

NEXUS JOURNAL #1

Introduction

Welcome to Nexus Journal, Ad Astra Games' periodic publication supporting the Ten Worlds setting. In this issue, we have a mix of fiction pieces, scenarios, new ships for Attack Vector: Tactical, and some of the background information that will be used to make ground combat games and RPGs in this setting. We have tactical advice for AV:T players, and draft rules for orbital mechanics on the AV:T game scale.

We expect to put out an issue each year - more often if we get lots of submissions! If you have some aspect of the Ten Worlds you'd like to see explored, bring it up on our web forums at: www.adastragames.com, or mail it to us at:

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—Ken Burnside, Editor

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Credits

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The Honey Trap

61 Cygni system

"That's a load of crap!" Thomas Achard gestured with a broad, sweeping motion, a risky maneuver in zero-gravity were it not for the foot restraints. The three of them were in the ship's lounge, though not at the usual table. A couple of guys from Supply had taken the quiet table where Thomas, Dale and Stefan met. That was the first major annoyance of the day for Thomas. Next up was Stefan's news that they weren't going to overtake the *Khalid bin-Hadel* before they reached the jump point. Their ship, ODV *Norman Schwarzkopf*, had been chasing the Medinan freighter halfway through the 61 Cygni transition zone. The third piece of bad news was this rumor of Stefan's that their home base at AD Leonis was no longer serving alcohol.

"No, I'm serious. Lonely Leo is a dry port now." Stefan replied, rubbing at a small cut on his hand. Leave it to Stefan to remind everyone why AD Leo was such a lousy duty station. No wives, no girlfriends, no dependents—no room.

"Where did you hear that?" Dale asked, tapping away with a stylus at the document reader he constantly carried with him. Dale was always reading when he wasn't working, either the ship's tech manuals or his courses on introductory German. Even back when they met, doing temporary duty in the galley after first being assigned to the ship, Dale always had that reader, absorbed in it the way Sawasky was over his dirty magazines.

"Wagner, off the *Hornet*, while we were in V1054. Some asshole got blitzed on five weeks' worth of beer rations and opened one of the airlocks that was tagged out for maintenance. Vented three sections before they got it locked down."

"That's total crap." Thomas replied. "Airlocks have safeties. You can't do that without setting off six kinds of alarm. I should know." He folded his arms

and cocked his head upward. Stefan was a bridge monkey, worked sensors, and knew nothing about how airlocks worked. Thomas was determined to set him straight.

"Don't give me that look," Stefan told him, waving in their general direction, "I may not be in damage control, but I know what I'm talking about. The airlock was tagged out."

"So?" Thomas shrugged. What did that matter? Maintenance would have physically secured the door. This was why he hated arguing with Stefan—Stefan always thought he knew everything.

"So, the alarms didn't go off." Stefan said pointedly.

"Look," Thomas replied, "it just doesn't work that way. Even when the lock is red-tagged, it won't open." Why couldn't Stefan just stick to what he actually knew about?

Dale looked up from the manual he was thumbing through. "It will if the deadbar is busted."

Thomas stopped. "It—what?" He stomped on his annoyance. Dale liked to meddle in everyone's affairs, but he knew ship's systems inside and out. Hell, Dale's entire family practically founded the ODF Space Arm.

Dale gave Thomas a condescending look. "The deadbar. The physical interlock for the doors. If the deadbar is busted and the door has power, you can open it without any safeties. It's pretty rare, though." Dale put the reader down on the table. "Usually whenever a deadbar breaks, they get someone out to fix it right away and secure the airtight doors at the section boundaries. Someone in maintenance screwed up."

"See." Stefan beamed, gesturing towards Dale. Thomas rolled his eyes, this time Stefan noticed. "You don't have to be that way about it."

"You need to be more thorough, Thomas. You do good work, but you miss the small things." Dale said. "The small things can kill you."

"Whatever." Thomas replied. "Let's just talk about something else."

"Ok." Dale turned to Stefan. "So, you talked to Wagner, eh? How's he doing?"

"Same as always," Stefan replied, "getting into trouble. He and two guys from his division painted their chief blue."

Dale busted out laughing. "That's great! How'd they manage that one?" A couple of guys at one of the other tables looked over at Dale, then returned to their conversation.

"Oh, their chief was always a heavy sleeper. They painted his face and hands blue and the chief never woke up. Next morning, he shows up at muster, and he's furious." Stefan told them.

"That's fantastic! That's better than anything we pulled here on the ship."

"Yeah, well *Hornet's* skipper didn't think so, but they couldn't prove Wagner did it, so he managed to avoid going to mast. He's got balls, I'd love to try something like that." Stefan glanced over in the direction of the Chief's Mess and leaned towards Dale. "You think Chief Weller sleeps soundly enough?"

"Probably not." Thomas replied.

"That's great." Dale had finally got his laughing under control.

"Not as good as when Wagner poured that degreaser into the ship's laundry." Stefan told him.

"That wasn't funny." Thomas complained.

"Oh, yes it was," Dale said, "it was great, everyone's uniforms were orange for a week."

by Matthew P. Picio

Stefan was laughing a bit now. "Yeah, and Captain Görlitz just put his work uniform on and showed up on the bridge like it was nothing. No one wanted to say anything to him about it, not even the Prime. By the next watch, the whole watch section was wearing the orange uniforms"

"Yeah," Dale replied, "the Old Man has got a great sense of humor."

"Good thing, too, since they caught you with the evidence," Stefan said pointedly.

"Well, I couldn't give Wagner up, he was on thin ice with the skipper already." Dale replied. "Sometimes you've just got to take one for the team."

"It took seven washes to get out that color."

"Lighten up, Thomas," Dale replied, "it's not like it hurt anybody."

"Yeah, alright." Dale said. He looked over at Stefan. "How's things going with your wife? Hear anything in the last mail call?"

"Amy's not doing too well. Her family is having serious money trouble, and she's been trying to help them out. She barely has enough for herself and the baby, even with my space pay."

"Yeah, I noticed you didn't drink much on Pacifica," Thomas replied.

"I couldn't," Stefan said, "I didn't have any money. Amy says the job market back home has dried up completely, so she's not able to work, and it means I'm probably going to have to re-up, assuming we get a choice with the war and all."

They talked for a few more minutes, then broke off for their individual duty stations. Thomas thought it was odd that they'd stayed in touch over the last three Olympian years, since their duty stations were on opposite ends of the ship. Most of the other guys who'd worked temporary duty never talked to each other afterwards. Even the three of them rarely spoke with anyone else they had temp'd with. They didn't see any of those guys anymore. Stefan still talked to Wagner, since they both worked in the same department on their respective ships.

Wagner had been transferred over to ODV *Hornet* more than an O-year ago, but the legacy of practical jokes remained, through Dale and two other guys from the old crowd. Once or twice every deployment, when morale started getting low, one of the three would do something crazy. Thomas rarely saw anything funny in the jokes. It wasn't that he had no sense of humor, it was just—you didn't do that kind of thing, people could get hurt. People like Edward.

Better not go there, he thought. Thinking about Edward was dangerous. His little brother had been dead for seven years now, and Thomas had paid the price. Better to think about work. Everyone should be at Repair One by now, they had to check and prep all the division gear before transit, in case any surprises waited for them in HR 8832.

Thomas checked his forward motion at the main repair locker and pulled himself through the hatch. Everyone was there except SPO Helfen, the senior petty officer for the division. The space was crowded, seven people crammed into what would be a large compartment, if not for all the oxygen tanks, patch supplies, emergency cables and battle lanterns, and assorted other equipment. The main repair locker was one of four in the ship, and the largest of them. This was the division office and the home of Repair One, the main repair team.

Thomas was part of Repair Three, the forward repair locker.

DC division, damage control, was part of the engineering department. They had a Division Officer, a Chief, an SPO, two JPOs and six Able Spacers. Most of them were dual-duty, working their normal hours in other departments; Deck, Operations—hell, Fischer was from Admin when he wasn't maintaining the damage plot in DC Central. Thomas was the lead PO for his DC team, so he divided his time between the two repair lockers.

He nodded to Probst, the other JPO in the division. Sawasky, the king of dirty magazines, was lounging against the bulkhead half-asleep, one arm crooked around a stanchion to keep from floating into the center of the compartment.

"Hey, Sawasky," Thomas said, prodding him awake, "grab the inventory list and start checking the gear in rack three." Sawasky grunted a form of acknowledgement and started moving. Probst had started trying to wrestle an HRU-4 Spider into its cradle on the port bulkhead. Schreiber and Wuhrer, the Wonder Twins, were watching him and trying not to laugh out loud. Both of them had hair dyed bright blue, one of the latest fads planetside on Olympia. So far, the ODFSA hadn't cracked down on it, maybe because it made it harder for people to hide during field days, when



all hands cleaned the ship from bow to stern.

Making his way around a rack full of hull patch kits and flexible conduit, Thomas found McMillan and Mitchell playing cards. "Come on, guys," Thomas said, "we're going into jump in less than four hours, and have to be ready for action. You know we're supposed to be inventorying the gear and you two are back here slacking off while your JPO is the only guy working."

"We were just getting the stuff together, Petty Officer Achard."

"Yeah, right, Mitchell. Look, I know you're a short-timer, what've you got, two more months?"

"Fifty-eight days," Mitchell replied.

Thomas didn't think they were going to let him go with the war going on, but he wasn't going to tell Mitchell that. "Mitchell," he said, "your work is getting pretty unsat, to begin with. I know you're ready to go home, but we've got a job to do. For crying out loud, if you're not going to do any actual work, at least look busy." He knew it was a mistake as soon as he said it. The SPO and Chief Saint were on his case to motivate Mitchell, and he'd just basically given Mitchell permission to just jerk around as long as he looked like he was doing something.

"I signed off on it all, yeah," McMillan replied.

The men were mostly joking around, taunting each other while cleaning and servicing the tools in the locker. Thomas squeezed himself some coffee from the brewer, and made his way over to the computer in the corner of the compartment. He floated across the compartment, dodging Probst's elbows as he continued to wrestle with the Spider. Whoever had designed the thing hadn't engineered the latches for zero-G, so storing it after maintenance was like punching a trampoline. Thomas remembered his first time working in Repair One. SPO Hawkins had assigned him to service the Spider and stow it. Servicing involved lubricating all the moving parts and checking it for wear, a grand total of five minutes' work. Stowing it took the better part of half an hour while he tried to figure out how to get it in there. It wasn't until later that he discovered the trick—you had to twist the unit while locking it into the rack, and that motion required you to brace yourself against the frame just so. He hadn't taught Probst that trick, though, and Probst hadn't learned it on his own yet. Hell if Thomas was going to help him after what Probst had said about his sister. That's the last time I pull out her picture in front of the guys, Thomas

team. Set Condition Two throughout the ship. This is not a drill. I say again, fire, fire, fire. Fire in the forward berthing..." the voice echoed through the corridors with a hollow metallic sound, and everyone in the compartment took immediate notice. Sawasky, Wuhrer, Mitchell, and Probst started grabbing their gear out of their lockers, and McMillan and Schreiber quickly grabbed air masks and headed out into the passageway, heading forward.

Thomas grabbed his mask and checked the battery charge on his comm set. Only half-charged. "Probst, this battery's half-dead, quit gundecking and check this crap before you sign off on it!" He double-checked his air canister—that was done right, fully charged. Thomas pushed himself off into the corridor, using handholds to whip around corners. He was headed upship a lot faster than safety dictated, but damn it, there was a fire in the ship. "DCC, Repair Three. What's the status of the fire?"

"DCC. Wait one, Repair Three." It sounded like SPO Helfen on the line. Where was Fischer? Having the SPO on the DC plot was overkill; Fischer was the non-rate who was assigned to DC Central with Lieutenant MacAllister.

Thomas dodged a couple crewmen while shouting "Make a hole!", and was

"Thomas didn't think they were going to let him go with the war going on, but he wasn't going to tell Mitchell that."

Thomas turned his attention to McMillan. "McMillan, are all the PRGs inspected?" The pressure regulatory garments were their protective suits.

"Yeah, I finished them an hour ago, and stocked the spare canisters in the rack."

"Did you do all the paperwork?" McMillan was totally gung-ho while working, but not so concerned about documenting what he did.

thought. Thomas watched him fumble around with the Spider while taking a sip of lukewarm coffee from the squeeze bulb. Jeez, you'd think he would have stowed one before at some point while a non-rate. Thomas turned and started on the long list of pending checklists. Ninety minutes later, he was checking the department email when the alarm came over the ship's speakers.

"Fire, fire, fire! Fire on Deck Two, forward berthing. Away the fire response

rewarded by clipping a pipe clamp with his shoulder. He rubbed at it as he continued his crazy trajectory through the passageway. Luckily this wasn't a *Wasp* class, or he'd be hitting a lot more fixtures in the *Wasp's* narrower corridors. The fixtures were padded, but padding just kept you from slicing something open, or killing yourself. Hit it hard enough, and you'd get bruised just the same.

"Repair Three, DCC. Chief Saint is leading the fire party, they report the fire is still being contained. Is that you, Achard? Muster your men on Deck Three and stand by. They're securing the perimeter, if the fire spreads they're going to vent the deck."

"Roger that," Thomas replied, "muster on Deck Three and stand by for Chief Saint. This is JPO Achard."

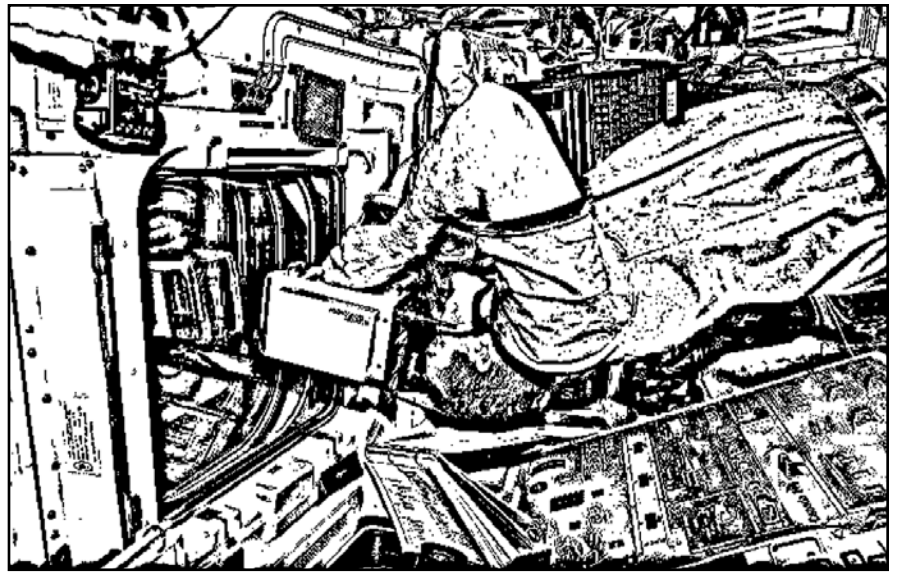
Thomas relayed the message to Probst and McMillan. McMillan was already on Deck Two, where the Chief had co-opted him for the fire party. Thomas stopped himself at Deck Three, where an airtight film had been stretched across the longitudinal passage to prevent the spread of smoke. Schreiber was there, pulling testers and scan equipment from the forward repair locker. As soon as the "all-clear" signal was given, they were going to have to get in there and make sure that the composite spars that ran through the berthing hadn't been damaged. A normal fire shouldn't get hot enough to damage the spars, but warships carried a lot of exotic materials onboard that did burn hot enough and could be ignited by a normal fire.

"Repair Three, Fire Party Leader. All clear for you to enter." Chief Saint's voice came across like gravel on channel two. "Seal her up behind you, we've got the reflash watch set."

"Roger that, Chief, Repair Three coming in." Thomas signaled back to Schreiber and Sawasky to grab their gear and follow, and took a moment to grab one of the HSAs, the Hull / Spar Analyzer. "Wuhrer, Mitchell. How about getting a couple of blowers rigged up?"

The compartment was a mess. Fires in zero-g had limited convection, since hot air didn't tend to rise away from the fire. The bulkheads, lockers and racks were covered with a dark, thin soot—at least, the ones he could see. The three of them were attached with a line in case of trouble, and with the residual smoke and firefighting chemicals, visibility was pretty poor.

"Schreiber, where are you at?" Thomas said over the repair channel.



"Port side, last row of racks, JPO." Schreiber replied. "I'm checking for leaks with the airflow sensor."

"Roger that," Thomas replied. "Sawasky, you got the power secured yet?"

"Uh, negative. The instructions are all in French."

"Damn it," Thomas muttered, "the power panel layouts were all supposed to be replaced." The *Schwarzkopf* was a former ship of the FN, the Federated Nations. Her original documentation was all in French. The shipyard said they had replaced the power schematics with English / German versions during the last yard cycle. In close to two decades of service with the ODF, they were still finding residual French documentation on components as they broke. Another gripe for the Chief to pass on up to the Lieutenant.

"Sawasky," the Chief said, "Grab a handheld and call up the schematics on that. You're supposed to have a handheld with you, where is it?"

"Busted, Chief."

"Here, use mine. You break it, I'll break your neck." Chief Saint went back to searching the racks.

