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LOST IN SPACE

Washingtonian Rick Hauck Led the Dramatic Rescue of Two Satellites. "I Didn't Fool Around," He Said. "I Didn't Smoke in the Dynamite Room."

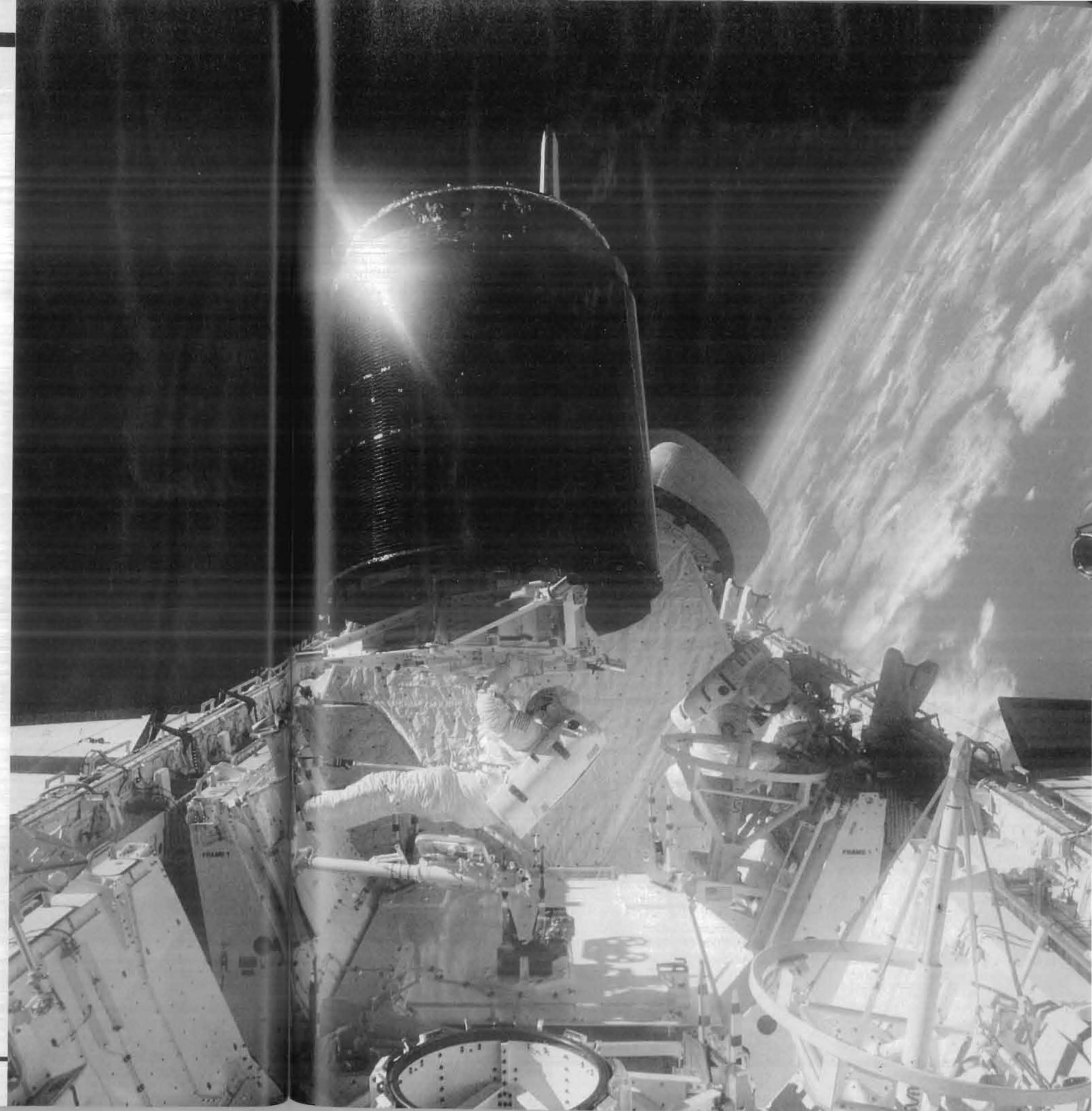
By James Reston Jr.

In June 1983, when Frederick Hauck was named the commander of the NASA shuttle project designated as 51-A, it appeared that he would be running an ordinary, garden-variety space mission. Inevitably, the manifest changed in the first months of training, as all astronauts have come to expect, and the commander tried his best to assign his crew of five to tasks that would survive the vagaries of the "customers." Hauck designed a training syllabus, and toward the end of 1983, the cargo looked as if it would be two communications satellites and a hodgepodge of small scientific experiments, nothing very exciting in this new age of routine space flight.

