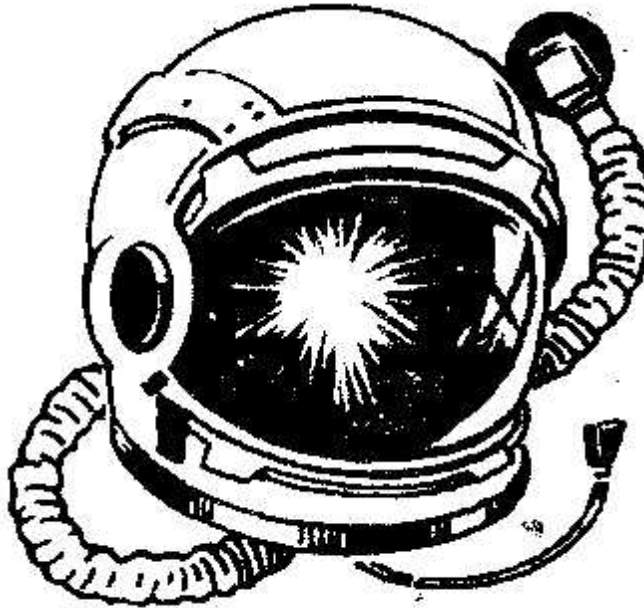


PERIOD OF TOTALITY

by Fred Saberhagen



Just recently, the author moved from his birthplace, Chicago, to New Mexico, where he and his family are enjoying the sun and scenery. His wife teaches mathematics, his children wear home-made 'Berserker' T-shirts to SF conventions, and Mr. Saberhagen has been selling science fiction since 1961.

* * * *

The old man in the spacesuit came out of the low cave mouth, squinting out across the scarred and airless surface of the world informally called Slag. The land before him was a jumble of craters and hillocks and strange structures like frozen wave-foam, some of which looked almost like examples of wind-erosion. Gray was the predominant color, in shades ranging from glaring silver to dull near-black. Kilometers away, though looking deceptively nearer in the airless distance, the silvery ovoid of an interstellar spaceship waited, balancing on its larger end. The old man's gaze was turned toward the ship, and from the same general direction a double line of wide-wheeled vehicle tracks approached the place where he was standing. The tracks wound around some of the more difficult features of the landscape, and finally vanished in the broad-mouthed cave.

The cave gaped like a small black mouth in the high, silvery scarp which, like a pedestal, held Slag's sole mountain on display. It would not have been much of a mountain anywhere else, but here it dominated all.

In his suited hands the old man gripped a broad, flat plate that might have made the seat of an uncomfortable chair. He bent down and hurriedly positioned this

plate on the powdery, crumbling soil, so that its flat side faced as squarely as possible toward the dwarfish sun, now creeping toward a prolonged noon. Behind the optical shelter of his faceplate the man's eyes were raised momentarily toward that alien sun, burning with a somehow dead-looking whiteness amid its unnamed constellations. A satellite looking somewhat broader than Earth's moon as seen from Earth showed a white scimitar of waning crescent. Without tarrying, the man turned and hurried back into the cave. **ERICH DU BOS** said the letters across his spacesuit's back.

At the start, the cave was a low overhang of rock, nearly fifty meters broad, though very shallow; inside that, its first real, sheltered chamber was only a tenth as wide, much deeper, and high enough to offer ample standing room. The cave seemed to be a series of bubble-spaces left in the mountain's base by some ancient outgassing of the planet's interior. Once inside, Du Bos edged his way around the low-slung, functional bulk of the roofless ground vehicle that took up a good part of this chamber's space, and came to stand beside his two shipmates. Clad in suit similar to his, they were silently gazing at the readout unit of the radiation counter whose pickup Du Bos had just positioned outside facing the sun. The counter was mounted in the vehicle's equipment rack.

As Du Bos watched now, Einar Amdo, ship's captain and commander of the small expedition, reached out a suited arm and switched scales on the counter. The wavering line of illuminated nines that ran across its digital panel wavered a little more, and then maintained its testimony that the intensity of the corpuscular radiation sleeting down outside was still in excess of the instrument's capacity to count at present settings. Amdo had to switch to an even less sensitive scale to get a meaningful reading, and the reading increased even as they watched. The wind that had driven the explorers to shelter was still rising.