Thomas checked the main structural members with the HSA. The Hull Spar Analyzer could detect even hairline cracks in the structural members. The drawback was that it was bulky as

hell, and fragile to boot. The damned thing cost more than he'd made in his enlistment thus far, and the ship only had two of them.

"Chief, we've got a fatality. It's Fischer." McMillan came floating out from the smoke and haze like an apparition.

Damn, Thomas thought. That explains why Helfen was in DCC.

"Fish?" The Chief inquired. "I thought his rack was in the aft berthing."

"Fish is admin, Chief, when he's not down in DCC. I think he was off-shift."

"I'll handle it." The Chief replied. "The Prime is on his way up here right now, and he and the old man is going to want someone to have some answers."

"What about in here?" someone asked.

"Petty Officer Achard," Chief Saint looked over at him through the smoke, "see if you can figure out how the fire started, and report to me as soon as you do."

"Roger that, Chief." Thomas replied.

A few minutes later, Wuhrer and Mitchell finished rigging the blowers, and began filtering the contaminated air out of the compartment. Thomas's vision began to clear and he was able to see the extent of the damage. It was mostly cosmetic. The berthing areas were built to withstand fire and decompression, but the personal effects that should have

adorned the racks and lockers were all burnt and gone. Photos, letters, all the little knickknacks that the crew had in this space, now just dust and ash. The trail of the fire wasn't hard to follow given the training Thomas had received in damage control school. Unlike most of the crew, Thomas had three O-years of training under his belt instead of the usual three week Basic DC course. Basic told you how to plug a hole, how to fight a fire, how to treat wounded. DC Specialty School went a lot deeper into theory. How fires start, their type and origin, how to lead a fire party. What you don't know can kill you, he thought while tracing the burn marks. Even though the air had been changed, he still had the mask around his neck, and was wearing his fire-retardant gloves.

The burn traces led toward a vent in the "overhead," though from Thomas's current orientation he thought of it as the left wall. Orientation was what you made of it when the engines weren't firing. Some of the larger loose items that the fire had freed from the bulkheads were getting in his way. He pushed them aside while bracing himself between the bulkhead and one of the racks. The vent cover should have been fixed in place—it wasn't. Thomas removed the cover and poked his head inside. There was just enough room to squeeze in a shoulder and arm, if he removed his helmet. The inside smelt like burnt socks, with an underlying, unidentifiable stench. Thomas jerked his head out of the vent, hitting the top of it against the lip of the vent.

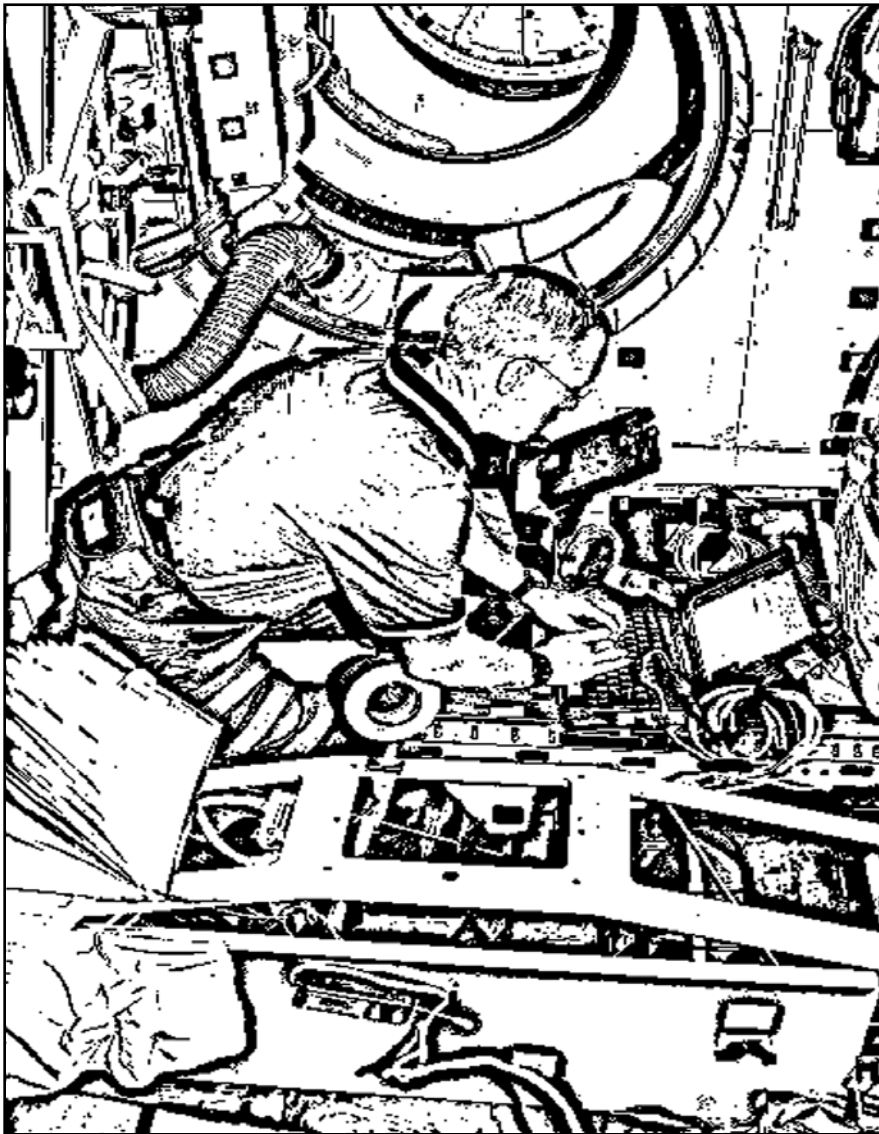
"Great," he muttered, "just great." He rubbed his scalp where he'd hit it. Of course, it was bleeding, but not bad. Putting his mask back over his face, he checked his O2 gauge. Still good, he had another eight minutes or so before he'd need to change canisters. Protected against the stench of the vent, he carefully poked his head and arm back inside. Using a shock-corded penlight, he examined the inside. Something was stuck over in the corner where the air feed entered the fan vestibule. He poked at it with a glove and pulled away something brown and soft. With a feeling of disgust, he realized it was a bag of human excrement. Okay, so that was the smell, but what started the fire? The scorch marks were coming from the fan shroud.

Thomas pulled a number three CR wrench from his coveralls and reached back up into the vent. It looked like the screws had been removed and replaced already—the hex heads were no longer sharp at the corners, but blunted as if by use of a tool in a hurry. He removed the screws and the housing, and found the rest of the crap. Someone had placed a bag of excrement inside the fan housing and shut it back in. The fan motor was completely burned out, jammed up by a pair of grips that had probably been used to push the bag back past the fan housing where it would have sat until it floated into the fan. The fans were necessary to maintain airflow in the ship and prevent areas of "stale air." Thomas removed the grips from between the fan blades. He turned them over and looked at the name engraved in the handle.

It said: (AM) JPO D. Klein, ENG-3.

Dale's grips. Damn it, this was a failed practical joke, and a bad one at that. Fischer was dead and the forward berthing was trashed. This was serious, he had to report it. He had to tell the Chief.

No, wait. This was Dale, he couldn't report it, they were friends. He'd met Dale's family, introduced Dale to his sister Carol, gotten drunk with Dale on Pacifica. If he reported this, that would be the end of Dale's career. He needed to talk to Dale first. As wrong as it was, he



had to hide the evidence. There had to be some way for Dale to turn himself in without it meaning the end of his career. He pocketed the grips, just before Chief Saint returned.

"Did you find the source?"

"Yes," Thomas replied, "someone put a bag of crap in the vent."

"What, you mean like something flammable?"

"No, I mean crap. Human dung."

"You're shi- you're kidding, right?"

"No, chief, I'm dead serious." Thomas replied. "Go take a sniff for yourself. I had to put the mask back on."

Chief Saint glided over to the vent, then pushed back towards Thomas once he got within a few feet. "Yep, that's what it is, all right."

"Do we know what caused it?" It was the

high enough for a flash fire." Thomas replied.

"Well, then why didn't the bridge or DCC get an O2 HIGH warning?"

"Maybe the sensor was bad." Thomas replied.

"Maybe. Why don't you have someone check the tagout logs and see if it was reported."

"Yes, Chief."

"Any other damage?" The Prime looked like he was about to hit something. Or someone.

"No, sir, the spars are all intact, no secondary fires were started. Lockers all look intact, airtight seals are all good." Thomas wondered how long it would be before Captain Görlitz himself came up.

"Well, there's that at least. We're closing on that Medinan freighter and we don't need anything getting in the way of the

"Will do, Chief." Thomas replied. He nodded to the Prime. "Sir."

Thomas started off, but the Chief's voice turned him around. "Achard."

"Yeah, Chief?"

"Find out who did this. Fish was one of ours, I want to know who was responsible."

Four hours later, after securing the site, and stowing his gear, Thomas went down to the lounge, and found Dale "seated" at the quiet table. As usual, he had his reader open, and was tapping at the screen.

"Where's Stefan?" Thomas asked.

"On the bridge. It's his watch, they're still monitoring the track on that Medinan freighter. I hope we nail those bastards." This was their third trip out since the war started. The Medinans had fired first, and used nukes in violation of

"Any other damage?" The Prime looked like he was about to hit something. Or someone.

Prime Lieutenant.

"Yes, sir," Thomas replied. "Someone put human dung in the vent and it burned out the fan motor. The fan motor started the fire."

"How'd it spread so much?" The Prime asked. "That's an awful lot of damage from a burnt motor. We've got three people from this compartment on their way to sickbay with some pretty bad burns."

Thomas peered into the vent. The emergency oxygen feed line was nicked, probably when Dale tried to remove the grips. Stupid design, he thought, they should have run the O2 line outside the fan housing.

"Well?" the Chief asked.

"Looks like the emergency O2 feed got damaged, probably raised the O2 level

pursuit. I'm going to have to open an investigation due to the death that was involved."

"We're going to need to let people back in to their racks, sir."

"They can wait," the Prime replied sharply, "I want to know who did this—the skipper's been very tolerant of the previous jokes, but none of them ever killed a man. Make sure a Master-at-Arms guards the vent, and tape it off. No one comes in until this vent is secured and guarded."

"What about air quality?" Thomas asked, looking at the Chief.

"There's two more vents servicing the compartment," Chief Saint replied, "air quality should be ok. Make sure there's nothing hazardous and let a couple of the berthing guys in to wipe everything down except around the secured area."

the Pacifica Ban. Since then, Medina and Olympia had been at war, and the ODFSA was trying hard to kick the Medinan Star Force's butt.

"We'll get them." Thomas replied, but there was no feeling in it. Dale was responsible for Fischer's death. Thomas hadn't known Fish real well, but still...

"More prize money for us," Dale said. "This will be the big Number Three." The other two trips had been profitable. One captured freighter on the first trip, two on the second. V1054 made an excellent staging point, it was a natural chokepoint for Medinan commercial traffic. They'd moved in closer for their third hit, through 70 Ophiuchi to 61 Cygni. If they could hold this back route, they could strangle Medina's trade—the easy routes all led past either Olympia or through their own base at AD Leonis.

Thomas wasn't interested in that at the moment, not after seeing Fish put into a body bag and pushed off towards sickbay. He kept hearing his father's voice echoing in his head.

"You're responsible for what happened to Edward, Thomas." The voice said.

"It was just a joke." Thomas replied with a small voice. "I didn't mean for it to hurt anybody."

"You killed your little brother, and I have nothing more to say to you."

"Thomas? You okay?" Dale looked concerned.

Damn him, he has no right to look

Thomas continued, "I've got to turn them in to the Chief at some point. Chief Saint and the Prime are hunting for blood."

"Just forget you found the tool, Thomas. Give it back to me and I'll put it back where it belongs and the whole problem goes away."

"I can't do that, Dale. Look, one of the guys from my division died in that fire, and you're responsible."

"I didn't kill him."

"Not directly, maybe. You're still at fault." Thomas said.

"Let me think about this for a bit. You

The Chief moved over next to the workstand Thomas was at. "There's something I was meaning to talk to you about. The fan shroud looked like it was hastily removed, and the fan blades were bent, must've been some sort of metal object in the fan that burned out the motor. Did you recover anything from the vent?"

Crap. Just what he needed, and he'd seen it coming. Do I save Dale's ass or turn him in? Friendship versus duty. "I recovered a pair of grips from the vent, but when we were securing the space, I set them down and they disappeared."

Chief Saint stared at him almost open-mouthed. "You WHAT!?"

"We're changing vectors," Wuhrer muttered ... ' Did the sublooey screw up?'

concerned, Thomas thought, he never takes anything seriously unless it directly affects his career.

"Hey, Olympia to Thomas."

"I know you were responsible." Thomas said suddenly.

Dale looked confused. "For what?" He asked.

"The berthing fire. It was a practical joke gone bad. I know you did it."

"Thomas, you're crazy. I had nothing to do with that."

"Right." Thomas folded his arms and just looked at him.

Dale set the reader down. "Look, just because I've done some practical jokes in the past doesn't mean I'm behind every joke on the ship."

"Oh, yeah? Well, I found one of your tools in the vent. You lost it in the vent and they floated into the fan and seized the motor. They've got your name right on them."

Dale had nothing to say to that. He just pressed his lips tightly together and looked as if thinking of what to say.

know if you turn that in, it'll be the end of my career."

"Fish is dead, and you're thinking about your career?"

"Keep your voice down." Dale said, as calmly as he could. Just wait until after we jump before you go giving those grips to the Chief."

"How'd you know it was a pair of grips if you didn't do it, Dale?"

"Just give me until after jump, alright?"

"Fine. We'll talk again after transit."

While Thomas was going over the maintenance paperwork, Chief Saint came in. Thomas didn't hear the chief at first, he was trying to decipher Sawasky's notes, which somewhat resembled English.

"Finish the after-incident report?" the Chief asked.

"Just about to, Chief." Thomas replied. "I'm just making sure everyone's statements are in here."

"Good. Be thorough."

"Trying to, Chief."

"I lost them, Chief."

"You've got to be kidding me. Achard, you know the importance of evidence like that, you should have called me immediately when you found them. The Prime's going to have both our asses for this!"

"I just set them down for a second, Chief. Someone in the berthing probably just picked them up, I can go back over there and take another look for them."

"Achard, you're lucky I don't write you up and send you to mast right now. You're going to find those grips, I don't care if you have to look for them all the way through jump. Find them. I've got the Prime and the Captain on my ass and one of my men is dead. If this bastard gets away because you lost evidence, you're getting court-martialed in his place, do you understand?"

"Yes, Chief. I'll get right on it."

"You damned well better."

Transit. Thomas sat in the forward repair locker, waiting for the word to come down from on high. The waiting was always the hardest part. At least

in CIC, they knew what was going on. His part was to sit still until the ship was damaged, then rush in and fix it, get them back into the fight. He wasn't alone, Wuhrer was with him, occupying himself by bouncing a hard rubber ball against the opposite bulkhead. He missed the ball just as Thomas felt a change in the ever-present falling sensation that was zero gravity.

"We're changing vectors." Wuhrer muttered as he reached for the errant ball. "Did the sublooeey screw up?" Sublieutenant Michaels was the *Schwarzkopfs* navigator, and so far he'd proved to be very good at his job.

"Dunno." Thomas replied. He didn't care at the moment. There were more pressing matters to deal with—what was he going to do about the berthing incident? Dale had made it clear that he wasn't going to accept responsibility, and Chief Saint had chewed Thomas out for losing evidence. If he didn't tell the truth soon, he was going to take the fall for Dale's mistake. It had been eight hours since he'd talked to the Chief, and nearly seventeen since the fire started. He'd hidden the grips in an access panel on Deck Four, one that was never used and far enough away from the radial corridor that no one could see him do it. After that, he'd spent some time "looking" for the tool, mostly around the forward berthing. Petty Officer Hawkins, one of the MAAs, was guarding the vent access. The ratings and petty officers up in the forward berthing had cleaned the place up pretty good, but it still had that burnt smell to it. Maybe he should just give the grips back to Dale. He didn't want to end Dale's career, and it might put Dale in prison if the skipper was as blood-hungry as the Prime seemed to be.

No, Thomas thought, I paid the price for what happened to Edward, even though I didn't mean it. Dale's got to own up to his responsibility too. Thomas had just about convinced himself when the Captain's voice came over the shipwide channel.

"This is the Captain."

"Well, something didn't go right." Wuhrer muttered.

"We have completed transit and are still on an intercept vector for the freighter *Khalid bin-Hadel*. Unfortunately, they are not alone. Two Medinan vessels are in-system, apparently waiting for us. We are maneuvering to get a better position on them, and will be remaining at Condition One Bravo for the next few minutes until the ship is stable and our maneuvering burn has begun. That is all."

Wuhrer let out a low whistle. "Think we'll turn and run?" he asked.

"No way. He'll engage. That freighter is too choice a target."

"Too bad you can't talk to your pal Stefan right now, I bet he knows what's going on."

"Yeah," Thomas replied, "but if this is anything like the last two times, we'll have some downtime before we engage, and I might get to talk to him." Hopefully, that was true. He had to talk to Stefan about the situation with Dale.

The light touch of gravity that signaled the in-system thrust of the ship's engines caused everything tethered in the repair locker to settle towards the floor. Wuhrer altered the toss of the ball to compensate as he continued to bounce it off the bulkhead.