To be sure, there was excitement and personal satisfaction in being selected to command a shuttle mission. Hauck was the first astronaut of a new breed. For nine years, extending back to the early days of the Apollo moon project, NASA had chosen no new astronauts. Then in 1978 a new crowd arrived on the campus of the Johnson Space Center in Houston. Out of 8,000 qualified applicants, Rick Hauck, test pilot and Vietnam combat flyer, was one of 25 winners.

Hauck, a captain in the Navy, came from a strong military tradition. His father was a Navy captain who had been on the USS *Utah* when the Japanese attacked Pearl Harbor in 1941. Though he moved around a lot as a child, Ordway Street in the District's Cleveland Park section was always considered home. After attending John Eaton School, Hauck went to Wilson High School for a year and then transferred to St. Albans School for his last two years of high school. He then went on to Tufts University, where he majored in physics on a Navy ROTC scholarship. He had always expected to be a Navy aviator; his uncle, Admiral Hamilton O. Hauck, had been an early pioneer in the country's guided-missile program. After Vietnam, where he flew 114 combat missions from the USS *Coral Sea*, Rick Hauck became a test pilot at

James Reston Jr. grew up in Washington, graduating from St. Albans School, and after ten years of living in North Carolina, where he taught creative writing, and New York, he has returned to live here. His most recent book, *Sherman's March and Vietnam*, about the Vietnam war's parallels to the Civil War, is being published by Macmillan this month. His other books include *Our Father Who Art in Hell: The Life and Death of Jim Jones*, *The Amnesty of John David Herndon*, *Perfectly Clear: Whittier to Watergate*, *The Innocence of Joan Little: A Southern Mystery*, and two novels, *To Defend, To Destroy* and *The Knock at Midnight*.



As the space shuttle *Discovery* orbits the earth, astronaut Dale Gardner pulls an errant communications satellite into the spacecraft's cargo bay. The November mission recovered two satellites—worth at least $180 million—that had gone into the wrong orbit earlier in 1984. Astronaut Joe Allen can be seen to the right of Gardner, helping to complete the retrieval.

NASA

Patuxent, Maryland, where he first became interested in the astronaut program.

Of the 25 astronauts selected for the new class in 1978, ten were pilots; the other fifteen were scientists and engineers who were to become the "mission specialists" in the back of the spaceship. Of the military men in the class, Hauck was senior in rank, although not in age, and he quickly became a leader of the class. Top assignments fell his way one after another: ground communicator to the spaceship on the first and second shuttle missions in 1981, the first copilot of the new class (on the seventh shuttle mission in 1983), and now the first commander on this, the fourteenth flight of the shuttle. He was the consummate figure of the space program's shuttle era, low-key, thoroughly professional, and largely faceless in the post-heroic age.

Then came February 1984, a month that those in the space program will not forget for a long time. To the astonishment of everyone, two nearly identical communications satellites, with a combined value of $180 million, spun perfectly and magnificently out of the shuttle's cargo bay, only to fizzle into totally worthless orbits 600 miles above the earth. For a satellite to work, it must ascend from a low-earth orbit of about 180 miles to a geosynchronous orbit at 22,300 miles above the earth. There it becomes stationary above its appropriate area of the earth. To boost the satellite to geosynchronous orbit is the function of its internal motor, called a perigee motor, and in the hours and days after the February disaster, it was established that the satellite perigee motor, built by the McDonnell Douglas Corporation, had blown up.

The February failures were a catastrophe. While the fault lay with the McDonnell Douglas Corporation—the astronauts and their Houston managers had performed perfectly—NASA knew that the public made no distinctions between contractors and the space agency. It was all "the space program," and this was a terrible space mission. And the disaster came at a time when NASA was under intensifying pressure from Ariane, the rockets of the new European Space Agency, which was launching satellites, often less expensively, from its pads in French Guiana. If the Americans could not be counted on, there was now an alternative.

In the days after the disaster, the technical people at NASA, McDonnell Douglas, and Hughes Aircraft Company (the manufacturer of the satellites themselves) wanted to know whether this was a random failure or a fatal flaw in the product line. So, too, did the owners of the two errant satellites, Western Union and the Indonesian government.

But there was another major player in the game: the insurers, most of whom were housed in the mysterious precincts of Lloyd's of London. To the insurers went the unpleasant duty of paying for the disaster, and because the figures were so high, the whole enterprise of space

FREDERICK HAMILTON HAUCK
Born: April 11, 1941, Long Beach, California
Entered St. Albans: Form V
Activities: Football, V, VI; Wrestling, V; Baseball, V, VI
Awards: StA-3, StA, Football, V, VI; StA-2, Wrestling, V; StA-3, Baseball, V
Special Interests: Tape recording, automechanics, photography, electronics
College: Tufts

Rich Hauck's entry in the St. Albans School yearbook of 1958, the year he graduated.

insurance was threatened. Nor was 1984 finished with its disasters. To the February mishaps were added another failure, in June, of another satellite from an unmanned NASA rocket (cost to the insurers: $65 million) and an on-orbit failure of an RCA satellite (another $35 million). The year 1984 was shaping up as one when insurance rates might rise to a level making the cost of satellite deployment prohibitive. The whole concept of space commercialization—which held out the hope that by 1990 the space program might pay for itself—was in doubt.