Outside the cave, all across the eternally sun-roasted landscape of this hemisphere of Slag, the storm of solar wind raged on, a deluge of subatomic particles from the so-innocent-looking sun. Du Bos was generally accounted one of the finest astrophysicists in the galaxy—or at least in that modest portion of it that had been colonized by Earth-descended man—but this storm had taken him completely by surprise. Nothing in the decades of records of this sun's spectrum and light-curves, made from far away, or in his own observations since coming in-system here a few standard days ago, had prepared him for any such squalling solar gale as this. A few days ago, a few hours ago even, the star had presented a corona quite mild and normal for its type. Then, out of nowhere as it seemed, a blizzard of protons, a hail of neutrons, an avalanche of helium nuclei ... all without the least trace of optical flaring on the sun, flaring that by all the known rules should have come to give a necessary and sufficient warning, as dark clouds and dropping pressure warn the mariner.

Du Bos leaned forward slightly, the captain drew back a little, deferentially, and the scientist took over the counter's controls. With it he sampled the divers

types and energies of particles in the bombardment outside. He grunted and shook his head, thought things over, and tried again.

When Du Bos stood back from the counter a little later, he announced: “There are only two things about this flux of particles that I can say now, with any certainty. First, some new refinement of astrophysical theory is going to be required to explain it.

“Second, if we should have to leave this deep cave while it is still in progress—did you estimate about twenty minutes’ driving time back to the ship, captain?—well, we are not likely to survive for that length of time outside.”

“If we’re in difficulties,” said a girl’s crisp voice, through the small radio speaker inside Du Bos’s helmet, “it’s my fault. That twenty minutes, I mean.” Selina Jabal, third member of the expedition, continued: “Airless planetary surfaces are supposed to be my field.”

“And survival is supposed to be mine,” said Captain Amdo. “So I can assume the burden for whatever difficulties we have. But first let’s see just how serious they are.” He moved to begin an inspection of the reserve oxygen tanks, which were stowed aboard the vehicle.

Selina had meant that the grotesque appearance of the landscape, seen close up, should have at once suggested to her expert eye the possibility that this surface underwent periodic intense bombardment by particle radiation; and, just as important, she should have been aware that what seemed to be solid surface here, safe for their loaded vehicle, might prove as treacherous as any glacial icefield.

They had come to this system seeking an explanation for Slag’s—and its satellite’s—survival of the nova explosions that must have accompanied the reduction of this star to its present white dwarf stage. They had decided to land near the mountain, by far Slag’s most conspicuous surface feature; and they had driven toward the mountain in their groundcar for less than a kilometer before being nearly killed when crevasses opened up behind them and ahead, as surface features eaten and eroded by ages of radiation suddenly collapsed beneath the expedition’s weight.

For a short time it had seemed that they were trapped, between bottomless-looking though narrow chasms. But their vehicle, its four-wheel electric motor drive powered by counter-rotating flywheels, was stable and agile as a mule, and considerably more powerful. They had driven on to solid ground; then the only apparent trouble, which at first seemed minor, was that the shortest feasible return route to the ship, one skirting the crevasse complex, had become twenty minutes long instead of two.

Amdo had the figures now on the factor that made the situation deadly. The

captain, rather stocky, and almost perfectly bald inside his helmet, turned back and gave the bad news to the others. “Well, if this storm goes on for sixteen hours or more, we’re going to face a very serious oxygen problem in trying to wait it out. Du Bos, what are the chances are that it will last that long?”

“I can’t say,” the tall, gray astrophysicist answered instantly. “It would be sheer guesswork if I tried.”

Selina Jabal, her figure even in its suit showing a suggestion of slender grace, was bending to aim one of her suit lights toward the cave’s entrance. A small portion of the outside surface could be seen from this sheltered observation post.

“Kind of a fairy-castle structure,” she mused on radio. “Obvious, even exaggerated. I should have thought of subatomic particle bombardment as soon as I saw it.”

Captain Amdo squatted down beside her. “I suppose there’s no telling from the condition of the surface how often these storms erupt, or how long they’re likely to last.”