"So," Wuhrer said, "I hear you're coming up on your re-enlistment date."

"Yeah." Thomas replied.

"Are you staying in? Going career?" Wuhrer asked.

Thomas thought for a moment before responding. "I don't know," he replied, "I've always said I'd give it at least three tours before getting out, and I sure as hell don't want to go back home."

"Family life that bad?"

"I'd rather not talk about it, but yeah." Thomas replied. "My sister Carol was the first to escape—she's got a nice job now in New Camden, well away from the family. With the war, no one can afford to go all the way out there to see her, and she's pretty happy about that. Hell, they're not going to let me out anyway unless the war ends first. I don't want to

stay in, but I sure as hell don't want to get out."

Wuhrer didn't have much else to say after that, and neither did Thomas.

About twenty minutes later, zero gravity returned and Captain Görlitz came back on the shipwide channel. "All hands, this is the Captain. Manuever changes are complete. We are on an intercept course with the Medinan ships and will engage them in approximately twenty-one hours. I want everyone ready to go at INDIA minus ninety. Check all your gear, make sure everything is as good as it can be. Let's show these people that the *Norman Schwarzkopf* is not to be trifled with. That is all."

"Stand down Condition One Bravo, now set Condition Two throughout the ship. Maneuvers are in progress. All hands stay prepared to take hold in case of burn."

"Well," Thomas said, "looks like we're going in. At least we'll have time to sleep and grab some chow."

"You go ahead, JPO," Wuhrer told him, "I'm really not all that hungry."

Thomas headed back downship to the lounge on Deck Four. He knew Stefan was likely to be there, since the current duty section would be first to eat and grab some downtime. He grabbed a quick tray from the galley and some coffee on his way into the lounge. A voice over the intercom warned that the ship was completing its burn and going inertial. Thomas hooked a nearby handhold and waited for the tone that signified the end of thrust. The falling sensation of zero-g returned, and a moment later the safety tone came over the intercom. Thomas turned the corner into the lounge. Stefan was at the quiet table. He gave a small wave as Thomas approached.

"Hey. We're here, we're not alone. I guess you heard that though."

"Yep." Thomas could tell than Stefan looked a bit uneasy. Was it because Dale had talked to him, or because of the Medinans in-system?

Stefan lowered his voice almost to a whisper. "Leftenant Schmidt doesn't think we're going to be able to beat these guys, he thinks the Captain is making a mistake taking them on."

"Why are we doing it then?"

"I don't know. The skipper doesn't want to lose this freighter. Maybe it's because of his son, I don't know."

"His son?" Thomas asked.

"Didn't you know? Captain Görnitz's son was a Senior Petty Officer on the *Warspite*. He was killed during the attack."

There was the name. *Warspite*. The *Saladin* Incident had started the war. Medina used nuclear weapons and blasted the *Warspite*. She'd survived, but a lot of her crew died in the battle, and some died afterwards. Radiation, not the quick death from blast or decompression. Ever since, every crew who encountered a Medinan warship was thinking the same

"I don't think he did it." Stefan told him.

"Stefan, you know Dale doesn't leave tools lying around."

"Yeah, but this is Dale we're talking about. Mister career-minded, always everything by the book. He wouldn't hurt a fly."

"I'm not saying it was intentional," Thomas said, "it had to have been an accident. Maybe someone caught him, or distracted him. I don't know."

"So, what are you going to do?" Stefan asked him.

"I've got to tell the Chief, or the Prime. I'd rather tell the Chief."

"You can't do that, it would destroy Dale's career. It'd be a court-martial."

"I can't just let this go, a man died and Chief Saint already knows something's up, he knows that there was a tool involved. I told him I set it down and it disappeared."

"You know, maybe I ought to leave." Stefan slipped his feet out of the straps.

"Maybe you should. I'm going to have a talk with Thomas and we're going to straighten this out."

Stefan passed close by Thomas as he left. "Just dump the tool, Thomas." He said.

"Give me the grips, Thomas."

"I thought we were going to have a talk. That sounds kind of like an order." Thomas replied.

"The practical joke was a mistake. No one should have gotten hurt. It wasn't done on purpose, there's no reason why anyone should have to go down for this."

Thomas clenched his fists. "Fischer died. You're responsible."

"None of it happened on purpose, Thomas. Why are you being so bull-headed about this?"

"I used to play pranks when I was young." Thomas looked Dale right in the

Suddenly, Dale was there. "What, is he trying to get you to say I did it too?"

thing. *Will they use them again?*

"No. I had no idea the Old Man's son was in that battle. You think he's trying to get back at them?"

"I don't know, but I think the Leftenant does."

"We've got another problem." Thomas said very quietly. "Dale caused the berthing fire."

Stefan sat there, motionless, a carefully neutral expression on his face.

"Did you hear me?"

"Yeah, I heard you," he replied quietly, "Why do you think Dale had anything to do with that?"

"I've got proof - I found one of his tools at the scene. He must have left it in there accidentally. It jammed the fan and the fan motor seized and caught fire."

"Do you still have the tool?" Stefan asked.

"Yes."

"Where is it?" Stefan asked.

"I hid it somewhere safe." Thomas told him.

"Just get rid of it. No one will ever know he had anything to do with it, if he did do it."

"I can't do that. A man died. I have to say something to the Chief."

Suddenly, Dale was there. "What, is he trying to get you to say I did it too?" he asked Stefan.

"Hey, I know you didn't do it, I wasn't going to say you did."

"Damned straight you weren't."

eye. "Seven years ago I locked my little brother up in the tool shed as a joke. He tried to get out, and pried one of the slats out at the back of the shed. When he tried to get out a bunch of crates fell over and landed on his head."

"Well, then you understand. Nobody meant for anyone to get hurt. Just give me the grips and nobody has to get court-martialed over it."

"No." Thomas replied, "I had to take responsibility for my brother's death, even though it meant my father never spoke to me again. You have to take responsibility for Fish."

Dale stared at him for a moment. "I didn't kill Fischer."

"If you didn't kill Fish, how did your grips get into that fan housing?"

Dale said nothing.

"Well?" Thomas asked.

"We've been friends a long time, Thomas. I brought you back to base when you got stone drunk in Pacifica. I stopped you from getting into a fight with five guys, where you would have gotten your ass kicked. I helped you study for your JPO exam. I've loaned you money at least twenty times, and never asked for anything back." Dale dropped his voice. "If you turn in those grips, my career in the Space Arm is over. It will damage my family's reputation, and it'll tell everybody on this ship that you won't help out your shipmate."

"Cover up for him, you mean."

"People cover up for other people for stuff all the time, Thomas. That's what they do. Don't look at the 'what,' look at the 'why.' If somebody deliberately tried to kill Fish, I'd say 'turn him in,' but that's not what happened."

"I have to tell the Chief, Dale. He's riding my ass and I've already stuck my neck out as it is."

"Give me the grips, Thomas." Dale put out his hand.

"No."

"Give me the grips." Dale repeated, moving closer.

Thomas moved back a step. "What if I don't?"

"Then I'm going to have to take them from you. You're not going to destroy anybody's life over this."

"That's it," Thomas said, turning around "I'm out of here."

Dale grabbed Thomas's shoulder and tried to swing him around.

"Let go of me, Dale, I'm warning you!"

"Give me the grips, Thomas."

Thomas attempted to push himself out of Dale's grip, but Dale had hooked his feet into the floor restraints and was properly braced. He managed to get a toehold on the side bulkhead and pushed hard, hitting Dale square in the chest with the top of his head.

Dale tried to get Thomas into a headlock, but one foot had come loose and he wasn't able to counter his own spin. The two of them traded blows ineffectively for a few seconds, unable to properly connect in zero-g. They had gathered an audience.

Thomas tried to break Dale's grip on his coveralls in order to push off and escape, but Dale pushed hard then, and used his grip to swing the two of them around each other in time to put Thomas between Dale and the furniture. Thomas felt a sharp pain in his temple as he collided with a corner of the table, and the two of them bounced off and started spinning around their common center towards the ceiling. Thomas broke Dale's grip briefly, but with the nearest bulkhead a full meter away there was nothing he could push off against.

Dale managed to snag Thomas's clothing again and closed an arm around Thomas's neck. Thomas's vision was starting to dim when the shouts around him stopped and one single clear voice rang out.

"Let that man go." It was the Prime.

Dale released his hold on Thomas and came to attention. Thomas got in one good breath, then started to cough.

"What's this about?" the Prime asked.

"We're just having a little disagreement, sir." Dale replied.

"I can see that, Petty Officer Klein." The Prime said. "What is the cause of the disagreement?"

Thomas was still coughing.

"Uh, it was over money, sir." Dale told the Prime.

"I realize that the impending ships in-system are getting people uptight, and I'm going to cut you some slack by not writing you up and sending you to captain's mast." The Prime said.

Thomas got his coughing under control and tried his best to stand straight.

"I think that the two of you need some time to cool off, though, and we've got at least eighteen hours before we secure for combat, so I'm having you confined to

the brig for a while." The Prime turned to the two Masters-at-Arms that had just entered the lounge. "Put these two in the brig until 04:30."

Dale and Thomas went down to Deck Five with them. Neither said a word.

The brig was barely worthy of the name, just two small cells separated from each other by an arm's length. Enough to confine a couple of drunks, or two guys busted for fighting each other. The cells were bare metal, smooth with no sharp edges or protrusions. A simple metal rack with sleep restraints was mounted to one bulkhead and a zero-g toilet and hand-washing station to the opposite one. The cell measured exactly two meters on a side. A small camera stared at them from a corner opposite the two cells.

"Happy now?" Dale asked after their jailers had left.

Thomas ignored him.

"Fine. Be that way." Dale said.

Thomas strapped into the rack to keep from drifting around the cell, and faced the bulkhead, away from Dale.

"How is Sharon taking it?" Dale said after a few moments.

"Who's Sharon?"

"Fischer's girlfriend. Petty Officer Danning, from Supply."

"I didn't know Fish had a girlfriend." Thomas replied. Wasn't that against regs anyway, having a relationship with someone in the same command? It didn't really matter at this point. What he really wanted to ask Dale was how he felt now, knowing that he'd killed Fischer, but he knew that the brig was tapped for audio.

"Yeah," Dale replied, "they've been going out for almost six months. Sharon is one of my exes."

"Look, Dale, I really don't want to get into this again right now."

"Fine. Yeah, whatever." Dale turned away and stared at the other wall.

They stayed in silence for seven hours, Dale watching the chronometer change,

Thomas drifting in and out of sleep, but mostly out. At 0400, SPO Jenkins released them from the brig, and held Thomas there for five more minutes until Dale had left the deck. Thomas went cross-ship to his berthing on Deck Five and climbed into his rack, ignoring the catcalls from various shipmates who'd heard about the fight. He'd managed to get a couple hours of sleep when Helfen woke him up.

"Achard."

"Yeah?" Thomas replied, rubbing at his eyes.

"Chief Saint told me to write you up, failure to report."

"I was in the brig," Thomas replied.

"Yeah, I know." Helfen said. "Half the ship's talking about it. You were supposed to report to the division muster an hour ago, after you got out of the brig. You slept right through it."

"Alright, alright. I'll get up there. Where do they want me?" He pulled himself out of the rack and reoriented so he was facing Helfen.

"Main Repair." Helfen said. "We've got a gear inspection starting at 0800. Then we're going to pre-stage some equipment on Deck Seven and do a loose gear walkdown at 1100."

Thomas yawned. "All right, I'm on my way."

The Chief chewed him out in person when he arrived at Repair One at 0647. Thomas nodded when he was supposed to and acted contrite, and managed to pull it off. Sawasky was wiping down the HSA, the HRUs had been cleaned, lubed and stowed, and Mitchell was busy telling everyone for the twelfth time exactly how 'short' he was. Fifty-seven days.

Thomas was on his third bulb of coffee, and starting to enjoy it—always a bad sign when one was talking about ODF coffee. Last time the ship had actually been to Pacifica, Thomas had the opportunity to try what Stefan had called "real" coffee. He needed to steal some of Stefan's stash.

SPO Teller came into the repair locker at 0730, and looked over the gear. Chief Saint followed at 0750 and gave everything a quick once-over, praising McMillan's work and getting Schreiber to change his uniform. Lieutenant MacAllister arrived promptly at 0800 and went over everything with the proverbial fine-toothed comb.

"Looks good, Chief." MacAllister proclaimed.

"Thanks, lieutenant. We'll be pre-staging next and doing an LG at 1100." Chief Saint replied.

"Very well, chief."

Thomas spent the next couple of hours moving gear up from Main Repair on Deck Ten to Deck Seven. Though the gear was weightless, it still had inertia, and could crush fingers and other appendages of the unwary.

At 1100, all crew not at their stations gathered at the bow and began the loose gear walkdown. The *Schwarzkopf* gave a quick burst with its pivot jets to dislodge anything that might be stuck in cracks or crevices, and everyone started making their way aft, collecting anything floating and depositing it in a collection bag or tethering it in place. Loose gear was dangerous—under thrust, everything became a potentially lethal projectile.

They ended the walkdown at 1415, and buttoned up at 1430 ship-time. Wuhrrer joined Thomas in the forward repair locker.

"Now hear this throughout the ship. Set Condition One. All hands man general quarters. All hands travel up and forward on the starboard side, down and aft on the port side. Make Condition One reports to DCC." The message was expected, it had been scheduled yesterday. The downside to space combat was always knowing the exact hour of your fate. They were at intercept minus ninety. Ninety minutes to get everything in order at their workstations and be prepared to meet the enemy.

It took them thirty minutes to finish preparing. Thomas and Wuhrrer started a hand of canasta.

At six minutes to intercept, the Prime gave a few final words, mostly amounting to "fight hard, fight well." Wuhrrer put the cards away. The two of them dogged their helmets, holstered their gauntlets and sat in silence. Nothing to do now but wait to be hit. No windows, no viewscreens. Just six walls and another human soul, sitting, waiting.

Three minutes to intercept. Two. One.

The burn alarm klaxon sounded through the ship. Thomas reached out with both hands and braced himself inside his little nook in Forward Repair. He felt a wave of nausea as the ship made a fast pivot to port and the engines kicked in. 7,500 tons of thrust pushed the *Schwarzkopf* forward at almost 10 meters per second squared. One full gravity. He felt heavy for the first time in months, like he did whenever he returned planetside to Olympia.

After a few seconds, he felt the staccato pulse of the cooling pumps for the starboard zone defense weapons. That's not good, he thought. He and Wuhrrer exchanged worried looks.

"ALL HANDS, BRACE FOR IMPACT!"

The incoming shells impacted with the sound of a truck explosion in a glass factory. The bulkhead shuddered with the impact and Thomas could hear the sound of venting air in the repair locker. The repair channel was suddenly filled with a dozen voices, simultaneously.

"Venting air aft!"

"Potable water leakage, port side, frame 40!"

"Sodium leak! We're leaking coolant!"

"Main power lost on Deck Three!"

The external noise dropped as air evacuated the repair locker. Thomas grabbed the scanner and a half-dozen sealant packs he'd placed next to him. Wuhrrer was already sealing a breach in the bulkhead of the repair locker, where the bulkhead seam had ruptured. They'd been on the roll when they were hit, that wasn't good. Torsional stress and a curved path through the ship due to the spin meant the damage was likely worse

than normal for the size shells they'd been hit with.

He turned to Wuhrer and keyed his comm. "Let's head out, dorsal forward."

Wuhrer finished sealing the seam. "Ready!"

They opened the airtight hatch and stepped out into hell. No fire, the oxygen had fled too fast. Half of Deck Two was shredded, jagged metal and composite everywhere. Looking towards the starboard side he was staring directly into space. Too big to patch, he thought, even with the Spider. He keyed the damage report to DCC. The two of them latched into nearby handholds with the recovery lines and started "walking" towards Deck One by alternating lines, clipping into the second handhold before unclipping the first. Somebody, Helfen perhaps, was screaming about the forward heat sink.

"We've got to flush it, right now, and it's not responding!" Thomas was having trouble making out parts of what he was saying with the other interruptions.

"SHUT UP, ALL OF YOU!" Thomas thundered over the comm.

Dead silence. In the middle of combat. God, that was surreal.

"Is that Helfen? This is Repair Three, JPO Achard. What was that about the heat sink?"

"Roger, Repair Three, this is DCC, SPO Helfen. The goddamned sodium is leaking from the forward heat sink, and we're in a cloud of our own potable water and oxygen. Every time we roll the ship, it's flashing right in our face. We can't see, we can't fight."

Thomas clipped in to another handhold, they were entering Deck One now.

"We're at deck one, DCC. If I copy correctly you want us to secure the sodium lines and jettison Sink One, is that correct?"

"Affirmative, Repair Three. Isolate and eject, ASAP."

"Roger that. Will advise on completion, Repair Three out." Six more frames to go, just six meters. It was slow going.

With the ship thrusting and pivoting in combat, they were constantly bracing themselves against equipment when handholds were not available. He heard his suit compressor kick into high gear, partly from his exertion, partly from the heat of the equipment he was approaching. The heat sink was a reservoir of liquid sodium and associated piping, twenty-three tons of it at a temperature of 1000 Kelvin. This heat sink absorbed heat from the forward reactor, storing it until the ship's radiators could be safely extended.