In February, the instinct was to control the brush fire. For NASA, it was substantially a public-relations problem, upon which the matter of "customer confidence" depended. The agency needed a spectacular success on the heels of the spectacular failure to re-establish its preeminence in space. For the insurers, it was a question of whether their losses might somehow be mitigated. McDonnell Douglas worried about how to restore confidence in its satellite motors and how to avoid three to five years of litigation. Indonesia desperately needed a replacement satellite as soon as possible, and Western Union wanted its lost equipment and lost profits covered. For Hughes Aircraft, it was a question of how its immensely profitable satellites were to be delivered into orbit reliably.

Almost immediately, the major players focused on whether the satellites could be retrieved. Were they worth retrieving? How was it to be done? Could all the parties sort out the legal and economic entanglements and cooperate in making a retrieval attempt possible?

The technical questions came first. Hughes certified that, apart from the perigee motor, the satellites were in perfect shape—merely in the wrong place. Thus, the hardware was worth having back, like a Rolls-Royce stashed away in a dusty garage down on the farm. The satellites' apogee motors, the motors that made the final adjustments in geosynchronous orbit, might be used to lower the satellites steadily and delicately to a 200-mile orbit, where the shuttle could reach it. (The shuttle is capable of only low-earth orbit, about 300 nautical miles.) If the satellites could be lowered to that level, NASA was certain it could rendezvous with them. (In May 1984 it proved that capability by rendezvousing with another crippled satellite, called Solar Max, which was repaired in space and redeployed.)

But how could the satellites be snared? They were not designed for recovery and offered nothing to grab on to without damaging precious skin and innards.

A final question remained: When might the retrieval adventure be fitted into the crowded schedule of upcoming launches? The answer was the 51-A mission commanded by Rick Hauck.

To the engineers at NASA and Hughes, the retrieval was a prospect that sent them into a kind of scientific ecstasy. This was what space adventure was supposed to be: the reaching for new demonstrations of technical genius, American ingenuity at its best. They salivated at the prospect of taking it on.

For NASA, the technical challenge merged with economic and political necessity. For several years, as the competition with Ariane intensified for the satellite-launching business, the American space agency had argued to its satellite customers that manned shuttle missions, in contrast to the unmanned Ariane shots, offered a critical advantage. If a satellite failed in low-earth orbit, it was not a total failure, for the equipment might be recovered or repaired by shuttle astronauts. Here was the opportunity to demonstrate that capability.

From the political standpoint, voices in Congress had begun to question the very matrix of the whole space enterprise: humans in space. Why have them there at all? Couldn't robots, controlled from Houston, do all the same things without the human risk?

By early spring, the in-house studies were in. Retrieval could be done. Let's go for it!

On March 22, Commander Hauck attended his first meeting in Houston that identified his as the retrieval mission and instructed him to begin the planning. He assigned his crewman—Dale Gardner, with whom he had flown F-14s at Patuxent, Maryland, in pre-NASA days—to the crew's liaison with industry on the design of the grappling hardware. They had six and a half months to settle on a concept, design the hardware, and train the crew. (Normally, shuttle missions take up to three years in the planning stage.) But Hauck and his crew knew they could do it. It was in the spirit of the place.

Not so fast. NASA had no right to recover anything. Spacewreck is controlled by terrestrial law, just as shipwreck is.

Hughes had no right to send the first electrical impulse to the crippled satellites to change their worthless position by a single degree. The satellites did not belong to NASA or Hughes. It was a question of property. The owners were Western Union and the Indonesian government, and they had the first call. Together, the owners were out of pocket $180 million, and they wanted immediate redress.

It quickly became apparent that the technical questions of retrieval might be the easy ones. More difficult would be to bring the six commercial parties together. Corporate and legal questions of complexity and consequence had to be carefully analyzed, for tens of millions, if not hundreds of millions, of dollars were at stake. Time was short.

NASA

In his earlier astronaut training, shuttle commander Rick Hauck got used to the zero gravity of space during a patterned parabolic curve flown by a KC-135 aircraft. Hauck's class of astronauts was the first in eight years, and the older astronauts referred to them as "the frigging new guys"—hence the TFNG on Hauck's T-shirt.