“I don’t see how. At least not without a major research-project.” Selina Jabal continued to stare at the surface, just at the entrance to the cave. “Look ... captain, we just drove the vehicle in here once, didn’t we? I mean, we didn’t maneuver in and out to fit the parking space or anything.”

“No . . . by God, I see what you’re looking at. You’re right.”

They were all bending down and looking now. There in the brittle, crumbly soil ran what must be the track of their vehicle’s left front roller, partially obliterated by the track of the left rear, which crossed it in a curve that showed how the tractor had been steered into this fortuitous shelter, less than a minute after the radiation alarm had sounded.

Now, just what had made those other, older, weathered-looking roller tracks that lay beneath their own?

Outside the cave, erosion that must have been wrought at least in part by repeated solar storms seemed to have destroyed any old tracks that might otherwise have existed. And inside the cave their own booted feet had already trampled almost everywhere except directly beneath the vehicle.

Amdo was down on hands and knees, already looking there. “Another vehicle was in here once,” he announced, focusing his suit lights..”More old tracks, plainer here. It had a different style of rollers from ours. In fact that looks like the kind of roller they had in use about the time . . .”

He was on his feet again abruptly, flashing his light about the cave, into niches and recesses toward which the refugees had scarcely looked as yet. “That’s not one of ours.”

He was on his feet again abruptly, flashing his light about the cave, into niches and recesses toward which the refugees had scarcely looked as yet. “That’s not one of ours.”

It was a portable oxygen tank, propped on a natural rock shelf in what would have been a prominent position if the whole chamber of the cave had been evenly lighted. In a moment they all saw that the tank was weighting down what appeared to be a folded sheet of writing plastic.

“I’d say it’s about as old as the rollers that made those tracks,” said Amdo, giving the oxygen cylinder a cursory examination as he took it down from the niche. “And empty now, of course.”

He next took down the writing plastic from the shelf, and opened its single fold. Its white surface lit up the whole chamber as the beams from three suit lamps fell on it at close range. There were a few paragraphs of handwriting, a rather unstable, wandering script.

The message, in the lingua franca of space exploration, began with a date, some forty standard years in the past, and told how the writer had been trapped in the cave, away from his ship, by an unforeseen particle storm issuing from an optically stable sun. It went on:

Part of the risk (which I have accepted) of working alone is that there’s now no one in the ship to move her to me.

No eclipse is due in the next couple of hours, so the one possible answer I have worked out won’t do me any good. If an eclipse were coming, the accompanying particle eclipse could save me. It begins in a different place, and some time ahead of the optical eclipse, but overlap of the areas shaded should be large. The white dwarf is so small that the optical period of totality is long—I would get the few minutes respite I need to reach my ship. Have been trapped in cave over 200 hours now with no letup of storm, and will just have to make a dash for it if weather is no better by the time my oxygen is down to half an hour. Have tried to rig a shield over the tractor with flooring & other gear but not much hope for it I fear. Not much hope that anyone will find this either but one tries.

Kevin Medellin

“So, that’s what happened to Medellin,” mused Amdo as he turned the sheet over in gloved fingers, started to refold it automatically, and then gave it instead to

Du Bos who had put out a hand.

The captain turned then, and caught sight of Selina Jabal's puzzled look behind her faceplate. "Maybe you've never heard of him. Medellin was an explorer and a rather crankish scientist—"

"Pseudo-scientist," put in Du Bos, with brief contempt.

"Whatever. He had some fancy theories about protostars and other things, that are quite out of favor now. Quite a controversialist, but with enough fame and authority to be allowed to go rattling around on solo exploration trips, on one of which he disappeared, no one knew where. There was quite a furor at the time, and there are still flurries of speculation on his fate." The captain spread his hands out, palms up, pulled them back. "Now we know. He was evidently in this cave, for the same reason we are, though I don't think anyone even guessed he was in this system. Once you start to take a close look at Slag, you want to see the mountain; and once you examine the mountain, there's this cave-mouth showing up like an empty eyesocket."

"We didn't see his ship," Selina mused. "But I suppose he could have taken off, even if he didn't make it—afterwards."

Amdo asked: "What's this he says about particle eclipses? Likely to do us any good?"

The astronomer was still poring over the note. "He was evidently already suffering from anoxia when he wrote this—there are several misspellings. Of course, a particle eclipse should really begin after the optical eclipse, not earlier. The, particles take longer to get here from the sun than the light does."