"There's the access panel." Wuhrer piped up.

"Got it." Thomas anchored to the adjacent handhold and unlatched the panel. He stared in disbelief for a second. The ejection panel instructions were clearly labeled, but in French. "Wuhrer, do you know French?"

"Nope..."

"Great. This day keeps getting better." Thomas looked over the diagrams printed on the inside of the access panel. I'm going to kill the yardbirds, he thought. At least pictures were somewhat universal.

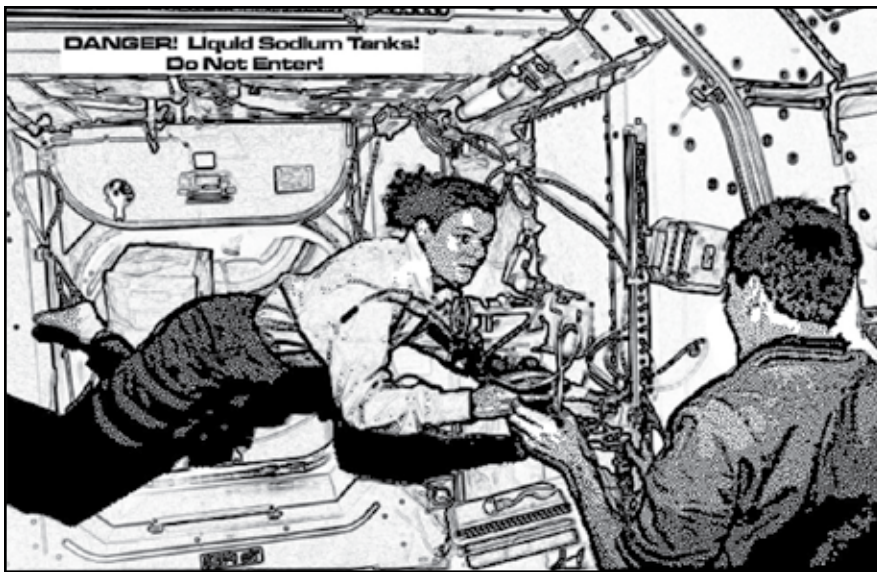
"Well?" Wuhrer echoed Thomas's nervousness.

"We need to close off the isolation valves. They should be marked, what's the French word for 'isolate'?" He'd failed basic hydrodynamics the first time in school, and avoided anything to do with the subject since. He'd almost failed the rating exam because of it.

"In German, it would be 'isolieren'," Wuhrer volunteered.

Thomas scanned the maze of piping before him, muttering, "iso, iso, iso... here they are, isoler." He closed both





valves. "Alright, Wuhrer, grab that release lever, we need to pull both at the same time."

Wuhrer unlatched the lever and took a firm grip. "Ready."

"On my mark, three, two, one, MARK!" They pulled the levers. The deck jerked beneath their feet as the module slid from the ship.

"Hey Achard," Wuhrer said, "doesn't your datapad have the ejection instructions in it?"

"Crap," Thomas said, mentally kicking himself.

Thomas keyed the isolated valves into his datapad and thumbed the repair channel on his comm. "DCC, Repair Three. Forward heat sink ejected, flow isolated."

"Roger that, Achard. Take your team aft and help Repair One on Deck Seven. We've got battery fires."

Thomas felt the blood rush away from his face. "Roger that, on our way." The batteries were explosive, and a number of the exotic metals involved in their construction produced their own oxygen when they burned. "Let's go!" he told Wuhrer, and started downship.

They'd made it as far as Deck Five when they felt the first of the battery explosions. The ship began to yaw to port, but the RCS corrected for it after a moment. Thomas banged his head hard on the overhead pipes, right where he'd bruised his scalp the day before.

"Damn it."

"What the hell was that?" Wuhrer asked.

Thomas glanced at his handheld. "Battery, Deck Seven. Most of the Deck Seven interior sensors are out." He checked his helmet readout for leakage from hitting the overhead. Green telltales, the helmet was intact.

"DCC, Repair Two." It was Schreiber.

"Go, Two." An unknown voice in DC Central, replacing Fischer.

"We lost Helfen. He was spaced by that explosion."

"Roger that, Schreiber. Report to Deck Six, join Repair Three."

"Copy, DCC. Join Repair Three on Deck Six."

"That's affirmative."

Thomas checked the telltales next to the airtight door to Deck Six. Complete vacuum on the other side, despite being sealed.

"No go over here, Wuhrer. Let's try the other passageway."

They took the transverse corridor over to the other side of the ship, keying into their handhelds any damage they witnessed. Most of the internal sensor grid on the nearby decks was out. As they approached the other airtight door, the ship rocked with another explosion, then another, and again. Thomas and Wuhrer pinballed off the bulkheads,

and the telltale hiss of escaping air told Thomas that the bulkheads had ruptured and were streaming air. The noise dropped off to silence in time with Thomas's external pressure gauge on his suit.

"You okay?" he asked Wuhrer.

"Yeah. That hurt like hell, but I don't think I broke anything. Suit meters are still green."

"Me too." Thomas replied. "No, wait, I've got a yellow light. Suit pack."

"Turn around." Wuhrer told him.

"How's it look?" he asked.

"Hang on." Wuhrer replied. Thomas felt Wuhrer moving something around in the suit pack on his back, then the double pat that signified that Wuhrer was done. "You're good," Wuhrer said, "you had a CO2 return leak, but I patched it. How's the pressure?"

Thomas checked the telltales, and chinned the helmet display. "Pressure's coming back up, looks good." The telltale winked from yellow to green.

"Hey." Wuhrer said.

"What?"

"Where'd everybody go?" Wuhrer asked. The repair channel was silent.

Thomas checked the handheld. He had the static ship display, but the network link had a red 'X.' "Repeaters are dead, I've got nothing. Switch comms to 'onboard.'" The suit communicators usually operated at very low power, relying on repeater antennae in the bulkheads to relay their signal throughout the ship. With the repeaters out, they had to broadcast in high-power mode, which would cut down their suit battery time.

"DCC, Repair Three."

Nothing.

"DCC, Repair Three." Thomas reached the second airtight door. The readout showed vacuum on both sides, so Thomas opened it.

"Achard, it's Sawasky."

"Go, Sawasky, where's Probst?"

"Dead. I can't find the Chief, and DCC has been hit. Lieutenant MacAllister is a casualty and DCC's comms are shredded." Sawasky was starting to break up.

"Roger that, where are you?" Thomas replied.

"Deck Ten, near DCC. We've got some guys from Engineering helping us. Reactors One and Two are down, Three is at half power. A bunch of the batteries are fragged."

"Sawasky, switch your handheld to local mode, channel four. We're going to link data." Thomas exchanged data with Sawasky's handheld. The ship was in trouble, maybe even dying.

"Thomas, CHENG wants you to vent Deck Eight to space. They've got a fire out of control on the deck and the magazine temperature has spiked by fifty."

The Chief Engineer can kiss my ass, Thomas thought. I'm not getting killed. Then he considered the situation. Crap. If the magazine went up, they could lose the rest of the ship.

"I'm on it." Thomas replied, and moved to position.

"Ready to release air on Deck Eight." Thomas said over the repair channel.

"Thomas!" It was Dale.

"Release atmo," the Prime said over the comm.

"Thomas, there's three of us in here fighting the fire, and we're not suited for decompression! If you purge the air, we're going to die over here."

"Clear the deck, Dale. Get the hell out of there!" Thomas exclaimed.

"The airtight door to Deck Nine is blocked. We're stuck here."

"Achard, this is Prime. Vent the deck, that's an order!"

"Get out, Dale, you've got thirty seconds." Thomas paused his hand over the release. Was this justice? Was this the universe's way of balancing Fish's death?

"Achard, this is CHENG. The temperature in the magazine is critical."

"Achard, vent the damn deck!"

Thomas hit the release. He could hear three voices yelling through the comm, then silence.

Dale was dead. Helfen, Probst, Schreiber, McMillan. Mitchell and Lieutenant MacAllister were in sickbay. That wasn't the worst of it though.

They'd destroyed a Medinan gunboat, and damaged one of the frigates, but Stefan had been right—they'd been outmatched. Captain Görlitz had extended the radiators and surrendered. The Medinans were on their way to take the ship.

Over the next two hours, Thomas, Wuhler, and Sawasky did what they could to patch the hull, run emergency power and communications, and repressurize parts of the ship, until the Prime had them stop. 'Get some rest,' he'd said. Thomas couldn't rest until he'd taken care of one last thing.

Thomas found the Chief on Deck Three, near the repair locker. He pulled out the pair of grips and handed them to the Chief.

"What's this?" the Chief asked.

"The grips. Dale Klein started the fire. I didn't lose them, I hid them. I didn't want Dale to get kicked out."

"I can't believe you're giving these to me now. Hell, I can't believe you're even owning up to this. Do you have any idea the trouble this puts you in?"

"Yeah, Chief," Thomas swallowed, tired. "I tried to get Dale to confess on his own. I tried to buy him time. You can go ahead and send me to prison if you want to."

"Hell, I'm not sending you to prison, the Medinans already got that covered. We're all about to become prisoners of war, Achard. I'll tell the Prime that Klein did it, but not the rest. No one's going to care about the rest of it under the circumstances. Klein's dead, everything works out."

"I guess I should say thanks." Thomas said.

"No, Achard, you should get the hell out of my sight. Consider yourself lucky, and get lost."

There wasn't much to be said to that. Thomas left the chief floating there and went back down-ship.

The crew was gathering on the mess decks. Rough hull patches marked the bulkheads. Thomas found a corner away from everyone else. The ambulatory wounded floated in spots, making it difficult. Stefan found him.

"I suppose you're happy now. You blamed Dale for the fire and now he's dead, so he can't stick up for himself. I suppose it doesn't matter to you that you've damaged his family name."

"Then he should have admitted he did it. He could have taken the honorable path."

"You still don't get it, do you?" Stefan said. "Dale didn't do it—I did."

"What?" Thomas said, confused.

"I did it, Thomas. I borrowed Dale's grips. I put that bag in the vent, I cut my hand trying to put the fan housing back on and then lost the grips. I had to place the vent cover back by hand and get out of there before the smell got into the compartment."

"Why didn't you say anything?" Thomas asked quietly.

"Why do you think, Thomas? I've got a wife and kid. If I'd confessed, they'd kick me out, and then who'd take care of them? Dale didn't say anything because he was looking out for me."

Thomas sat there, stunned. I killed Dale, and he wasn't the one responsible.

"We both thought you'd come around, and get rid of the evidence. It's not like I meant for anybody to get hurt. I suppose you're going to turn me in now."

Thomas sat in silence.

"Fine. It doesn't matter anyway. The *Ali Ismail* is about to dock with us, and they're going to take us all prisoner anyway. I hope you're happy with yourself." Stefan pushed off around the corner and out of Thomas's sight.

Thomas watched him go, and waited for the Medinans to arrive.



Clover

July 7, 2244, Earth Gregorian

Frank stretched and rubbed his eyes, trying to force himself to finish working through the full 300 item Pre-Transit Checklist. Two years and countless arguments later, he no longer bothered to fight when Captain Kirkover assigned the list. It didn't matter that no other ship in the company used the damn thing more than once a year, any more than it mattered that the bulk of the items could be done by a computer. It was In The Book, and on Kirkover's ship, the Protocol was God and Kirkover was its Prophet. In his estimation, Kirkover needed to get the spanner removed from her posterior. Even on leave, she never broke loose. Never drank with the crew, never went to whatever night life existed in rust-bucket can city they were laid over at. Only at Evenwood did she ever seem to indulge, and that was so private as to not count. He wondered how long she'd run - her med files said she was sixty-one. Old enough to have been born on Earth, even. Made her something of a rarity these days.

'Back to work,' he thought. Even if it's pointless drudgery, getting it done now means it's at least over.

Another dozen items off the checklist. Running the solar weather reports and correlating the forecast at their destination star. This, at least, merited human judgement, not that Kirkover would actually trust his report. She'd demand to do it over again herself. Then the maintenance logs, which hadn't changed in the three days since *Minerva*'d transited to here. Rumor had it that Kirkover would actually break things just for the excuse of dressing you down when it didn't show up on your report. He worked down to the last item and signed off the list. Predictable as a clock, Kirkover came on bridge thirty minutes early for her watch, in time to give the order to transit. Of course—Protocol dictated that the Captain was on deck for transit.

"Captain on Deck."

Frank and the astrogator snapped off salutes. Frank, not for the first time, thanked whatever gods were listening that the Protocol was written for zero G, or else Kirkover would make them come to bloody attention.

Kirkover looked over the room from her handhold by the door and nodded. "As you were. Report, Mr. Dunston."

"All systems nominal. Solar activity is within accepted parameters, helm and astrogation show us on optimum course through the transit zone."

"Very well." Kirkover nodded again, and pushed off to her station chair. For the next five minutes, Frank read down the checklist and tagged off the teltales on his console. The same teltales displayed on the Captain's console and, in fact, anywhere in the ship that the Captain cared to access them. To Frank, it was just another example of pointless ritual.

"Thank you Mr. Dunston."

"Aye Aye, Captain." Frank saved his sigh of relief until he was out in the companionway, handing "down" towards the mess. Normally, he didn't stress quite so much about Kirkover's obsessions, but then, normally, he wasn't smuggling nukes in Machine Shop Two.

— Three weeks earlier —

Station commander Liu Chin smiled slightly as a new contact appeared on the transit sweep. Even before the identification came in, he knew it would be *Minerva*. Nobody liked Kirkover, but in the eight years since she had taken over the trade route past Evenwood, Chin had never seen her outside the scheduled transit window. There were planetary navies that couldn't boast similar performance. He dispatched the waiting message and went to oversee the docking and unloading.

Minerva released her bulk cargo pods into a trailing orbit behind the station, for leisurely retrieval later. She matched speed and rotation with Evenwood Station as cables snaked out and docking



by Richard Leclercq and James Brown

thrusters flared. The ship and the station drifted gently together and came to rest. Lights winked green on the station and the ship as seals met and locks flooded with atmosphere. Crew started moving back and forth, moving sensitive cargo as well as simply getting off the ship. Shore leave at a can city was not much of a shore leave, but the station did have recreational facilities. Every station sold what every spacer wanted: sex, alcohol, and gravity. In a room overlooking the docking bay, Chin and Kirkover concluded their business. "Everything appears to be in order, Captain." Chin paused briefly, as he always did. "Unless you had any personal arrangements you wish to make."

"I have a selection of earth stock seeds you may be interested in, Mr. Chin. Squash and other gourds, a variety of flowering plants, and mandarin oranges. For the usual arrangement, if you please." "Of course, Captain."

Watching from the floor of the cargo deck, Frank rolled his eyes as they shook hands and parted ways. Evenwood was the only station Kirkover ever bent the rules on, and he was damned if he could figure out why. Although this time, given the cryptic message from Chin, maybe he'd find something out. When he finished supervising the docking crew, he'd see what Chin had to say.

Frank strained to see as he entered the dimly lit restaurant. When his eyes adjusted, he could tell that the owners weren't just trying to save on the power bill: the poor lighting did a reasonable job of hiding the shabbiness of the furniture. With so few people around in the middle of the afternoon, he had no problem spotting the stationmaster sitting in a rear booth. Chin rose as he approached.

"Officer Dunston. I'm glad you were able to meet with me."

"No problem, Mr. Chin. The company is always willing to accommodate our clients, although I will confess your message was a bit, ah, cryptic."

"Yes, my apologies for that. But I have a cargo that needs to be taken to a

drop zone that is along your route, and the parties involved prefer to remain anonymous."

"A side deal."

Chin nodded. "Just so. The pay is eight million Damso Corporate marks, ten percent on agreement, another ten percent when the drop is made, and the remainder on confirmation of pickup." He slid a sheet across the table. "Here are the cargo specifications."

Glancing down at the specs, Frank did some quick math and his eyebrows rose. "Awfully dense for precision machined equipment, isn't it?"

"The principal suggested it was unnecessary to visually inspect the cargo. I have chosen to comply with their wishes. It seemed... prudent."

Frank snorted, then shrugged and slid the specs back. "No side deals on *Minerva*. They're against company policy."

"I'm sure you can appreciate that I do not particularly desire to have this equipment remain on my station longer than strictly necessary, and we see little traffic. It will be several months at best before another ship comes through with a route that passes near the drop area. Nine million."

"It'll take more than that to slip this under the Captain. For twelve, I'll risk it."

"Twelve is too high. It would be easier for me to just dump it and let it drift into the sun."

Either Chin was telling the truth or he was one hell of a poker player; Frank couldn't tell. "Eleven then—this is more than a one-man job; I'll need to involve other members of the crew."

"Ten, I can do, but no higher."

Frank thought about his options. To pull it off, he'd need to split four or five ways, probably. Smuggling what was almost certainly nuclear material was a hell of a risk for two million Damso, but working on *Minerva* was thin on profit, and he was longing to tweak Kirkover's nose. "Ten, and you tell me what Kirkover smuggles in here."

"I believe we have an agreement, Officer Dunston." Chin smiled. "Let me tell you about Evenwood station, and you will learn in due course what your captain is bringing me."

July 19, 2244

Two days after *Minerva* docked at Walden III, the plan started to fall apart.