Recovery was arguably not in the interest of everyone. Hughes Aircraft, for example, was in the business of selling new satellites at more than $40 million each. What if two "used" satellites suddenly appeared on their lot? A "flight-tested" satellite good as new for half the price? Was this analogous to a used-car dealership? While the engineers at Hughes could scarcely contain themselves, the lords of the ledger sheet were not so exuberant.

Western Union, in turn, evinced no interest in recovery from the start. Its satellite, Westar VI, had been the first to deploy and fizzle, and so its loss was a straightforward proposition of being reimbursed. Westar VI was to be one of the five satellite systems for continuous video and voice communications for the United States, and the company had insured its potential earnings of $40 million as well as the equipment itself.

Indonesia was more vulnerable. Its satellite, Palapa B-2, was to be a backup for its primary television and communications network. As a developing nation, whose archipelago of nearly 14,000 islands stretched over 3,000 miles of the Indian Ocean, it had made satellite communications central to its hopes for modernization. The country swelled with pride in its status in the space age, for it had been the third country in the world, after the United States and Canada, to have a satellite-communications system. The very name Palapa connoted integration and unity. But Palapa, with the identical motor that had failed on Westar three days before, was launched over the considerable doubts of the NASA engineers. Indeed, NASA had told the Indonesian experts in Mission Control that had the satellite been NASA's property, it would not have been launched until it was clear why the motor on Westar had failed. Indonesia, therefore, found itself susceptible to the argument, which it might well have to counter in an American court of law, that it should not have launched its satellite in the first place.

Now Indonesia's priorities were twofold. It needed another satellite launched as soon as possible, and it wanted to be paid off. It could not afford many months of dilatory negotiations over this interesting, but untried, proposal for retrieval—negotiations that might very probably collapse—for it would mean many months before its primary communications would have a back-up.

The insurance world was far from a homogeneous party in this drama. Rather, the underwriters were a collection of insurance companies, spread all over the world, with layers of primary insurers and reinsurers and excess insurers, all of whom had been brought together into an insurance "treaty" that guaranteed a successful deployment. Even within Lloyd's of London, the most powerful of the insurers, there was no central authority.

Lloyd's is a group of syndicates, rather than a single entity, with many individuals making up each syndicate. By the time retrieval negotiations became serious, the space-insurance world had sustained a total loss of $283 million in one year. It would not lightly assume the additional cost of at least $10 million that the recovery effort required.

After the February failure, Stephen Merrett became the key player for the insurance world. He is the chairman of Merrett Syndicates Ltd., perhaps the largest syndicate within Lloyd's in-

volved in space risks. Even though scores of companies had underwritten the two satellites, Merrett held the "salvage rights" exclusively for Westar and 72 percent for Palapa. From the beginning, he was recognized by NASA and Hughes as the man to deal with on insurance. Even though Merrett had been involved with space insurance for some years, Palapa and Westar were his first losses, and he was determined in his effort both to be fair and to mitigate his large loss. If the mitigation could be done in a way that did not harm the American space effort, so much the better.

But Lloyd's is built on a tradition going back 300 years, and this had both advantages and disadvantages. One advantage lay in the loyalty within the company. In the case of a loss, Lloyd's companies have always joined forces behind the leading underwriter. (There is no such tradition in the American insurance world.) But the traditional course in a disaster is a lawsuit, and to be innovative, Merrett would have to overcome the sentiment to take McDonnell Douglas to court, a course that ultimately might return more money to Lloyd's and the other underwriters.

Several days after the second failure, Merrett flew to Washington from London as Paul Visher, the senior vice president of Hughes Aircraft, flew in from the West Coast. From Visher, Merrett got the news that both satellites were in perfect shape, just in the wrong place, and that they could probably be lowered to a shuttle orbit, using the apogee motor. James Beggs, the administrator of NASA, assured the Englishman that recovery was probable if the satellites were in low-earth orbit. Thus, within days of the failures, the notion of retrieval was declared possible, and Merrett had his work cut out for him.

Existing insurance contracts had never imagined a salvage opportunity like this one, but salvage rights existed only if Merrett could receive title to the spacewrecks from their owners. Merrett wanted to minimize his payout and felt that the owners had a duty to join him in supporting the recovery effort. Neither Indonesia nor Western Union was in a charitable mood. They wanted their money.

Merrett proposed a revolutionary scheme, one that would become the focus of worldwide negotiation—and, in some people's minds, worldwide agony—for the next five months. It became known as the dual-track approach. Merrett's central obligation, as he saw it, was to restore the aggrieved owners to the position they had enjoyed before the disaster, and this did not necessarily mean just paying off the insurance. He argued that the two satellites were a partial, not a total, loss, given the fact that both Hughes and NASA believed recovery to be possible.