"But a particle eclipse should actually occur?"

"Oh, yes. I believe there's some similar effect in the SunEarth-Moon system, for example. Of course there the solar wind intensity can't be anything like this, but the principle will be the same." Du Bos pulled his calculator from its holster at his belt. "To determine when the next eclipse is due here, I'll have to go outside long enough to take a sighting or two on the satellite."

Privately, Du Bos was hopeful. The orbital plane of the moon of Slag was nearly parallel with that of the planet's orbit around its sun, so that a solar eclipse must come during nearly every revolution of the satellite. While approaching for a landing, the explorers had seen the broad spot of the shadow on the slow-rotating planet's midsection.

It was the young woman's turn now to study the note, while Du Bos selected instruments from the vehicle and went to make his observations. Amdo volunteered

to take a turn outside, and thus minimize the older man's exposure to radiation, but Du Bos brushed him off. Less than a minute should be required, he said, and he preferred to do his own observing.

He was back as promptly as promised, and the relief in his voice was evident. "We're in luck. There'll be an eclipse this conjunction, we're right in its path, And first contact is due only about two standard hours and fifteen minutes from now. Totality will come very quickly after that and should last about twelve minutes, for the optical eclipse. Then we can watch for the particle eclipse—just how long it will last is hard to estimate—and be ready to move out in the vehicle the instant the radiation falls off. For the next couple of hours I suppose we'd better get some rest and conserve our air."

Amdo's smile was broad. "Sounds like a good plan." Selina stood straighter, and some of her innate sprightliness came back. When the two men went into an inner chamber of the cave to rest, where there was reasonable room to stretch out at approximately full length, she remained in the larger room, saying she wanted to do a little work.

Alone, she first set about gathering some samples of material from the floors and walls of the cave, and taking 'photographs. Shortly she paused, to frowningly re-read Medellin's note. Then she stowed her samples and pictures neatly on the vehicle, and unrolled a new sheet of plasticized paper, used for field notes and sketches, from a container on the same rack. She affixed the paper to a handy flat spot provided on the tractor's flank, and began to draw, still frowning.

It was about half an hour later when she approached the resting men, sketch in her hand.

"Doctor Du Bos?"

His eyes opened alertly on the instant. "Yes?"

Her tone- was almost apologetic. "I've been trying to figure this out . . . look, it seems to me that maybe Medellin was right when he said that the particle eclipse comes first."

She squatted down beside the old man, holding out her diagram. It was done rather sloppily, and Amdo looking at it from Du Bos's other side could not really make out the point of it. Of course the large arc must be meant as a segment of Slag's orbit round its sun. And around the little circle that must be Slag a larger concentric circle was sketched in, holding a dot that was evidently supposed to represent the satellite in its path around the planet.

"No," said Du Bos. He started to reach for his calculator, then let it stay unneeded in its case. "Look, the light from the sun gets here in eight or nine minutes.

The particles of this dangerous radiation travel much slower than light—we're not concerned with gamma rays or x-rays here, for example . . .”

“I understand that.”

“Of course. /Well, the particles take much longer to travel the same distance ...” He went on, phrasing it a different way., then in still other words after that.

Amdo thought he would hate to have to argue with this man. Selina tried once or twice to get a word in, then in effect gave up. The expression of uncertainty with which she had approached the men stayed on her face.

“—understand?” Du Bos concluded.

She signed assent—or maybe it was only surrender—with a nod, and sealed it with a vague smile. “There’s some more work I want to do,” she said, and stood up and went back to the main cave.

Amdo and Du Bos exchanged a glance. The scientist signed that they should switch their suit radios to an alternate channel.

“I’m a little worried about the girl,” Du Bos said when they had done this. “It hit her rather hard, evidently, that she failed to keep us out of this mess we’re in by foreseeing the collapsing surface structures. Now I’d say she’s trying a little too hard to prove herself, accomplish something to make amends.”

“Maybe.” Amdo pondered. “You see any reason to believe that she’s not going to be all right?”

“Personnel psychology’s more your field than mine. I just thought I’d better pass on my impression.”