"Mr. Dunston, the cargo we are supposed to pick up is delayed. The IFL *Kentucky* has transited in-system on schedule, but is several degrees off their projected orbit and it will push them back three days, consequently pushing us back three days.

We can make up the time if we bypass GJ 2005 and NN 4360 and jump directly to GJ 1286. I'll expect you to update the crew schedules to reflect our altered itinerary." Kirkover started to leave the table.

"But... we can't deviate from the schedule!"

"That's not accurate, Mr. Dunston." Kirkover's voice was particularly chill at being defied. "You know as well as I do that we only have a cargo pickup in GJ 2005 about one time in three. We keep the transit on the itinerary in case there has been a drop off, and to maintain consistency, but it isn't strictly required. Keeping our overall timetable is the higher priority."

Frank sat staring in space long after Kirkover had left. "Shit."

— Three weeks earlier —

Frank slid into the booth and leaned in close to be heard over the pounding music. "Thanks for coming, Dave."

Dave Margolin was the Supercargo on *Minerva*, and any side deals would go belly up without his approval; nothing big could get on or off the ship without him knowing. "No problem Frank; anything to put a knot in Kirkover's shorts. What's going on?"

Frank shook his head. "Let's wait for Jess to get here; I don't want to have to explain things twice in this place. NoGo will be right over, he's grabbing drinks."

A couple rounds went by before Jess Anderson showed up. Jess was a former

FN groundpounder from Schwarzvaal who went private and now ran the maintenance crew on *Minerva*. Jess didn't love Kirkover any more than the rest of them did; more importantly, she was desperate not to get dumped back on Schwarzvaal. Only a couple years from retirement, Jess hadn't built up enough savings to afford Olympia, because she was stuck on *Minerva*.

"Ok, here's the deal. Chin has an easy mule run for us, but the cargo is heavy, probably hot, and definitely under the table—which means the Ice Captain won't touch it. It's worth ten million Damso: one upfront, one on dropoff, the rest on confirmed pickup. All we have to do is shove it out the airlock in NN 4360 with a delayed transponder and it's easy street."

Dave started with the obvious question. "How heavy is 'heavy?'"

Frank slid the spec sheet across and the three others looked it over. Even before they'd all finished it, Dave was shaking his head. "This is a lot of mass to hide, Frank. Kirkover spot checks my numbers by god-damned visual inspection, and trying to hide this in the cargo would stick out like a military torch."

"I know. That's one of the reasons I called Jess in on this. Jess, when is the last time we actually needed the zero-g lathe?"

She shrugged. "I don't know off-hand. Not yet this year, for sure, though. Where are you going with this?"

"*Minerva* being an ancient piece of crap is going to work in our favor for once—that thing is bloody huge, and masses nearly what Chin's cargo does. We leave it here and, after the drop is done, we backfill the logs to show it was put in for regular maintenance. Next time through we pick up the 'repaired' lathe and everything is on the up and up. Dave, that cuts down what you have to hide to by about 80%. Can you manage that?"

Dave nodded, a bit reluctantly. "I can shuffle that much. There's always a little bit of slip in consumables."

Dave turned to look at the navigator, N'Guomo M'Bata. "NoGo, you and I

end up with the heavy stress, because we'll have to run the numbers right under Kirkover's nose. She watches the trip numbers like a hawk and she'll notice if we backlog the fuel. That means we're going to have to cook the numbers as we go, and math is your department."

He stretched back and looked at each of them. "I think we can do this, and I'm sick of taking Kirkover's crap. For two and a half Damso I can get the hell off this boat, and that's worth the risk. Is anyone out?"

Only NoGo spoke up. "I think we're all in, Frank; it's a good plan. I just want to know one thing. What do we do if it all goes out the airlock?"

Frank smiled. "I've got some ideas. And if things really lose pressure, there's a little surprise I've been keeping for Kirkover, and a doctor on Walden III that owes me some serious favors."

July 21, 2244

Frank floated outside the hatch and took a deep breath to keep calm. This certainly wasn't the first time he'd been called into Kirkover's wardroom to get yelled at, but it was the first time he was lying to her face instead of just putting up with her crap. He spun the wheel and handed himself through. The hatch was barely closed behind him before Kirkover started.

"Mr. Dunston, can you please explain what the hell is going on? Mr. M'Bata has filed a request to hold to our original itinerary to avoid—" she held up a report—"unnecessary delays due to orbital complications between the ideal transit paths. Meanwhile, Supercargo Margolin has apparently been an amateur astrogator all these years, because he's passed on his miraculous knowledge of a favorable conjunction in GJ 2005 that can cut our delay to a mere 34 hours and suggests that with an extra sustained burn in NN 4360 we can cut that down even further."

Frank took a deep breath. Here goes nothing. "They aren't the only ones, either, Captain. This morning, Jess Anderson put a complaint into my office reporting that the down time through GJ

2005 was scheduled for docking thruster maintenance and that she refused to be held accountable if it didn't take place before our next cargo transfer. The crew on this ship are used to status quo. Change routes and they get their backs up." He gave a convincing shrug. "Maybe we should reconsider the itinerary."

"I'm not going to let this happen."

Frank must have managed an appropriately puzzled expression, because Kirkover's next words weren't stripping him of his rank. "Someone on my ship desperately wants us to go through GJ 2005 and NN 4360, Mr. Dunston." Her voice shook with constrained fury. "I will not allow my ship to be used for smuggling. You will find out who is involved in this and they are never going to work in this company again. I am going over this ship rivet by rivet if I have to, until I find that cargo and dump it. You are dismissed, Mr. Dunston."

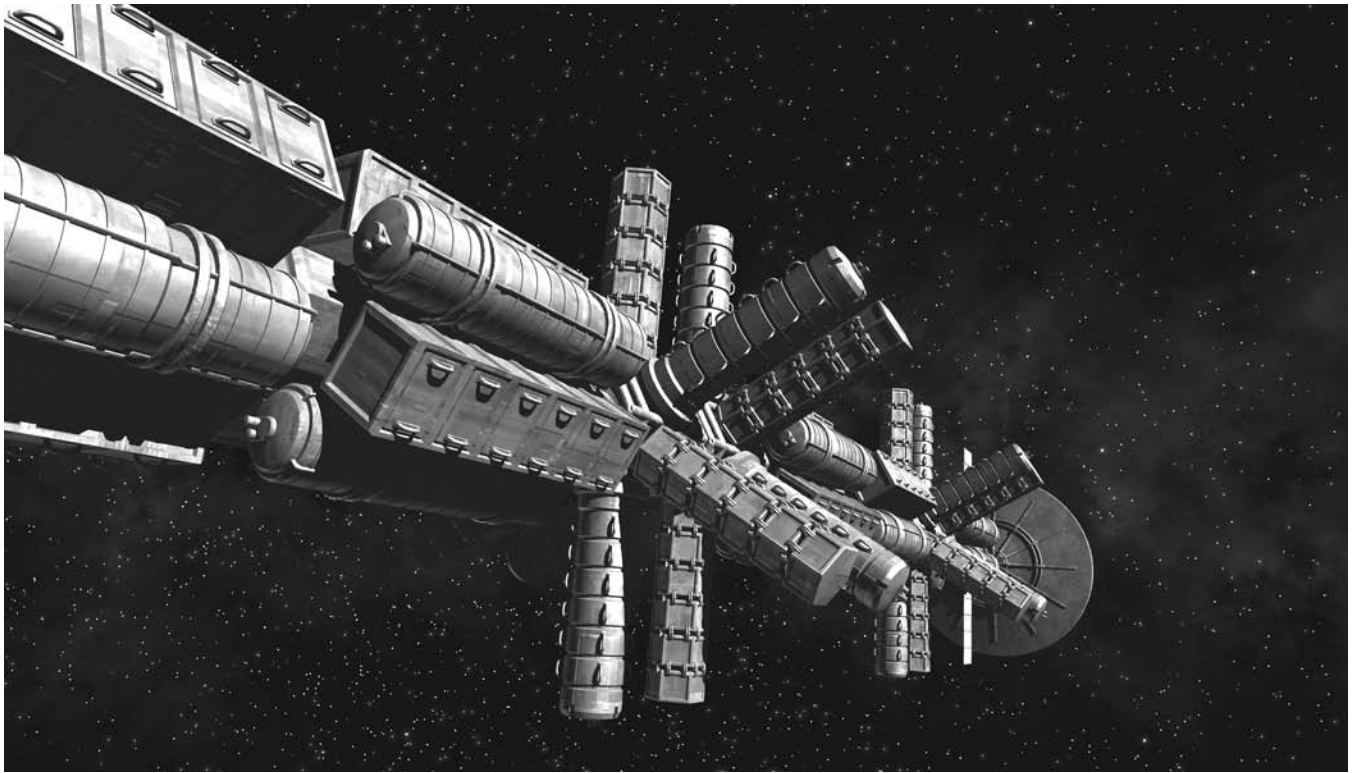
Frank spun the hatch shut behind him and blew his breath out. "Well, that didn't work."

Twelve hours later, Kirkover's biomed reported a mild fever. Most people would have ignored it and kept working, but, just as Protocol required and Frank had hoped, Kirkover reported to the nearest medical facility. The only thing that could have made Frank happier was if he was there to see Kirkover's face.

"Measles? That's impossible!" Kirkover was outraged.

"No captain, just very unlikely." The doctor was unfazed. "Measles was effectively wiped out years ago, but it still crops up here and there. Very rare, but not fatal or even particularly debilitating in a healthy adult. I am, however, required under international agreements to keep you under quarantine for a minimum period of three weeks; more likely five to six for a typical progression. Your ship will be vacuum-exposed and the crew all tested. If this is not an isolated case, it may be necessary to interdict *Minerva*."

Kirkover had nearly blown a gasket, and had only calmed down under



threat of restraint, but in the end had no choice but to concede defeat. Frank had been startled to learn that Kirkover could swear like a dockworker when she snapped, but no amount of bluster could change The Book, and it was right there in black and white. "In the event of medical incapacity on the part of the Captain, the Executive Officer is required to assume command." And elsewhere: "Any crew unable to complete their duties due to medical reasons (such as injury or illness) for periods longer than fourteen days are considered to be unavailable for valid medical cause."

Never mind that the intent of the rules was put in by the union to ensure injured crew were covered under company insurance—taken literally, it meant that, because Kirkover was in quarantine, Frank got the ship. The charges for possessing or smuggling communicable diseases were very harsh, but only if you were caught. Burning Kirkover with her own precious Protocol had been worth the risk.

Relieved of the need for any serious secrecy, Frank asked the others to meet him in Machine Shop Two for

a celebratory drink. And that he had something else to tell them.

NoGo was incredulous. "Seeds? Kirkover was smuggling goddamn seeds?"

Frank grinned. "Yup. Earth-stock stuff. It's not worth a damn thing on any of the colonies because it usually doesn't survive, but Chin's desperate to get his hands on any he can."

Dave was shaking his head. "That's how she could be so damn righteous about side deals! She found something she could trade that didn't exceed her 'personal effects' mass. But what the hell does Evenwood want seed for?"

"According to Chin, back before the Whatever it was one of those utopia stations—some political group with too much money and not enough sense built it to be entirely self-sufficient; one of those 'retire from the human race' deals. When the trade routes collapsed, a bunch of 'em tried to go back to Earth and there weren't enough left to keep it running. Chin got his greedy paws on it after it had been dead for a good fifteen or twenty years, and now he's trying to rebuild the greenbelt."

NoGo was still shaking his head. "I still can't believe she was smuggling goddamn seeds. It's not like they're worth a lot of money. What was Kirkover getting out of this?"

"That's the weird thing. Chin said that all Kirkover ever asked for was unrestricted access to the station greenbelt and hydroponics. Said she locked herself into the area where they're growing something called clover for hours on end." He shrugged. "Must be some reminder of Earth or her childhood or something like that. I'm well on my way to two and a half million Damso, and I don't care." He raised his drink. "To side deals!"

"To side deals!"

August 7, 2244

Frank blinked and shook his head to clear the after-effects of Transit. He stared blearily at the board while fuzzy glows resolved themselves into sharp telltales. Green across the board. Normal transit, only a touch off the nominal orbit, and all without that damn checklist. Frank smirked. "Well NoGo, did you complete the pre-transit checklist?"

He grinned back. "No sir, I seem to have missed it. And yet we still seem to be in NN 4360. I can't understand it, captain."

"I hear you. All right, business. How's our time in system looking?"

"We've got about eighteen hours of burn to get into the transit zone for GJ 1286. We could do it with only six hours of burn and a long drift, but that would have us spending a lot of time in the system, and pushes us well off schedule. As it is, we've barely gained back a day since Walden III."

"Do it. We'll drop the cargo off at the end. That leaves Dave plenty of time to get it to the cargo lock and tagged with the transponder. I'll be in the wardroom if you need me."

He cut to a private channel. "NoGo! Get your ass up here and prep for transit!"

A few painfully slow moments later, NoGo and Jess pulled themselves into the bridge and started strapping in. Jess snapped, "What the hell is going on?"

Frank was grim. "*Garibaldi*."

"Shit. What is she doing here? I thought the last sighting was AD Leonis?"

"It was, but that was at least three months ago. Jess, I want you to handle nav as well as comm. NoGo, don't do anything but get us the hell out of this system." Frank's own hands were flying across his board as he ran course plots. The tapping of keyboards and the soft background hiss of the environmental controls were the only sounds on the

"*Garibaldi* is in-system and moving to intercept. If we dump our cargo she might leave us alone."

"*Garibaldi*? That old Italian frigate?"

"Given the remarkable lack of an Italy for the last 30 years Dave, I'd guess she's gone rogue. Get ready to drop cargo, damn it!"

"Jess, start telling them we're a commercial freighter, we surrender, whatever they want to hear."

"What the hell do you think I've been doing? No response at all. Nav shows she'll reach intercept range in twelve minutes."

"Shit. NoGo?"

"Fourteen to jump."

"Target is still accelerating, now at 1 gravity. She is now on an intercept course with us."

August 8, 2244

Twenty hours and a sleep cycle later, Frank was on the bridge by himself, working through the weather report and waiting for NoGo to come back on watch and start the pre-transit checks. Snide comments about Kirkover aside, there was a fair bit of work for a transit to go smoothly; it just didn't involve three hundred steps.

Deet deet deet deet

It took a couple seconds for Frank to recognize the 'confirmed contact' alert, mostly because there wasn't any traffic due through here on any of the published schedules. He checked the plot and realized it was a ship already in system; it had just lit up for an intercept, and nobody'd bothered to check for IR signatures. He was starting to query the computer about projected flight paths, when the transponder ID came in and things got complicated.

"All hands, full alert! All hands, full alert—this is not a drill! All hands, full alert."

bridge for a few minutes, until finally Frank relaxed.

"We're good, folks. Course plots don't cross within 2,000 clicks, and if she wanted to try and follow us through our jump window, then she would have."

Jess cut him off, beating the alarm by a heartbeat. "Her heat profile is changing! Contact is accelerating—.25g and climbing. She's coming for us."

Frank fought down a wave of nausea. "NoGo?"

"Capacitors still filling, sir. Seventeen minutes until we can jump."

Jess' voice showed tightly controlled panic. "Target is still accelerating, now at one gravity. She is now on an intercept course with us."

Frank nodded, desperately working his own console. He tagged open a comm channel. "Dave, prepare to drop pods and eject cargo."

"What? Why?"

"Dave, drop cargo. If we don't need it to eat or breathe, I want it off the ship and going different directions. Let's hope *Garibaldi*'s hungry enough to stop and collect it all."

Subliminal shudders carried through the ship as explosive charges broke the connections to *Minerva*'s external pods and sent them drifting slowly away. At the same time, the cargo dock opened and crates and bags began streaming slowly out, spiraling away from *Minerva*.

"Frank! Feeding you new plot data; she's cut engines and is drifting in."

Frank nodded in acknowledgement as he integrated the new numbers. "Closest intercept is in eight minutes, at 800 kilometers." He blew out his breath. "No frigate can carry a beam big enough to do anything at that kind of range, and she wouldn't need to get that close to us for kinetics. But don't slow down, NoGo. Just in case."

A few tense minutes slid by as *Minerva*'s cargo drifted further out in all directions.

Finally, Jess spoke. "Closest approach. 783 clicks and now increasing."

NoGo followed on her heels with "Jump in two minutes, cap—"

An alarm blared and Frank's board flooded with red while his face drained white. "We don't have two minutes. Prep for transit and hope we lost enough mass to do it on a short load from capacitors." His board showed a new contact on a direct vector from *Garibaldi*, burning hard at eight g's.

Missile. Frank watched as his future burned closer. It split into 4 separate contacts, all arrowing straight in. No freighter was designed to survive getting holed by a meter-long rod of depleted uranium, let alone four of them. Jess intoned dully, "Twenty-six seconds to impact."

NoGo swore. "Load balanced. Jumping NOW."

August 9, 2244

Another 20 hours later, this time without the benefit of sleep, Frank was fairly confident that the *Garibaldi* was not chasing them anytime soon. All of his projections—this time accounting for a military torch—said that if she hadn't come through already then she would have drifted through the transit point and have to orbit around again. GJ 1286 had a station they were normally due to stop at, but the cargo they were expecting was almost certainly being plundered by *Garibaldi* right about now. The stationmaster wasn't exactly thrilled—neither by the lack of goods he'd paid for, nor by the sighting of *Garibaldi* one jump away—but couldn't really do a whole lot about either problem.