Merrett further argued that the owners, particularly Indonesia, had a *duty* to mitigate their loss by financing the recovery effort. For it is a standard clause in all insurance contracts that the owner must do what he can to minimize loss. (If a car owner stalls his car on a frozen lake, he has the duty to call a tow truck before the ice melts.)

Both Western Union and Indonesia flatly denied that they had any duty whatever to support recovery and demanded immediate full payment, with no obligation to transfer title to their spacecraft. Western Union's claim was more solid, and it was paid its full $105 million. But Indonesia had launched a disaster despite the fair warning of NASA.

Merrett, therefore, put the following proposition to the Indonesians: We will put the entire amount of your insurance, $75 million, in an escrow account and withdraw from it the cost of retrieval. In the meantime, you contract with Hughes to begin construction of a new satellite, Palapa B-3. If recovery is successful, the satellite will be refurbished and relaunched, and you can shelve the contract for B-3. We will take over the half-constructed satellite and sell it elsewhere. If recovery is unsuccessful, the full amount of the escrow, plus retrieval costs, will be paid out, and you can apply it to the construction of your new Palapa B-3.

From Merrett's standpoint, the plan allowed Indonesia to win both ways. It supported an innovative American effort without losing any time toward the redeployment of a back-up satellite. And Merrett was winning, too, by not immediately kissing $75 million good-bye.

NASA very much wanted to attempt the recovery, so it sweetened the proposal by offering to launch the recovered and refurbished Palapa at the earliest opportunity for the 1984 price of $10 million, rather than the 1985 launch price of $18 million. The agency further promised to refund the full cost of the recovery should the operation fail.

Indonesia waffled. In Djakarta, President Soeharto at first seemed to support the dual-track approach and publicly lauded Merrett for his creative suggestion. But the plan was so experimental that anxiety rose rapidly in Djakarta. Were they being made patsies for NASA's passion for the extravaganza?

NASA officials flew to Indonesia to allay these fears. Months passed without resolution—no agreement to recover, no contract with Hughes for a new satellite, and not a dime of recovered loss in Indonesia's pocket. To the Indonesian press, government spokesmen stressed that no retrieval could be contemplated until the insurance was paid. The attitude had taken hold in Djakarta that the less risky course was to enter into a contract with Hughes for the new satellite. In April it was announced that Indonesia would sign an agreement in May for a new satellite, due for launch in March 1986, but that that did not necessarily undercut the dual-track plan.

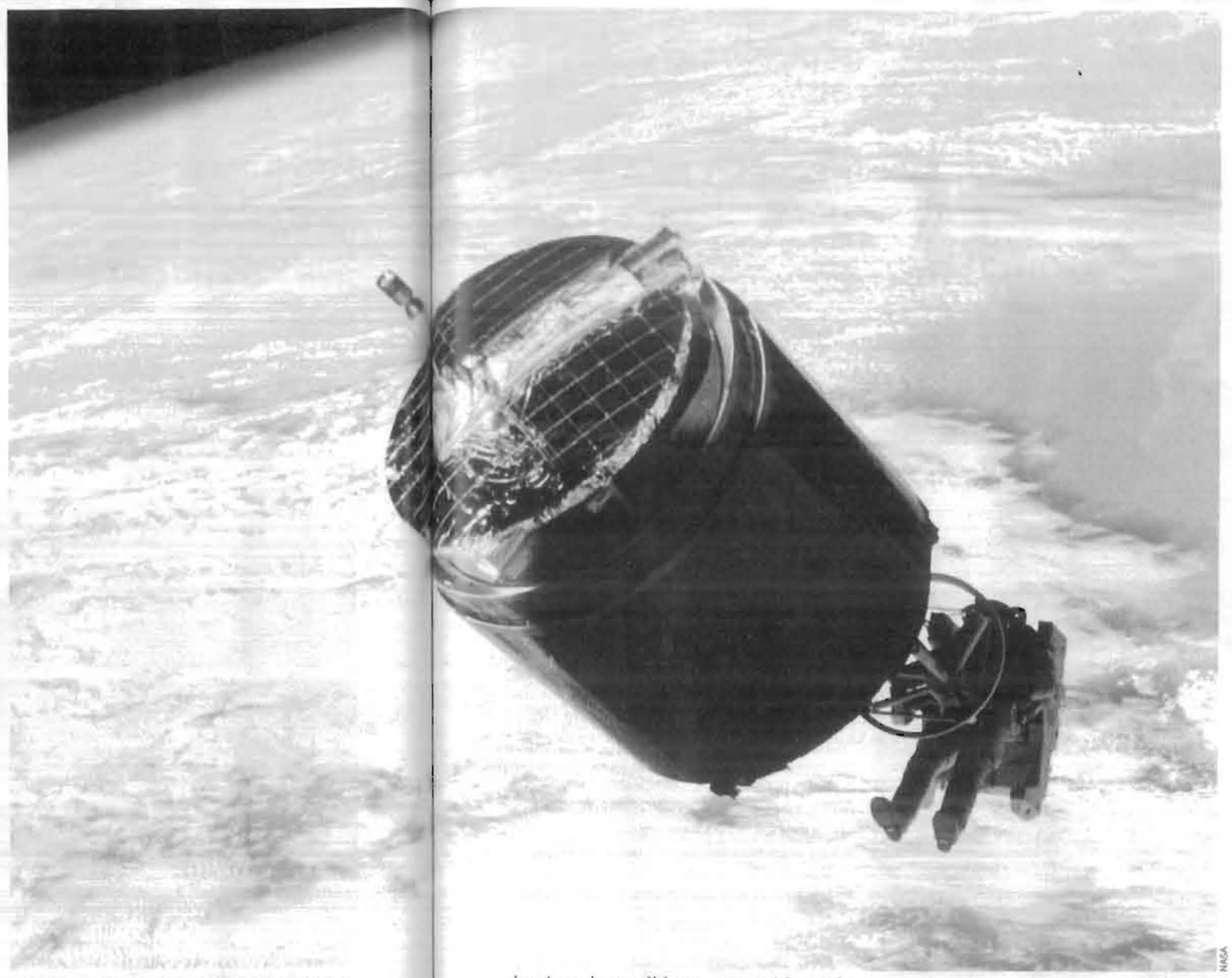
By his double-track proposal, Merrett found himself in battles on three fronts. Besides the Indonesians, he had to deal with American underwriters, who held 28 percent of Palapa's insurance. The Americans were an independent lot of more than 75 participating companies, and they were prickly about Merrett's tendency to portray himself as the sole insurance player in the game. Indeed, the Americans did not accept Merrett's claim to the recovery, for they felt that a salvage of this type had never been specifically addressed in the original policy.