Amdo was silent for some minutes. “I’ll just take a little walk,” he said then, and got to his feet, switching his radio back to the normal channel as he did so; he noted from a corner of his eye that Du Bos, remaining at rest, switched back too.

After the captain went out, Du Bos continued to rest against the cave wall, with the equanimity of one who has lived long enough and well enough to feel himself at least partially at home in any part of the universe that man could reach and enter. He had not the least intention of dying of radiation or lack of air on this forsaken world. But such would be an acceptable end, for him, if fate should have it so.

On a sudden impulse he switched once more to the alternate channel of communications, and picked up Selina Jabal’s voice in mid-sentence: “.. . *does* come *before* the optical eclipse.”

“Look,” came Amdo’s patient reply, “you showed this to Doctor Du Bos, right?”

Du Bos switched them off. Settling this kind of difficulty was the captain’s field. In his mind as he drifted toward sleep he saw the white dwarf, isolated in a pure mathematical space; and he began to play with a subtle equation that might tell what sequence it had followed to reach this state without the total destruction of its planets. Maybe enlightenment would come to him, as to Kekule, in a dream . . . he was only vaguely aware of it when Amdo came back to sit down tiredly beside him once again.

The flywheel-powered electric motors of the tractor worked in the next thing to perfect silence and freedom from vibration, so all that woke them both from edgy sleep, coming through rock and suit to flesh and bone, was the gentle crunching of its rollers on the ground.

And, only a second or two later, Selina’s voice on radio: “The particle readings have dropped, all across the board. I’m off to get the ship.”

Both men, wide awake at once, scrambled into the main room of the cave, the captain only a step ahead. The chamber was big and empty without the vehicle. Selina had left the radiation meter behind, sitting on the ledge where Medellin had left his note. At the moment, the readings on the meter’s face were in fact very low.

Du Bos hastily checked his chronometer—first contact on the optical eclipse, according to his calculations, was not due for another hour. Then he quickly followed Amdo out of the cave, onto the glaring surface, and at once looked up to check the position of the moon in the black sky. As expected, its wide silvery crescent was still on the same side of, though now much closer to, the immobile, dazzling sun.

Amdo had taken half a dozen quick strides and then stopped, staring in frustration after the receding vehicle. Glowing orange out here in the sun’s glare, it was already much too far away for a man chasing it on foot to have any chance of catching up and grabbing on. And it was dwindling quickly, evidently moving at speed as Selina steered it on a sinuous course, keeping to the safest ground as she went the long way round to get the ship.

The captain’s voice on radio was calm, “Selina. If—when you get the ship lifted and moved over here, set her down on the white rock about -a hundred meters in front of the cave. That looks about the solidest.”

“Understand, captain,” the girl’s voice came back. “That does look like the best place. I’m sorry to do it this way, but I just couldn’t take the time to argue any more. If totality lasts only about twelve minutes for the particle eclipse too, there’s

not a second to waste. At best I'm going to get a good dose of radiation at the other end, before I reach the ship and get inside."

Du Bos had Amdo by the arm and was tugging him back toward the cave, and at the same time he was motioning for a switch to the alternate radio channel.

The captain went along; and they ducked back in together, looking up then simultaneously to see that the indicated radiation level was still quite low. On the channel that should give them privacy, Du Bos said: "I—I must leave it up to you as to whether to order that girl to come back at once; but understand that whatever has caused this apparent lull in the storm—some magnetic effect, perhaps—may change again at any moment."

"In the first place, I don't think she'd come back, if I gave the order."

Du Bos was still gripping him. "Another possibility is that the counter's pickup unit"—he nodded toward the outside—"may have failed under overload. You'd better get her back."

"And in the second place, Doctor Du Bos, I do know something about our hardware. These counters are *very* unlikely to be knocked out by a particle bombardment. In the third place, Medellin didn't have any temporary magnetic lulls in *his* storm; I'm sure he would have taken advantage of one if it had come." As if reluctantly, the captain added: "He did say that the particle eclipse should come first. He had no authority with him and he had to think the thing out for himself."

The old man stiffened. "It can't work that way, I tell you." "Doctor Du Bos, eclipses are not quite the same thing as astrophysics, are they?"

Du Bos glared at him but did not answer.

"Have you made any particular study of eclipses?"