Frank could sympathize.

The four of them met in the wardroom and Dave opened up. "Well, now what the hell do we do?"

"Kiss our ten million goodbye is what we do." Jess was not pleased. "We've got squat to show for busting our asses, and now the rest of our cargo is gone. We might as well vent the ship and save Kirkover the trouble of spacing us."

"Hang on, it's not all out yet. We've got our one up front, and as soon as the mail goes out, there's the coded message to confirm the drop; that's another one. And maybe *Garibaldi* was the pickup, we don't know." Frank was doing his best, but Jess didn't look very convinced.

"If she was the pickup, then why the missile?"

"I don't know. And I'm not about to turn around and ask. I say we go on, business as usual. Company insurance will cover the cargo—acts of piracy are in the policy, and it's happened before. NoGo, you and David work through updating the itinerary with what pickups and drops we can still do and where we can just skip. We'll keep on around until the rest of the pay comes in—"

"If the rest of the pay comes in." Jess muttered.

Frank ignored her. "—and we keep our heads down, pick up the lathe, and Kirkover never knows."

Nobody was big on the idea, but there wasn't a whole lot they could do about it. That seemed to be going around.

January 2, 2245

When the *Minerva* transited back to Evenwood, a Federated Nations frigate was in-system, and any thoughts about last-minute cutting and running evaporated. Things grew steadily worse when docking was complete, and the external pick up showed not just an angry Kirkover, but the stationmaster, an FN officer of some rank, and a trio of very staid gentlemen with guns.

Kirkover barely waited for the hatch seal to crack before she started. "Dunston, you mutinous little bastard, I'm going to..." the hatch swung open to reveal N'Guomo M'Bata. "M'Bata? Where the hell is Dunston?"

"Executive Officer Dunston jumped ship three transits ago. I have been acting commander of the ship since that time."

While Kirkover struggled to assimilate this, the FN officer turned to Chin. "It will be necessary to impound the *Minerva* pending the results of the

investigation. Can your facility take this on?"

Chin merely bowed slightly in acknowledgement. Kirkover exploded. "WHAT? You can't pull my ship, you—"

The officer cut her off. "Captain Kirkover, you and your remaining officers will accompany me to Pacifica for trial, and I would advise you to consider your options carefully. Trafficking in nuclear weapons is not a charge the Federated Nations takes lightly."

Chin walked along the station towards the greenbelt. Even if Kirkover and the rest were completely exonerated, it would be at least a year before the trial wound up. In the worst case, he had a year with the *Minerva* to crack Kirkover's logs and find out where she was getting her seed stock. Best case, he got the *Minerva* as well. A few investments, here and there, and the trial could drag out for quite some time. Some work would need doing to track down Dunston, lest he be tempted to turn state's evidence.

He spun open a hatch and stepped through into the carefully regulated climate of Evenwood's green belt, his eyes tracing the curve of the floor as it arched towards overhead. Ferns and small shrubs grew in carefully tended plots. Two of his station workers were carefully hand pollinating some orange blossoms. One looked furtively over her shoulder, and both bent back to the task at hand. The fruit would fetch a premium price in a few weeks, thanks to Kirkover's mania.

A few dozen paces further, and he reached another experimental area - a patch of compacted packing peanuts under a mulch, covered in green. Less than thirty square meters of Old Earth. The recorded birdsong was a nice touch, he'd thought. Were it successful as an attraction...but no, most of the spacers barely remembered planet-bound life anymore.

He rubbed at his eyes - the pollen here always made them itch. The clover was a nice enough smell, he supposed, but nothing to obsess over.



Schwarzvaalan Travelogue

For someone used to the spaceports on other worlds, Nhlangano's looks threadbare and ill-kept. The landing strips are in good repair, but everything else looks half abandoned, like a deserted city center. Weeds grow everywhere, the concrete on the sidewalks and parking lots is patched and cracked, the windows of the buildings frosted with grime. Some of the outer buildings have collapsed or are in the process of collapsing, and as we made our final approach, we saw a pair of light vehicles chasing what appeared to be scavengers from the ruins of a distant outbuilding – a faint sparking from the back of the vehicles indicated automatic weapons fire. The sight was more than a little disconcerting, but it was not the last time we would have that feeling on Schwarzvaal.

Our visit to Schwarzvaal was underwritten by National Astrographic magazine, with the cooperation of the University of Santissima Trinidad and the Collegium of Buenos Aires on Altiplano. My husband and I have been interested in the biosphere of Schwarzvaal for many years, especially the unique flora that makes the world such a treasure-trove of petrochemicals. Evolutionary development is slowed on this chilly world, and despite the huge number of amino acids present in the ecosystem, biodiversity is quite low. The world was a biologist's dream, filled with unanswered questions and uncataloged lifeforms.

Medical Adjustments

Prior to our landing on Schwarzvaal, we had undergone the usual pre-landing medical examination and treatments. Everyone who has traveled into space has done this, but because of the large number of potential allergens on Schwarzvaal, we had to undergo a more extensive battery of tests than usual. After examining the patient's medical records for known reactions, the tests begin. An area of skin on the arms or thigh (the patient's choice – the area

required is quite large) is inoculated with a representative sample of the potential allergens. Any reactions are noted. From this data, a series of anti-allergy treatments can be prepared and administered during the trip. The first injections are not especially painful for the majority of people, but make up in annoyance what they lack in discomfort. In most cases the area of the tests remains slightly irritated and inflamed for one or two days as well.

Photographer Etien Moreau was an exception – his arm was sore for most of the trip out because of his extreme reactions. "Ordinarily, I just have a couple of minor reddish spots," he said, "but Schwarzvaal is where every allergy in the universe goes to be reincarnated." Moreau had severe reactions to forty-two of the ninety-six most common allergens, and his upper arm was dotted with small, regularly-spaced red spots, each marking a problem reaction. As a result of the tests, Moreau and the rest of our party (myself, my husband, and our two student interns from the university) received inoculations against everything that could conceivably give any of us problems on Schwarzvaal during our visit. We were lucky, in many ways, because we intended on subsisting entirely on off-world rations during our sojourn on Schwarzvaal – many of the inhabitants are not so lucky. Even terrestrial life can end up being reservoirs for some local allergens unless scrupulous care is taken to see that it receives only harmless nutrients. This can have extreme repercussions for some members of the population, as we were to witness firsthand later on.

Our trip to the 107 Piscium system was totally uneventful – and we transferred to the atmospheric interface craft without a hitch. System and close orbit control of the system is the responsibility of the Xing Cheng controllers on the ground, and everything went smoothly as we entered atmosphere and maneuvered into our landing flightway. I wasn't able

to observe the cockpit as we descended, but the trip was smooth and the Xing Cheng flight crew impressed all of us as being highly professional.

Landing

Our approach to Nhlangano was something of a surprise, however. Schwarzvaal itself means black grass or black plains, but as we flew closer to Nhlangano we saw that as we approached the city from the east, we saw that the legendary black grass was fading as terrestrial varieties have literally taken root near the larger cities. The largest patch of green is Robert Olowabi's personal compound, but we were directed on a flight path that did not give us a very good view of it, for security reasons. Our flight path also came in mostly over water, for safety reasons – should anything go wrong, we would crash in the ocean, and be much less of a hazard to the developed region surrounding the city. The spaceport itself is located south of Nhlangano, towards the coast, for similar reasons.

As we disembarked, we were met by Chao Tai, a representative of the Xing Cheng consulate and a lieutenant in the Xing Cheng armed forces assigned to Schwarzvaal. Lt. Chao arrived in a small van, driven by an Xing Cheng private soldier and followed by a decrepit utility truck carrying two unsavory-looking types. These last, we learned were our baggage handlers who would unload our luggage and supplies and take them to our quarters inside the Xing Cheng civilian compound in the city.

My look of concern at learning this prompted Lt. Chao to assure me that our luggage was perfectly safe – the private would accompany the truck to the compound, to insure that everything arrived safe and untouched. Ordinary

by Loren Wisemen

travelers, he told us, are required to bribe the baggage handlers to make sure their luggage doesn't get lost or damaged in transit. Evidently considerable skill is needed to do this properly – too little and the handlers will feel cheated and steal it anyway, too much and they will wonder what you are trying to hide from them and open the bags to see. All of this assumes that the handlers are not Olowabi's special agents, assigned to inspect the bags of incoming visitors for contraband.

Since we were the guests of the Xing Cheng consul, however, our baggage was to be guarded by a man with a gun, and Lt. Chao would drive us back to the city. Approaching the van, I saw it was equipped with bulletproof glass and runflat tires, and was clearly and brightly painted with Xing Cheng markings. As we boarded the van, I noticed that Lt. Chao took the driver's seat, and that there was another PDW in a rack between the two front seats.

From the Starport to the City

We were in the back of the van as the lieutenant drove us to the city, so we could not talk with him. We chatted among ourselves, and looked at the scene outside through the bulletproof glass. Most of the highway was in good condition, but the repairs looked recent. The highway ran alongside a railway, which was also kept in good repair. Nhlangano starport is the main entry point for offworld trade with Schwarzvaal, and the railway is a necessity, as there are probably not enough working trucks on the whole planet to carry the bulk cargos that come and go. Passengers, however, can travel by highway, and thus free the rails for the important traffic – tank cars and hopper cars outbound, boxcars inbound.

The countryside by the highway had been cleared within 500 meters on either side – by “cleared” I mean anything large enough to conceal a person had been removed, burnt down, or blasted into smaller pieces. I have to assume that this was to prevent ambushes by bandits, otherwise I can't imagine why it was so thorough – few things on Schwarzvaal are carried through to such a degree.

We passed through the checkpoint at the city's edge – the sentry in the guardbox raised the barrier for us and stood at attention as we passed. Evidently sparkling clean vans driven by lieutenants do not require an inspection simply to enter the ruins that were once the outer neighborhoods of a vibrant city. I noticed, however, that we acquired an escort, in the form of a light vehicle with a machinegun on a post in the open bed. I gather this was window dressing, because streets through the outskirts of the city had been cleared of all structures large enough to conceal a person for several hundred meters on either side – again, probably to prevent ambush. The neighborhood we drove through looked like it had once been a fairly nice suburb, although it was now nothing but fields of rubble too barren even for the scavengers.

The Xing Cheng Compound

We arrived at the Xing Cheng civilian compound in the early afternoon, and were shown to our quarters. Our bags were already there, although the truck carrying them had left the starport after we did – evidently it had taken a different route. They were intact, albeit slightly soiled from their journey in the open truck.

The compound was surrounded by open fields in every direction, and was constructed of modular housing units similar to those you see everywhere in the Ten Worlds. There was a perimeter fence, but it did not seem to pose much of a barrier. Atop each fence post, however, there was a large floodlight (not turned on in the daytime), and I could see tire tracks around the outside indicating extensive sentry patrols by a light vehicle of some sort. Lt. Chao assured us that the fences were for the benefit of the civilians in the compound. “Olowabi's subjects would never dare harm any of us.” He said.

After we had cleaned up and changed clothes, Lt. Chao (who had picked up a new private as a driver) accompanied us in the van from the civilian compound to the Xing Cheng consulate. We were conducted to a meeting with the vice-consul, who welcomed us to

Schwarzvaal, and chatted with us for a few minutes about the nature of our visit – he was clearly not much interested in the local fauna, and was only interested in the local flora to the extent that it produced raw materials for Xing Cheng. Finally, he signed a stack of papers on his desk and presented the bundle to Lt. Chao.

“I hope your visit to Schwarzvaal is enjoyable. Please let the lieutenant know of your requirements.” He turned and left the room almost before we noticed, leaving Lt. Chao, who was putting the bundle of papers into his briefcase. Noting my quizzical expression, he explained.

“These are your visas, your permits to tour certain facilities of the Republic of Xing Cheng, your permits to hire transport and drivers, and the letters to each of the mayors you will be visiting.” He paused briefly, then continued “We call each of Olowabi's strongmen ‘Mayor.’ It gives them a title and allows them the illusion that they have power.” Bowing, he gestured to the door. “If you will accompany me to the van, we can visit Olowabi's headquarters and get his final approval for your tour.”

Olowabi's Headquarters

The drive to Olowabi's headquarters took us out of the suburbs and into the city center, and it was as different as night and day. Leaving the compound we drove past block after block of rubble, then suddenly we passed another checkpoint, and we were back in a living city. Granted, it was a seedy, run-down, poorly maintained city, but it was clearly lived in. In the late afternoon, there were people on the streets, children playing, a few patched up, jerry-rigged vehicles, and no significant amount of trash on the streets. If there had been a streetcar, I'm sure it would have been running on time.

Olowabi has his headquarters in the old Nhlangano Provincial Government House, which is quite impressive even by offworld standards, and positively palatial here. Built in 2206 from locally quarried limestone, using funding from the massive petrochemical and industrial revenues, the building has it's own power supply, but Olowabi insists

that it run on the city grid whenever possible. Little things like this help demonstrate that Olowabi's rule is efficient and beneficial, and woe betide the generating plant manager who allows the city power service to be interrupted.

We met with Pier Ndebele, one of Olowabi's lieutenants, and he provided us with the equivalent travel documents that we had received at the consulate. He also gave us our officially approved itinerary, a number of long outdated maps, and a few general instructions.

The gist of his talk was that we must go only where Olowabi's writ was in full force, that we must use local labor whenever possible for things such as drivers, baggage handlers, and so on. Ndebele stressed that we would not be needing any security escort whatsoever, as there was no danger to offworlders in any area under Olowabi's control, and therefore none would be provided to us from his soldiers, as they were engaged in protecting civilization from the dangers outside Olowabi's territory. "Of course," he said, "we will provide you with a guide who is familiar with the territory you will be visiting, as well as translators for the local languages."

On the way back to the Xing Cheng compound, Lt. Chao told us that despite what Ndebele had told us, he was ordered to accompany us with four soldiers, just to make sure everything went well. "Things aren't as under control as Olowabi wants," he said, but he cannot officially admit that by sending guards along with every party of foreigners that comes here. He lets us do that, and calls it 'Offworlder paranoia.'"

HISTORY

What were the reasons behind the conditions on the strange world we were about to explore? How did Schwarzvaal become the sick man of the Ten Worlds?

Schwarzvaal was founded in 2175 as a joint venture colony by a consortium of Terran nations. The intent was to establish an ethnically diverse and multi-national colony, and settlers were chosen from more than a dozen nations. Within a year of the initial settlement, just over 79,000 colonists

Schwarzvaal Timeline

2149

107 Piscium system surveyed by deep space telescopes.

2164-2165

RadSat survey determines 107 Piscium II potentially habitable.

2166

Bidding war over settlement rights to 107 Piscium II.

2167

107 Piscium Colonization Consortium formed.

2170

Consortium renamed Schwarzvaal Colonization Consortium

7 Jan 2175

Survey party arrives.

11 June 2175

First colonists land, Port Mandela founded.

26 Sep 2175

Lindiwe Mahlangu appointed governor of Schwarzvaal.

19 Dec 2175

Second wave of colonists lands.

14 Dec 2175

First provincial elections held.

11 Jan 2176

Constitution adopted at planet-wide convention.

1 June 2177

Marius Qwase becomes first President of Union of Schwarzvaal.
First Parliament elected, first judges appointed.

2177

Reproductive Crisis begins.

26 Sep 2179

Government moves to new capital at New Praetoria.

11 Oct 2179

Nhlangano uprising begins.

2205

Fourth stage of colonization.

2210

First formal census of Schwarzvaal conducted.

24 May 2214

News of Whatever arrives, riots, population decline begins.

2220

Robert Olowabi born on Refuge, date and place unknown.

2241

Olowabi employed as mercenary by Damso Corporation.

2243

Failed coup by Olowabi.

2245

Robert Olowabi returns to Schwarzvaal some time this year
(assuming he ever left).

18 Oct 2245

Garibaldi Incident begins.

6 Jan 2146

Garibaldi Incident ends.

2146

Robert Olowabi appointed Mayor of Nhlangano.

2265

The Present.

had founded hundreds of farms and villages, dozens of towns, and six cities. Within a year, a constitution had been adopted, provincial governors elected, and a body of laws passed. Within two years, a president and a parliament had been elected, a new capitol city had been built, and the beginnings of a bustling economy established. The world was an enigma for biologists – over 70 amino acids were present, which was a number unheard of on any other world. The bizarre lifeforms included plants that could create petrochemicals – plastic feedstocks, raw petroleum, and the like, which made two surprises.

The third and worst surprise for the colonists came after only six months on the planet. Because of the unpredictable effects the enormous number of amino acids and allergens in Schwarzvaal's ecosystem had on the reproductive systems of terrestrial life, pregnancies that didn't spontaneously abort or end in stillbirth resulted in children with developmental problems and birth defects. The birthrate of humans and the domestic animals brought from Earth to aid in the settlement dropped to microscopic levels. Without future generations, the colony was doomed.

An intensive research program discovered that if expectant mothers were isolated from most of the local environmental offenders, primarily carried to them in the local foods, the pregnancies could proceed normally. If the infants were likewise insulated from local contaminants until their systems could develop immunities to them, they developed normally. Maternity hospitals became the new growth industry on Schwarzvaal.