The largest of the American underwriters was a Washington-based company, Intec, which held 8 percent of Palapa. Its president, James Barrett, was a pioneer in space insurance who had underwritten his first satellite in 1965. Barrett disagreed with the dual-track approach from the start.

By putting the squeeze on the Indonesians, he would profess later, the watchwords of the insurance business—good faith and fair dealing—were being violated and dual track was causing unnecessary misery for NASA, for the Indonesians, and for himself. He had come to suspect that the whole scheme was a ploy to delay paying the Indonesian claim as long as possible.

But Barrett himself was not immune to a bit of fast dealing. He had flown to Djakarta in March, only a few weeks after the disaster, and tried to wrest the title to Palapa with an offer of immediate payoff of his share. The Indonesians had politely declined, saying they could not deal with more than one underwriter, and they encouraged him to get together with Merrett. Barrett's only choice, therefore, was to get behind dual track, but he did so reluctantly, sure that it would fail. Barrett and Merrett had dealt with each other for years, but over dual track their relationship became correct and formal.

And Merrett had problems even within his own company. Merrett Syndicates was the "excess" insurer for Westar VI, and under the terms of that policy, the salvage rights went to the excess insurer. But there was also a "primary insurer" in Lloyd's named Richard Maylam, who had put $3 million into the pot and now argued that anyone who sustained a loss in the two satellites was entitled to share in the proceeds of recovery. Thus, Lloyd's syndicates were set one against the other, and in June the problem came close to shifting into a London court of law. Merrett held firm, and Maylam eventually capitulated. He said he did not wish to give the appearance of blocking the recovery effort.



NASA

Left: Astronaut Dale Gardner uses a manned maneuvering unit—also known as the Buck Rogers backpack—which enables him to move about in space via jets of air and to dock with a spinning Westar VI satellite. He soon pulled the satellite into the shuttle's cargo bay.

In Houston and in El Segundo, California, NASA and Hughes hurtled forward to solve the technical problems. There was a general feeling, perhaps spiced with naiveté, that somehow the Byzantine commercial entanglements would be straightened out.

Under Rick Hauck's direction, crew member Dale Gardner worked with the engineers on how to grapple a satellite that was not meant to be grappled. On the back of envelopes in the cafeteria at the Johnson Space Center, astronauts sketched out various devices that might do the job. Eventually, the experts settled on the "stinger" approach. The astronaut would fly out to the satellite with a pinion, ram it up the spent apogee motor, and expand the spring-loaded toggles inside. This would then arrest the slow rotation of the satellite, and the crewman would then maneuver the satellite close to the shuttle, where it could be grabbed by the remote arm.

As I began to know the crew of the 51-A mission in the summer of 1984, another crew member, the diminutive Joe Allen, known affectionately as the astronaut-philosopher, remarked to me, "Between Freud and Cervantes, we are going to be the butt of a thousand crude and tasteless jokes."

