back-up to Nato-1. Originally scheduled for launch on January 27, it was delayed for a week by a fault in the Delta second stage.