The Whatever

When word of the Whatever reached Schwarzvaal, there was considerable unrest. Because of the reproductive problems presented by the local ecosystem, life became more expensive for every colonist on Schwarzvaal. The colonists had demanded and received economic and technological aid from their home countries, and by the time the loss of contact with Sol system, more than half the population was dependant on offworld subsidies of one sort or another. When the news arrived that no more subsidies would be forthcoming, there was considerable economic dislocation. As various governments either tried and failed to take up the economic slack or decided not to make the attempt, there was a major depression. Wages were suddenly inadequate to support many families, prices for even the most basic of needs skyrocketed, and the value of the SVR plummeted, meaning that offworld supplies were more expensive at the very time when fewer families could afford them.

Before things could straighten themselves out, there were numerous riots and demonstrations demanding that government at every level do something to remedy the situation immediately. Some provincial governors managed to defuse the situation, but some did not, and a number of revolutionary movements came into being, seeking a fundamental change in the government, although each of them had a different notion of what this should be.

In general, however, most of the governments, both provincial and

planetary, became more conservative, and less willing to tolerate dissent in any form.

The Garibaldi Incident

The *Alfredo Garibaldi* was an ex-Italian naval frigate that was cut off from Earth after the Whatever, and spent the next three decades wandering the Ten Worlds selling planetary defense services in return for maintenance and supplies. The original crew was largely replaced over the years.

In October of 2244, its hyperdrive underwent a catastrophic failure in the 107 Piscium system, and rather than become involuntary colonists, the crew decided to take over the government using their one remaining nuclear weapon for blackmail. When the Government of Schwarzvaal refused to surrender, the *Garibaldi* dropped the weapon on the (then) capitol of New Praetoria. The airburst caused massive casualties, not the least of which was the government of Schwarzvaal. Although it was not killed outright, both the planetary and provincial governments were mortally wounded by the blast.

Into the chaos came Robert Olowabi, a soldier of fortune who was determined to take over Schwarzvaal. Almost nothing is known of his career prior to his arrival on Schwarzvaal in 2239, but he soon rose to control most of the continent of Praetoria through an interlocking system of alliances.

On Praetoria

I think I am safe in saying that the most bizarre plants in the known universe occur on Schwarzvaal, and I and my husband are familiar with every ecosystem in the Ten Worlds. The animal forms on Schwarzvaal are also rather strange, but they pale to insignificance beside the utter alienness of the plants. We had come to Schwarzvaal primarily to study the plant life, especially the potential ecological effects of the introduction of terrestrial flora, but we had other motives as well. First, however, we had to go through the motions of taking the "official tour" Olowabi offered us.

We loaded our equipment and baggage into the three trucks and the passenger van Xing Cheng provided us (although they had been given magnetic signs proclaiming they were the property of the City of Nhlangano – window dressing for Olowabi's benefit). We left the city shortly after breakfast, and traveled along the well-maintained highway leading to the mining district north of Nhlangano until we came to the first stop.

The Model Farm

Our first visit was to the Baylov farming commune, about four hours drive *northwest* of Nhlangano on the main highway. The Baylov commune was originally the village of Baylov, but most of the population left during the dislocation following the *Garibaldi* Incident. Shortly after he took over as Mayor of Nhlangano, Robert Olowabi sent a crew of agricultural experts and a group of families to found the first of his model farms – this particular one was created especially to grow fruits and vegetables for the Nhlangano University Maternity Center. The farm has been extended and reinforced several times since that time.

We arrived in the early afternoon, and were interested to see that the entire compound had been seeded with terrestrial grass – the bright green almost hurt our eyes after the near black of the flora along the highway. We were greeted by the manager of the commune, Janos Mahler, who took us into the farm's community center – the large common hall used for meetings, movies, and occasional dances. We were shown the displays of children's artwork, a subtle way of showing off how many children lived on the facility, and demonstrating the Olowabi regime's superior maternal care technology.

As we entered the main room, we saw that a table had been laid out in anticipation of our visit, loaded down with examples of the farm's produce: apples, grapes, assorted berries, plums, tomatoes and oranges for the fruits, carrots, potatoes, spinach, celery, peas, three different types of lettuce, and seven different kinds of beans for the

vegetables. We were offered a chance to nibble and then taken on a tour of the farm. The daycare building behind the community hall had a fenced off playground that looked large enough for several dozen children, but only a handful were using it as we walked past. We first visited the housing units, which were rather spartan by the standards of other worlds, but given the time and place we thought them quite adequate. The ones we saw were warm and dry, each family assigned a two-bedroom section of a duplex unit (two families per building). Single workers were housed in dormitories that we were not shown, but they looked well-maintained from the outside. We saw no fences, no barriers, and no guards (we later learned that the protective patrols for the highway had cleared the region of wandering brigands).

The commune has its own water and sewage treatment facilities, and a power generating plant fueled by oil burning turbines. We were not treated to a tour of these facilities, but we were assured that they were among the best on Schwarzvaal, and we had no reason to doubt that statement.

The greenhouses were enormous – there were more than forty of them in the cluster we saw, each covering nearly two hectares of ground, and we were told this was only a small segment of the whole farm. They were built of steel framing members, with sheet metal sides and transparent plexiglass panels in the roof. The roof was opaque with condensation, but the most amazing part was inside: this was an orange grove, but the “tree” were no more than a meter or two high, and grown in hydroponic tanks. The farm manager was practically bubbling over with pride as he pointed out that last fact. Evidently it was one Nhlangano University’s proudest achievements to have grafted orange branches to a short stumpy shrub suitable for cultivation in a greenhouse. The hydroponic tanks allowed more precise control of the nutrients that went into the fruit, and guaranteed that contamination with local elements was kept to a minimum.

“This is our first orange grove,” Mahler said, beaming. “We have been growing the trees for two years, grafting and refining the technique, but this crop you see here is the first we felt suitable to send back to the city. We have to ship them in sealed containers filled with pure nitrogen – at planetary temperature and pressure – because the oxygen content of the atmosphere causes vitamin C to deteriorate very rapidly.”

We asked about the hydroponics. “We’ve had that for almost five years,” the manager said, “it is far better than trying to use the local soil. We have to go through such an involved process to remove the contaminating factors and make it safe enough to use. It was very expensive in terms of both time and manpower.” He patted one of the carboys of chemicals sitting by the door. “These are much better.”

We spent the next several hours looking at plants and animals we had seen all our lives, on many worlds, and trying not to look bored. The purpose of the tour was clearly to impress the offworlders with the sophistication of the facility, with no consideration given to the actual reason of our visit – the local fauna and flora.

After touring two more greenhouses and taking what we hoped would appear to be a suitable amount of photographs, we bid the manager farewell, and resumed our journey. Our next stop was at the Xing Cheng way station, established for the truck convoys from Nhlangano to the oil producing regions up the road. We spent an uneventful night, and spent the next day in transit to the next stop on the Olowabi tour – the petroleum district at Inhambane. This was not intended to be a model of anything special, except perhaps in how it showed that the Olowabi regime can produce natural resources as well as oranges.

The Inhambane Oilfields

Inhambane is the center of the northern petroleum district on Praetoria, and is over 400 km inland. The town itself occupies about the same area as it did in 2245, and the population is greater, since most of the petroleum workers and their families make their homes here. One of Robert Olowabi’s most trusted

underlings, Joachim Van Elder, rules Inhambane – it is one of the regime’s most vital resource areas. Petroleum exports are the largest source of hard currency on Schwarzvaal, and one of the keystones of the Olowabi regime’s economy.

Once again, we were staying at one of the Xing Cheng civilian hostels, which were maintained separate from the town, and near the railroad station. We were allowed to unload our baggage from the trucks, shown to our quarters, and allowed to spend a couple of hours resting and refreshing ourselves.

We were presently taken to the government house, which was aptly named in one sense, as it was a converted civilian dwelling, but was misnamed if it was intended to bear any resemblance to a center of government. It was clearly the home of the former mayor of Inhambane, converted to Van Elder’s private use. It was rather large, and quite well-appointed even by offworld standards, but it was clearly more often used as a pleasure palace than center of government. We met with Van Elder briefly, in what was once a parlor, but now seemed to be a reception hall for visitors. What little we saw of the rest of the house indicated that Van Elder’s visitors were more often party guests than off-world tourists.

Van Elder himself was clearly not used to visitors, and mumbled something about welcome before turning us over to his assistant, who was clearly a representative of Xing Cheng in Olowabi livery. Van Elder then left, and his assistant handed us a printed schedule of our tour and escorted us on the first leg of the tour, which was the loading facilities at the rail yard.

From high up in a railroad control tower, we could see the entire switching yard where the oil trains were loaded and assembled for their journey to Nhlangano. Tanker trucks from the oil fields were driven in one side of the enormous facility (which had clearly been built well before 2245, and was designed to handle a much larger capacity than at present), where huge cranes lifted the detachable tanks off

the truck bodies and loaded them onto waiting railcars. The trucks then went to another area, where they received a different detachable tank (presumably empty) and moved out again. It was clearly intended to impress us, but it was clear that almost two thirds of the side tracks in the switching yard were unused – the rust on their rails was proof that they hadn't seen railcars in quite some time, even if the grass growing on some of the tracks hadn't been a dead giveaway.

Tete: At the Fringe of the Icecap

The next day, we boarded the passenger train to Tete, the town on the edge of the Praetorian icecap. The trip occupied the better part of five days, not because of the distance involved, but because the train had to travel slowly. We were told that this was due to our presence, in the event we wanted to photograph the scenery along the way. Granted, the scenery was striking, but I believe the real reason was that the rails were poorly maintained, and the train could not travel at a very high rate of speed without risking derailment. My suspicions were first aroused when I noticed an approaching train pulling off onto a siding to allow us to proceed. The rails along the route we traveled were double track, allowing trains headed in different directions to travel along the same route at the same time, but the second train had nevertheless been diverted to allow us priority (and prevent a deadly collision). The only reason I could think of was that one set of the rails was in such a state of disrepair that trains could not safely be run upon them.

We arrived at Tete, and spent a few hours photographing the distant glaciers and taking samples of the tundra plant life. While this was going on, our train detached a few freight cars onto the siding at the station, and took on a few. When the railway workers had completed this shuffling, we re-embarked, and discovered that the porter had converted the seats in our roomettes into beds for the night.

Across to Beira

The fishing village of Beria lies on the west coast of the continent of Praetoria, far to the north of Port Mandela. The

train's approach was down a series of curving switchbacks, carrying us across the saddle and down the slope of a huge volcano cone (railroads have limits on the degree of slope they can descend, and construction engineers use the long, gentle back and forth curves of a switchback to descend slopes). At Beria, we changed trains, and were transferred to what is called an observation car, which contained more spacious sleeper rooms in place of the smaller roomettes, and had an observation lounge on the top of the car, which we put to good use during our trip southward to Port Mandela. The western coast of Praetoria is a landscape and seascape of rare beauty, and we were astounded at every twist and turn of the railroad along the way.

By Rail to Port Mandela

The trip down the coastal rail line to Port Mandela was very restful. The scenery was beautiful and quite photogenic, and Moreau's tripod-mounted camera was almost a permanent fixture of the observation lounge in our car. We had the car to ourselves, and took full advantage of it, spreading out to occupy all the sleepers, converting one into an office, and another into an impromptu dining room. Aside from the occasional village or security guard post, the railroad appeared to be passing through unoccupied territory. At sea, we sometimes saw a small fishing boat, but that was the only sign of human exploitation of the water.

Port Mandela

We arrived at Port Mandela late in the day after a long, exhausting train ride, so we went directly to the Xing Cheng enclave, where we were assigned quarters in the civilian dormitories, ate a light meal and went immediately to bed. On arising the next morning, we met one of the more interesting people we were to encounter in our sojourn here – Katrin Ndebele. Katrin's great-grandfather, Jan Kindervaag, was one of the first wave of settlers on Schwarzvaal, and one of the original inhabitants of Port Mandela. She let us read his journal of the trials of the original settlement. It was one of the most moving documents I have ever

read, and we asked to make a copy for publication.

The remainder of our stay in Port Mandela was taken up in a tour of the port district, and the other areas controlled by Olowabi's stooge. Following our previously agreed upon plan, Henri and I distracted our tour guide while Moreau struck out on his own to meet with our contact. The main purpose of our trip to Schwarzvaal was to smuggle certain vital supplies to Colin MacKenzie, a Canadian warlord on Brunswick with whom the magazine had made contact through a number of covert contacts. Travel to Brunswick was restricted, and we would be required to use a hired fishing boat not under Olowabi's control – the Mayor of Nhlanguano would certainly not approve of our trip.

The port district was as shabby as the rest of Port Mandela, but at least it showed some signs of life. There were fully functional boats in the harbor, ranging from fishing boats to cargo schooners. There were, sadly, larger ships in the harbor – huge, rusting hulks testifying to Port Mandela's pre-2245 status as a maritime center. Some of these were rusting at the larger wharves, some had sunk out in the harbor, their upper works serving as mooring platforms for smaller boats.

Henri and I pretended to be fascinated with everything our guide had to say, pestering him with questions and seeking the history of every street, almost every building. After two hours, the guide had begun to tire of our questions, but by that time Moreau had re-joined us and his absence had not been noticed.

Getting to Brunswick

After we were back in our quarters, Moreau reported on his meeting. Our contact had managed to secure passage on a fishing boat for Henri, Moreau, and I. We and our baggage were to be taken to a small fishing village on the shore of the continent of Brunswick, where we would seek out the Canadian Warlord Colin MacKenzie and interview him. The remainder of our group was to go to the Xing Cheng enclave and place themselves under Xing Cheng's

Selections from the Journal of Jan Kindervaag

8 June, 2175: We are in transit to the world, and I have decided to set down my thoughts and experiences as I and my family begin our new life on Schwarzvaal. Sitting in our cramped quarters on the starship, we are all very excited about our new home, and the waiting has made us all short-tempered and irritable. We take heart in the brightness of our prospects on this new world. As a physician, I am a highly valued colonist, and we have been assigned to land with the first group of families in what is to be the first city founded on the world. Anya, the children, and I will share a dormitory room at first, but my papers say that we are on the list to receive one of the first private homes to be built. I am enormously honored.

11 June, 2175: We had to remain in our acceleration cots for most of the trip down from orbit, and it was very hard on all of us. After what seemed like an eternity, but was only seven or eight hours in reality, we came down on Schwarzvaal. We were allowed to leave our cots, but our freedom was restricted to the cramped quarters we had occupied all the way from Earth. Staring at the four overly familiar walls, we waited another eternity to be called to the disembarkation bay – it finally came. We and our baggage – the meager possessions we had brought with us to start our new lives left the ship and stepped out onto the new world. We were glad of the light jackets we had been ordered to put on in the disembarkation bay, as it was quite chilly. The colonization briefing had warned us of the climate, and we were mentally prepared for that. No one mentioned the abominable, pervasive stench, however.

Once on the ground, we saw that the world was well-named – the black plains stretched out in all directions as far as the eye could see, relieved only by the reflection of the sky in the vast ocean to our west. It was, of course, not a true black – the briefing told us it was really a mix of very, very dark greens,

browns, purples and reds – but the difference is academic as far as we were concerned, the plant life absorbs light like a sponge absorbs water. We stood by our possessions, and stared open-mouthed at the alien landscape that we were to call home. For a moment, I had to wonder if we would not have been better off to remain on Earth. Our home there had been only slightly larger than our quarters on the colony ship. And it was not without its offensive odors also.

We moved into our temporary quarters, and I reported to the clinic in the tent that was set up near the disembarkation point. There was little work for a surgeon, so I could take it easy during my work shifts – I merely had to be available in case of emergency. There were very few elective procedures to be performed.

7 July, 2175: The building crews have finished our home – it is the second one on that particular city block – and we moved in this morning. Anya says it is difficult to adjust to the construction noises around us. I find it hard to internalize that all the rooms in the building are for our personal use. Just us, and no one else. We have a small yard, which I will sow with terrestrial grass as soon as I can afford to have a bag of seed sent from home. The school for the children was finished only last week, and they are happy to be in a place where they have their own desk, all to themselves.

27 September 2175: The word came over the newsnet today – Lindiwe Mahlangu has been appointed governor of Schwarzvaal, his term to run until planet-wide elections can be held. One of his first official acts was to appoint an election commission, and as one of the leading citizens of Port Mandela, I have been chosen to serve on our provincial commission. After the local elections are held, we citizens will vote on delegates to a constitutional convention.

Mahlangu also announced the schedule for world wide elections. He is forbidden to run in that election, or in any other on this world, but he is to receive a pension and rumor has it he has already purchased land for a plantation from the colonization commission.

11 October 2175: I went to the first meeting of the provincial election committee, and we laid the groundwork for the new elections. Registration of voters is simple, since the colonization commission has a record of everyone on the world. The plans for the settlement of the remaining districts of the city and the province let us plan for voting places, and shipments of the necessary supplies have already been supplied by the colonization authorities.

1 December 2175: The building crews finally completed the last house in our neighborhood, and the family is due to move in a few days. The neighborhood filled back in October, and the city, as it was initially laid out, is filling quickly. There is already talk of surveying a new suburb. New colonists are arriving monthly, and each ship brings new nationalities. Translation at the clinic could become a problem if this keeps up.