Rick Hauck and I had been schoolmates twenty years ago at St. Albans, where his claim to immortality was the wrestling mat and a strange form of prep-school boogie known as "the rooster." The rekindling of our friendship in Houston came at the time that the high-stakes negotiations over the fate of the mission were coming to a head.

His frustration over the commercial and legal entanglements was acute. The prospect of retrieval excited and challenged him. And yet he was ambivalent. "No one wants to be part of a failure," he told me, and with the prestige of NASA on the line, they had only six and a half months to prepare. "If we get one satellite, that will be spectacular; if we get

NASA

The recovered satellites actually belonged to the insurance underwriters who had paid off Western Union and Indonesia after the satellites went astray, but astronaut Dale Gardner couldn't resist showing a "For Sale" sign after pulling the satellites in. Reflected in Gardner's helmet is Joe Allen, who is standing near the shuttle's remote manipulator system.

two, that will be a miracle," became his refrain.

But they might not have the chance to get any at all. He was aware of the "poker game" that was going on at that moment among the high-priced lawyers and the captains of industry, the Indonesian ministers, and the mysterious Mr. Merrett of Lloyd's, and he worried that NASA might not be the best poker player in the game.

By June, NASA had already spent more than $3 million. Hughes had spent nearly $4 million. While Merrett continued to dispense optimism that things would be worked out, retrieval remained a matter of speculation.

But now Merrett's optimism was not quite enough for the Hughes managers. "The sincerity of the underwriters needed to be calibrated," as a Hughes executive put it to me. Hughes demanded a contract. NASA followed with its own demand: It wanted the costs of its training and hardware covered. If they were not, it would pull the plug. Merrett's representative in Washington, attorney Delbert Smith, listened to the threats and ultimatums, nodded, and ignored them.

On June 22, a delegation of sixteen Indonesians came to Washington, and at Merrett's request, NASA staged a demonstration, replete with color slides of the Solar Max repair mission in April and flowery speeches from Merrett and James Beggs. A faint hope remained that Indonesia would change its mind and participate in the recovery. The Indonesians attended out of courtesy and curiosity, but they had firmly decided to go with a new replacement satellite. To them, there were simply too many unknowns in the retrieval process, and they left the distinct impression that they were receiving advice from other quarters that cautioned that retrieval might not be as easy as NASA and Hughes were making out.

After the demonstration, Merrett and Barrett repaired to an adjoining conference room with the guests, and there, in polite but firm tones, in the stylized manner of international negotiation, the Indonesians delivered their final rejection. Dual track had collapsed.

It was time to take stock. The Indonesians agreed to transfer title to the underwriters and were paid off their full $75 million. On June 26, the countdown of the thirteenth shuttle mission halted at T minus 3.5 seconds, with an engine failure after two of the three main engines had already fired up. NASA hailed the shutdown as a backhanded triumph, having proved that the emergency shutdown worked just as the system was designed. But in the insurance world, the abort was treated as a "near miss."

Between the losses and the near misses, space insurance was getting a bad name. Lloyd's alone had paid out in a year twice what it had brought in. The insurers concluded that their premiums for such a high risk were woefully low. The next insurance treaty that was due for negotiation applied to a mission in May 1985, when the shuttle was to deploy three satellites. That was three-quarters of the shuttle's payload capacity, and obviously, the more packed the bay could be, the more cost-effective was the flight for the taxpayer. For that mission, the underwriters now demanded premiums amounting to 17 percent of the insured value, nearly triple the 1984 rate. That meant that for one shuttle launch, the amount of insurance needed approached $400 million.

With Merrett now holding title to the "former Indonesian satellite," he approached NASA in the new position of underwriter-contractor. His Washington representative, Delbert Smith, concluded a contract with NASA to retrieve. It was called a preliminary agreement, pointing toward a later official "Launch Services Agreement" once the Western Union situation was clarified, and NASA referred to it as a "pilot demonstration."

By the agreement, Merrett promised to pay NASA $4.8 million for the retrieval of one satellite and $2.75 million each if two were retrieved (assuming Merrett could get title to the Western Union property). NASA's offer was generous, for this two-satellite price made the second grappling almost a penny sale. The space agency was anxious to make the agreement sweet, and for Merrett, the economies of scale clearly lay in recovering two satellites rather than one. As one of his Lloyd's colleagues would put it, "Fishing for two is cheaper than fishing for one."

To sweeten the deal further, NASA renewed its offer to the underwriters that it had made to the Indonesians: a launch date of July 1985 for the refurbished satellite at a price $8 million cheaper than for other customers. In return, NASA now had the guarantee—or so it thought—that its costs would be covered. NASA expected $4.8 million to be paid to it by Merrett on August 31.

