the nearby Patrick AFB, while Collins spent an hour doing aerobatics in a Northrop T.38 with astronaut chief Donald Slayton, so as to acclimatise to the high-g forces experienced during launch. "I tried to make Mr Slayton sick, and he tried to make me sick, and neither of us could," was Collins' comment after landing. Aldrin, on the ground, was reviewing launch preparations.
NASA was clearly concerned about the widespread com-placency attending the flight. A warning was sounded by Dr Wernher Von Braun, Director of the Marshall Space Flight Centre, on July 10, that there was a very real risk of failure, and that he thought that the American public were not sufficiently alive to the possibility of a shock; the resounding success of previous Apollo flights, he said, had instilled a sense of over-confidence in many people outside the space programme. Dr Thomas O. Paine, NASA Administrator, had also cautioned: "We should never forget that these are inherently risky missions . . . men are going into an area where no man has ever been before ... it is quite possible that we shall not be successful on our first landing attempt."

Final countdown

The final countdown went very smoothly. By the time of the first, 16hr, "hold" at 0100BST on July 13, there were no problems, and the programme was actually ahead of schedule. Saturday, July 12, was the last full day of work for the astronauts. Armstrong and Aldrin rehearsed the landing procedure, while Collins practised his solo-flying techniques. Sunday was a day off but the chances of finding a secluded piece of beach along the crowded Florida shore were, predict-ably, zero, and they relaxed at the crew quarters. Meanwhile the area around the Cape continued to fill up with tourists; all hotels and motels were filled, and the overspill was accommodating itself, as best it might, in private houses. On Monday, July 14, the astronauts were given a "clear" for the launch. Meanwhile work went ahead on the busiest stage of the countdown, with the installation of launch-vehicle batteries and destruct devices and the loading of fuel into the three stages. The Tuesday was restful for the astronauts, and there were no hardware snags. On the Wednesday the crew was awakened at 0415 local time and, after a brief medical examination, sat down to the traditional astronaut breakfast of steak, eggs, coffee and orange juice. They were then driven the seven miles to Pad A and, by mid-day, were installed in the command module.

All roads to the coast had long since been choked with sightseers and their cars; commercial America was making a bomb with Moonburgers, and Mooncheese was ready to be unleashed on the public as soon as the astronauts splashed down.

All continued go. The minutes ticked away. The thin cloud layer, which had caused some slight concern, was breaking up. The wind was between 5kt-10kt, well inside the limits. At T— 15min the spacecraft went on internal power. Among the watching VIPs were ex-President Johnson and Vice-President Agnew and—a link with the past—75-year-old Dr Hermann Oberth, one of the earliest protagonists of spaceflight. President Nixon watched on TV at Washington. At T—3min lOsee the automatic firing sequence was initiated. The ignition sequence, starting at T—8.9sec, was followed by "the all engines running" signal at T—2sec.

At 0932 local time and 1432BST, Apollo 11 lifted from
the launch pad with impressive noise and deliberation. The first manned-landing flight to the Moon had begun. A 600ft pencil of flame denoted over 3,000 tons of thrust at work. Soon the rocket had penetrated the thin cloud layer. As alti-tude increased, the flame pattern broadened into the classical, beautiful fan shape.

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The S-IC was staged 2min 41.6sec from lift-off, when the vehicle was 50.2 miles downrange, at an altitude of 219,984ft. The velocity was 9,065ft/sec. The S-II stage then took over and continued to thrust the spacecraft towards Earth orbit. Second-stage separation took place 9min 12sec after lift-off at a range of 888 miles, a height of 609,980ft, and a speed of 22,757ft/sec, just under orbital velocity. The S-IVB was fired for 2min 25sec, beginning at T+9min 15sec. At T+llmin 50sec, Apollo 11 was in a 105.4X 103.6-mile Earth orbit. The spacecraft circled the Earth for 1| orbits while the crew made checks in preparation for the next event. During the first orbit a brief TV transmission was received, but was cut after 60sec. Houston came up with the message: "You are go for TLI," and at T+2hr 44min 15sec the S-IVB was ignited for its second, 5min 48sec, burn to place the space-craft in trans-lunar orbit at 35,538ft/sec. Apollo 11 was on its way. Thirty-six minutes after the TLI burn, the command module (named Columbia), and service module were separated from the S-IVB and lunar module assembly (now known as Eagle) for the transposition and docking manoeuvre. This took place to the accompaniment of complete silence from the crew; these Moon-landers were not, seemingly, loquacious The last main event of the launch day was the S-IVB separation, at 2211BST, and the insertion of the third stage into orbit around the Sun to get it out of the way.

A brief resume of the first day's flight showed only two less-than-nominal performances: the on-board computer was 724msec late in scheduling the lift-off, and Aldrin used slightly more fuel than had been predicted in the T&D manoeuvre. The general verdict: smoothest countdown yet.
The rest of the journey to the Moon was quiet and unevent-ful. A 3sec mid-course correction (21ft/sec) was made on Thursday. Earlier that day the first long TV transmission was made, showing the Earth (all the TV transmissions, except that from the Moon's surface, were in colour). Earlier difficulties with the TV were pinned down to the incorrect use of a ground-station aerial.
The important event of Friday, July 18, was the checkout of the LM. Armstrong and Aldrin donned their bulky space-suits and climbed through the narrow docking tunnel into the lunar module for this exercise and, while they were there, made one of the best TV transmissions yet seen. A mid-course correction (MCC3) was deleted.
Saturday, July 19, was LOI (lunar-orbit insertion) day. George Hage, Deputy Director of Apollo, who had earlier that day held a meeting with Apollo sub-contractors, reported that the technical state of the spacecraft was better than that of any previous flight. The astronauts continued in peak health. So accurate was the flight path that MCC4 was deleted.

Behind the Moon

At 1813BST Apollo 11 disappeared behind the Moon. Would the critical lunar-orbit insertion burn be made? Thirty-four minutes later a burst of computer data from the spacecraft picked up at the Madrid tracking station, proclaimed that it had, and that the spacecraft was in elliptical (60 n.m. by 170 n.m.) orbit around the Moon. The first comment from this rather laconic crew came from Aldrin, who remarked that they were working on their antenna orientation to improve the noticeably poor telemetry reception on Earth.
A second burn of the service propulsion engine put the spacecraft into a 54 n.m. by 65 n.m. orbit. It was calculated that, by the time came for the LM to rendezvous with the CSM later in the flight, this orbit would have changed (by the action of lunar perturbation) into the required 60 n.m. circular path. Quite the finest of all TV pictures of the lunar surface were transmitted before the second SPS burn; thes showed very clearly, from about 80 n.m., the chosen landing area, Site 2 in the Sea of Tranquillity, with the crater Moltke and the prominent rille known as US Highway One.
After another long sleep by the astronauts—no insomnia with this crew—and Sunday was well advanced. Armstrong and Aldrin entered the LM at 1520BST for a final check, and, at 1605BST, Mission Control gave the go-ahead for undocking. The crucial part of the flight was at hand.

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