"No, have you? Are you qualified to even begin. . . ?" The scientist choked down still angrier words.

The captain grimaced. "I never did really try to figure out the truth about when this particle eclipse should start, not even when Selina was arguing with me . . . so I'm not going to try now, not with only ten minutes or so left before ... one way or the other. But two very bright people *have* really studied this thing, knowing their lives depended on it, and have come to the opposite conclusion from your offhand opinion. If you were Joe Doakes—"

"Which they are, in this case."

"—all right, if you were Joe Doakes too, the question would still have been

very much open. But just because you were the eminent astronomer I bowed my head to you and never tried to think it out. And that I do regret. This trip so far hasn't been exactly my finest effort in space."

He glanced up abruptly at the counter, then switched to the radio channel that Selina presumably still was using. "How's it going, Jabal?"

"Good enough, captain."

"Radiation is still very low here, quite tolerable. I'll let you know at once of any change."

"Understand, captain. Thank you. Fifteen more minutes and I should be in the ship."

About two more minutes of silence passed, before Du Bos walked out into the middle of the empty-looking cave, and squatted down to sketch with a gloved finger on the crumbly floor his own version of Selina's now-vanished eclipse diagram. Amdo, watching, saw the arc of planetary orbit appear, and then the epicyclic circle of the satellite's path; crude arrow-markers seemed to show that each body was moving counterclockwise in its track, as if seen from a hypothetical observers' post somewhere high above the north pole of the planet.

After staring for a full minute at what he had drawn, Du Bos stood up and got out his calculator; Amdo got the impression that the machine was only being used this time to put into rigorous, acceptable form something already done, like typing a document after the last handwritten draft is done, the fateful content known...

The glowing digits on the counter's face were suddenly jumping again, and the captain got on the radio at once. "Selina, a sharp rise in particle radiation has just started here. Not back to previous levels yet, but if it keeps on going up like this it soon will be."

"I understand, captain. Five more minutes and I should be in the ship." She started to say more, but a torrent of radiation-produced noise was cutting communication off.

Du Bos was holstering his calculator again. He cleared his throat; it was a startling, uncharacteristic, nervous-old-uncle sound, that almost made Amdo jump.

Du Bos said: "The particles *do* take much longer than the light to get here, as I said before. But then it doesn't follow at all that the particle eclipse will lag the optical eclipse by the same amount of time. You see, the particles that will strike the planet during the optical eclipse must have passed within the satellite's orbit some minutes earlier." He scuffed with a boot at the cave floor as he might have waved his hand at a classroom display. "See? The satellite in effect plows a clear space

through the sea of particles flowing outward from the sun. This wake, cleared of particles, drifts back, lagging the satellite—”

“The way the clear space under an umbrella lags behind when you run in the rain.”

“Well, yes. And although the satellite,, from *our* point of view, looks as if it’s moving backwards, from west to east,” Du Bos said, gesturing overhead, “Slag is carrying us and the satellite along in its orbit *faster* than the satellite is looping back, so the net movement is still forward, both still clockwise with respect to the sun, and we *do* enter the wake—the particle eclipse—first.”

“You’re saying that you were wrong.”

Du Bos came over to stand beside him, watching the counter. The radiation outside was hellish. A silence began to stretch. It was an almost timeless stillness, reaching for eternity. But then the silence was riddled, dissolved, made—almost—irrelevant, by the glorious loud crunching of an egg-shaped hull bottom grinding down on rock and pumice a few tens of meters from the cave . . .

Slag was a million kilometers below, and sinking fast now beneath the push of interstellar engines. The corpuscular storm that still filled this solar system raged harmlessly beyond the layer of forces shielding the ovoid hull.

Selina lay in sickbay and Du Bos had been ministering to her. The tall, gray man was at her bedside helping her to a drink when Amdo came in, clutching a small wad of printout. “The medical boxes say you may be a sick lady for a while, Selina,” Amdo announced, waving the prognosis he had just gotten on the bridge. “But nothing worse than that.”

She smiled. And then Du Bos, who seemed to have been waiting for the proper in-person witness, smiled down at her as well, and Amdo for the first time heard from the old man something that he could construe as evidence of greatness.

“I’m sorry,” said the galaxy’s first astrophysicist. “I was most terribly wrong.”