With title to Palapa and NASA treating him as a bona fide customer, Merrett's representative now approached Western Union. Technically, Western Union did not have to lift a finger. It had been paid, and there was no condition that it divest its title. Nevertheless, with the extra measure of cooperation that characterized all the major parties in this enterprise, Western Union handed over title, with the condition that it bear no liability should some disaster in space befall the recovery effort. This agreement was concluded on August 20.

On August 15, agreement had been reached with Hughes Aircraft to begin the slow and delicate process of lowering the orbit and slowing down the satellites' rotation from 50 revolutions per minute to three.

In Houston there was elation, for it appeared that all the systems in the world of high finance were go. Crewmen Joe Allen and Dale Gardner could practice the choreography of their grappling techniques in the water tank of the Johnson Space Center with a renewed sense of purpose. They also traveled to Denver, where at a facility of Martin Marietta (which had designed the spacewalker's jet backpack) they rehearsed the approach to the satellites with the stinger. Rick Hauck concentrated on his "hot landings," as those with an unusually heavy load are sometimes called. More important, he practiced the procedures for rendezvous and station-keeping with the two satellites in the Houston shuttle simulator.

The shuttle crew was aware that the NASA negotiators were not entirely out of the woods, and this was underscored when their Houston bosses ordered the astronauts to say nothing to the press about the retrieval techniques. The crew was told simply that negotiations had remained in a sensitive stage, and a wrong word from them about possible success—or failure—might upset things.

Hauck did not know that the main challenge he faced as an aviator could cause great anxiety among the underwriters, for the complexity of this shuttle mission was approaching that of the lunar missions of the early 1970s.

To rendezvous and keep station with the satellites as they were skewered would take 44 propulsive burns of the shuttle orbital maneuvering jets, far more than on any previous shuttle mission. This meant that the "fuel budget" was extremely tight. If any one of the burns was done incorrectly, the error would

NASA

Washington lawyer Delbert Smith represented the lead insurer, Stephen Merrett. Together they worked out the tortuous agreement that led to NASA's agreement to try to recover the two misplaced communications satellites.

"propagate" itself, requiring fuel for correction and more fuel to start the process all over again. Any pilot error would very likely negate the opportunity to get the second satellite. No wonder the refrain of the crew: *If we get one, it will be spectacular; if we get two, it will be a miracle*. For Hauck could well imagine a situation where he would run too short on fuel to go for the second. To a NASA executive, he said, "I don't want to come back with one satellite and have the world think that NASA failed."

As good businessmen, Merrett and his people were thinking ahead about the eventual sale of their satellites once they were back on earth. By its nature, a satellite is a money machine for everyone who has a piece of it. Both Palapa and Westar came from the line of Hughes satellites known as HS 376, which carry 24 transponders. Once an owner has such a satellite at its appropriate stationary orbit above the earth, he normally leases each transponder at an average cost of $10 million each. Almost overnight, the value of the "condominium" satellite becomes $240 million. The lessor of the transponder might then turn around and rent space to the likes of CBS at a hefty profit, so that the value of the equipment over its intended life span of ten years could reach as high as $400 million.

By the failure of its perigee motors in February, McDonnell Douglas was, therefore, arguably liable for a loss of up to $800 million. If Merrett had trouble lining up all the insurance enterprises in Lloyd's behind the retrieval concept, not to mention the 80-odd companies in the American market, it was because many found it hard to forgo the delights of simply suing the pants off McDonnell Douglas.

McDonnell Douglas was well aware of its liability and tried, through the spring and summer of 1984, to correct its motor flaws. It had run exhaustive tests, including a CAT scan (computerized axial tomography), on its perigee motors and had narrowed the problem to the motor nozzle. On August 30, as NASA and Hughes and McDonnell Douglas held their collective breath, a shuttle successfully launched two Hughes 376 satellites with CAT-scanned motors.

Now, as McDonnell Douglas's part of the recovery adventure, it was being asked by Merrett to provide a perigee motor at a bargain-basement price for the refurbished satellites in return for avoiding the courtroom. (As of early January, those negotiations are still under way.) More than money was involved. If space contractors started to turn on one another as adversaries rather than partners, the whole American space enterprise was threatened.

In September, final agreements were being readied on 19th Street in Washington. Before it was over, nine separate contracts had been negotiated, and Merrett had maneuvered himself into a position to offer potential buyers of his satellites quite a deal. Only two problems remained. No matter how many tens of millions of dollars he stood to gain from the eventual sale, it would amount to only a fraction of the overall losses the insurance industry had incurred. And he had to get his property back to earth.

The deadline of August 31—when NASA expected its check of $4.8 millon from its customer—approached, and every-