22 December 2175: The provincial elections are over. Colm Patterson was elected mayor of Port Mandela – he is one of the settlers from Capetown on earth, and originally intended to be a farmer, but his administrative talents are too valuable to be restricted to a single plantation. Thoko Ndebele was elected governor of Mandela province.

My bag of grass seed arrived today, but I must wait until this coming weekend to seed the yard. Several of my co-workers have re-planted their yards with grass from Earth, and they tell me that I need not remove the native groundcover – the new grass will soon crowd it out, evidently.

11 January 2176: The constitutional convention adopted the convention today. We are all surprised that it took

them so long, but evidently each passage had to be discussed, even though everything had already been arranged behind the scenes long before. It was clearly all for show, since no significant changes were made to the document.

23 January 2176: Anya is pregnant! It is our third child, which seems totally extraordinary by Earth standards – we were considered profligates for having two children in Durban – but we have plenty of room for a nursery in our glorious new home, and enough love for a dozen children in our glorious new life.

As if to celebrate with us, the grass has exploded in the yard, practically obliterating the native plants. It is good to see the green grass of Earth, as it makes the new home seem more like the old one. It is spreading to our neighboring yards, which angers me a little – I wouldn't have gone to the trouble and expense of importing a 20 kilo bag of seed from Antiplano if I had know all I had to do was wait for one of my neighbors to do it!

28 February 2176: Anya miscarried today.

3 March 2176: I was not home when Anya felt the first pains, and she had Petra, our neighbor, drive her to the

hospital. I learned of her admission while I was in surgery, and Dr Linus called in a replacement so I could be with her, but it was over by the time I got there. I sat in the room and we wept together for our lost child. She came home from the hospital today, and Wilhelm and Ruprecht were relieved to see her, and sensed that she was still not well, despite her attempts at good cheer. The day Anya went to the hospital, I had explained to them as best I could that mummy was sick, and that their baby sister had died, and that we would all be sad for a while.

We decided to wait a year or so, and try again.

28 May 2176: Since Anya's miscarriage, I have discovered that the hospital has experienced a huge number of miscarriages and stillbirths. The obstetrics & gynecology section at the hospital is very secretive about the exact numbers, but rumors are flying, and not just in the medical community.

18 July 2176: Not only are we experiencing miscarriages in inordinate numbers, but also a calamitous increase in developmental problems among newborns. Dr. Van Gelder at the university has spent the last week in our maternity ward. He has been conducting tests with rats at

the university, and believes there is something in the local food or water that is the root cause of both problems.

He has come here because he wanted to study uterine replicators, and they have no human ones in his lab. The Ob/Gyn section has two of them which we use for women who are unable to carry children to term on their own for whatever reason. The replicators have had no problems with premature termination, and Van Gelder thinks it is because they are insulated from the outside environment. The nutrients supplied to the replicators are purified, the water distilled, and everything else filtered and sterilized. Van Gelder wants us to begin a program to isolate pregnant women and newborns, feeding them only offworld food and distilled water, and filtering the air. This technique works with rats in the lab, he says, and should solve the problem.

7 April 2177: The first of Van Gelder's isolated pregnancies have come to term, without problems. He believes the newborns should also be isolated, on the basis of experiments with animals.

1 June 2177: The elections are over. Marius Qwase was elected first President of Union of Schwarzvaal, the world parliament was elected, and our government is well-established.

protection. We had allies there who would hide them until their offworld transport could be arranged. The three of us would eventually return to Standput, where we would leave the world under the protection of Xing Cheng as well.

The Voyage to Brunswick

We left the Xing Cheng compound before dawn, getting out by the simple expedient of bribing the guard at the main gate to look the other way while our luggage was loaded onto the truck Moreau had arranged to hire. The truck also carried the four off-world bodyguards we had hired to accompany us into the wilds of Brunswick. The truck took us through the still sleeping city to the docks, where we again bribed a guard to let us through the checkpoint.

We loaded our baggage onto the fishing boat, and left Port Mandela, all before the sun was up. We were soon well out to sea, and discovered that, once you get away from the shore and the dark plant life, the sea on Schwarzvaal is very much the same as those on Pacifica or Earth – the blue takes over, and things brighten up, especially on a sunny day. If it were only warmer, everything would be perfect.

Borstel am Zee

Borstel am Zee is a small fishing village on the coast of the continent of Brunswick, inside the territory ruled by the German warlord Götz Von Berlichingen. The village itself is controlled by Helmut Baumgardner, a small-time thug whose only redeeming

quality is that once bribed, he stays bought. Baumgardner was "persuaded" to allow us to hire a number of his people as porters to carry the supplies we had brought along with us. The bribe was high tech goodies that he could trade to other warlords for far more than their value, but nothing that could be used as a weapon – especially against us.

Across the Wilds

Entering the bush was to go from the light of the seacoast into the dark. The trek across the wilderness of Brunswick was carefully calculated to take us through the least occupied portion of Götz Von Berlichingen's territory. Our bodyguards had experience in this region, and had been through it several times before, on missions we

did not enquire into and which they did not expand upon. Our porters were also experienced at their jobs, and also seemed to have done it all before. We eventually came to the edge of Götz Von Berlichingen's territory, and awoke one morning to find our porters gone, although our bodyguards told us this was part of their contract, and that nothing critical had been taken. Evidently their reputation was at stake.

Our guards told us that we should remain in camp and wait to be contacted. This happened shortly after dawn the next day.

Contact

Our camp was approached by a lone individual, who approached with a great deal of noise – much more than was normal for anyone we had seen moving in the bush on Schwarzvaal. My surmise was that he did not want his approach to be taken as hostile, and this was later shown to be correct. He stopped at a range of 100 meters or so and hallooed the camp in English. Henri speaks English quite well, so he conducted the discussions – I speak it well enough to get by provided I don't get involved in scientific discussions.

Our visitor approached and we learned he represented Colin MacKenzie. We showed him the supplies we had brought, and asked to be taken to MacKenzie. Fortunately, MacKenzie had briefed his messenger well, and had also made preparations. Within hours of our contact, porters from MacKenzie's people had arrived, and we were once again on our way.

We arrived at MacKenzie's campsite shortly after noon four days later.

Colin MacKenzie

Colin MacKenzie is a tribal leader of Canadian descent, whose people control approximately 21,000 hectares of land north of what used to be New Windsor on Brunswick. He is opposed to Robert Olowabi and his regime, and allied with a number of like-minded Canadian tribes on Brunswick. Although his people number less than three thousand, and are scattered over many kilometers of what we would call wilderness, his

is the most advanced of the Canadian tribes on the continent.

MacKenzie himself is hesitant to talk of his past, but discussions with some of his lieutenants revealed that he had once been a faction leader in Columbia City under Henry Vatsa. MacKenzie controlled the section of Colombia City that had once contained the provincial hospital and maternity center, and did his best to get it operating again, despite the lack of supplies and equipment, and the unreliable support of Vatsa himself. When Vatsa decided to throw his lot in with Robert Olowabi, MacKenzie and his followers fled the city, taking as much of the hospital equipment and supplies as they could carry. MacKenzie attempted to resettle near New Windsor and re-open the maternity center there, but within a few months, one of Olowabi's patrols found it. The fledgling facility was destroyed, and MacKenzie's dislike of Olowabi became a deep and abiding hatred. He and his followers fled New Windsor and MacKenzie's natural leadership enabled him to merge his tribe with several existing groups in the region north of New Windsor.

As we observed MacKenzie over a period of days, we saw that he is genuinely concerned with the welfare of his tribe, and rules them with a firm but fair hand. From the beginning, he insisted that he ruled at the will of his people, and calls an annual meeting of the various subgroups to hold a vote on his leadership. He offers to stand down in favor of any other leader in the tribe, provided the majority of the tribe assents. He has never been seriously challenged.

Over the week we were with him, I could not help but contrast his personal, hands-on method of government with the isolated strongmen we had encountered everywhere else on Schwarzvaal. He was open and above board in all our dealings with him, and instantly consented to our interview (which will be published in a special issue of *National Astrographic*, later this year).

MacKenzie was overjoyed to receive the gifts we had brought him – tribal

leaders such as he value medical supplies over all else, especially those of use to their maternity clinics. MacKenzie's clinic is a source of great pride to him and his followers, since it represents the future of his family, his clan, and his tribe – children are especially valued because of the effort that goes into their birth and early years. It has taken many years to build it, staff it, and supply it, and MacKenzie is obsessed with its protection. For this reason, we were especially honored then he decided to take us on a tour of his clinic. We later discovered that we are one of the few groups of outsiders to see it.

The clinic itself is unremarkable – dozens of stone or adobe structures, carefully camouflaged to look like any other village in the region. The expectant mothers are housed in small huts, one or two each, scattered throughout the compound, roofed in thick layers of sheet plastic covered with thatch to make them look like farming huts from the air, in case a recon aircraft is in the area. MacKenzie is not concerned about aircraft in the hands of the Xing Cheng patrols flying out of Columbia City – those are interested in bandits, not farmsteads or villages – it is only Olowabi's patrols (from the same city) that MacKenzie has to be concerned about, and those have very few aircraft at their disposal. The plastic in the roof of a maternity hut is thick and opaque, the usually kind made by tribal farmers on Schwarzvaal wherever there are ruba trees. What is unique about the maternity huts is that they have windows of thin, transparent plastic that lets the sunlight through but keeps out the contaminants that can cause miscarriages or defects. Ventilation is provided by filtering air through fibrous air filters, similar to those in use in the HVAC systems in advanced buildings, but these are laborious made from plant fibers MacKenzie's people call kopak, after a similar substance on earth. The air thus treated is not perfectly cleansed of contaminants, but it is clean enough to reduce the rate of problem pregnancies by seventy percent – still horrendous by civilized standards, but vastly better than is normal on this world. MacKenzie

can do nothing about the problems caused by the high oxygen content of the atmosphere. The air is moved by fans driven by a man-powered treadmill, another of MacKenzie's innovations.

MacKenzie had a doctor at his clinic until last year, when a party of Olowabi's raiders captured her while she was on a trip to Borstel am Zee for supplies. Martya Karwal was an Olympian volunteer smuggled in by one of the numerous organizations horrified by what they see as Olowabi's genocidal policies. Martya brought supplies and equipment, but her main contribution was knowledge. As a citizen of Olympia, she should have been returned there immediately, but MacKenzie has heard rumors she is still in Olowabi's custody, working at one of his maternity hospitals. People can officially vanish here quite easily – her family may have been told that Martya was killed by MacKenzie's tribe or by bandits (National Astrographic has been unable to locate any of her family). For now, MacKenzie's clinic uses the seven nurses Martya trained while she was here. There were eight, but one was kidnapped recently by Fahber, the German warlord to the west, who probably wants to set up a maternity clinic of his own.

Clinics

The greatest problem for the clinic is the food supply. Experiments have shown that proper diet is vitally important to a successful pregnancy on Schwarzvaal – it must be as free as possible of contaminants and allergens. This can be accomplished only by greenhouses, and those are very hard to conceal from aerial observation. Every tribe on the planet, however, tries to maintain greenhouses to grow contaminant free fruits, vegetables, and small livestock such as chickens or guinea pigs, so the presence of greenhouses in an area is not proof that there is also a clinic. MacKenzie's people try to space out their greenhouses, so as not to provide a clue to the clinic's location. Olowabi's raiders still destroy them from time to time, but raiding too many is likely to bring a reprimand from Xing Cheng in response to offworld interests.

Columbia City

Once a thriving seaport and manufacturing center, Columbia city is but a husk of its former self. Although it managed to survive the aftermath of the Whatever relatively intact, its economy slowly declined and its government became increasingly dictatorial as the years passed. The *Garibaldi* Incident provided the straw that broke the camel's back, and the city and provincial governments collapsed into dozens of squabbling gangs. As rivalry became warfare, the population dropped catastrophically as the citizens fled the city for the allegedly safer countryside. Industrial plants were abandoned, the shipyards fell apart, and the railroads and highways began to deteriorate from lack of maintenance. The populace mostly fled the city for the countryside (which was not happy to see the additional mouths to feed), and most became bandits or died within a very short time.

Henry Vatsa is the latest in a series of warlords to control the port district of Columbia city, deposing his predecessor five years ago in a nearly

bloodless coup. Vatsa immediately sent out feelers to Robert Olowabi, and finally concluded an alliance – by sending his wife and children to Nhlango as hostages to insure his loyalty. This has allowed Olowabi to gain a foothold on Brunswick, and support a small contingent of allegedly anti-brigand patrols that are actually engaged in suppressing non-approved maternity clinics on the continent. Olowabi also keeps an "embassy" near Vatsa's capital (the former Columbia City harbor master's offices), mainly to make sure that Vatsa behaves himself and to keep an eye on Xing Cheng's presence on Brunswick.

Xing Cheng maintains a small base on the southern outskirts of Columbia City, at the former airfield there. The base contains three Xing Cheng military scout helicopters and their ground crews, plus a small security contingent. Officially, the contingent acts to suppress brigand activity, but the real purpose is to keep an eye on Olowabi's actions on Brunswick, and help keep atrocities by Olowabi's patrols to a minimum.

Greenhouse construction requires four things: thin, transparent sheets for the roof, a lightweight but strong framework to support the roof, decontaminated soil, and thick sheets under the soil to prevent recontamination. Each of these is needed in large quantities, and a significant number of MacKenzie's people are almost constantly involved in making them.

The main problem in constructing a maternal greenhouse is proper preparation of the soil to remove potential contaminants and isolation of the prepared soil from the rest of the environment. Isolation is achieved by either clearing an area down to bedrock or sealing the soil with thick sheets of ruba plastic sheet. The sheets are laid down in overlapping layers, and the joints sealed with ruba sap to make a waterproof substrate for the purified

soil. Care must be taken not to puncture this layer, so the workers are not allowed to wear shoes during the process – something which must make for some very cold feet by the end of the day.

The soil itself must first be roasted at a high enough temperature to cause the allergens within it to break down into their component compounds. It is done in large pans, a few hundred kilos at a time, and is a very labor intensive process: the fire underneath the pans must be constantly tended to maintain the proper temperature, and the soil being processed must be constantly raked and turned for optimum heating. During the process, allergen pure organic material (usually night soil from the maternity latrines) is mixed in and the fire is allowed to burn down. After a few hours, the soil is raked into a mound and allergen free vegetable matter (usually

garbage from the maternity kitchens) mixed in. When the fire has gone out and the pan cooled enough not to melt it, a ruba plastic sheet is wrapped around the pan and the mound allowed to compost for several weeks. When it is done, it is quickly carried to the greenhouse and spread on the prepared substrate (again, the workers cannot wear shoes).

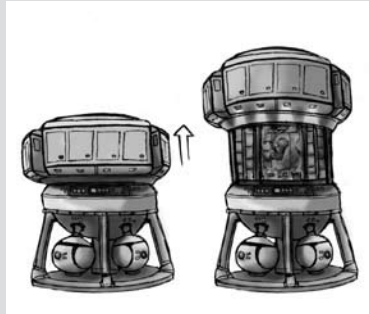
Few greenhouses can raise trees, at least not very large ones, so fruits such as apples and pears cannot be grown in most places. Their trunks and root systems are too large for the substrate, and the trees either die, fall over, or pierce the substrate. For fruits, MacKenzie's people grow berries, grapes, melons, and anything else that grows on a bush or a vine. MacKenzie even knew of the detrimental effects on vitamin potency due to the high level of oxygen in the atmosphere. What a remarkable man!

Grain is especially hard to raise in any quantities under greenhouse conditions, so the expectant mothers at the clinic see little of it. Starches are supplied from other sources, such as potatoes, yams and cassava. MacKenzie told us he was hoping to be able to grow food hydroponically, but lacked the equipment and nutrients.

Livestock is wasteful of plant nutrients, but some types are raised for the maternity clinic. Chickens and ducks do well on vegetable scraps from the maternity clinic's kitchens, and especially enjoy feeding on the terrestrial weevils that somehow make their way into almost everything given enough time. Their eggs are a precious commodity in the clinic's kitchen, and are rationed among the expectant mothers, since they cannot be preserved for long. Aside from a few kept for breeding, the males are eaten.

The clinic also keeps two small goats, whose milk substitutes for those mothers who cannot produce enough. Even though there is no shortage of nursing mothers willing to take on another woman's child, there always seems to be a shortage of milk. The animals must be maintained in a barn sealed from outside contaminants as thoroughly as is the

Uterine Replicators



A uterine replicator is an artificial womb, designed originally for mothers who were too weak or otherwise unable to give birth by conventional means. The unit simulates the lining of the uterus and interfaces with the placenta when it develops after the implantation of the fertilized egg.

The most modern versions take up about 0.5 cubic meter, are computerized, and require a daily supply of fresh blood (much like a dialysis machine), several liters of sterile distilled water, assorted nutrient solutions, and a constant power supply. The machines supply the developing fetus with nutrients, oxygen, heat, and even the sounds of a beating heart, peristalsis, and human voices (normally recordings of the parents). A fully-equipped unit with nine months worth of nutrients and supplies weighs 100kg (including its shipping crate).

maternity ward, and the animals dung provide a valuable source of contaminant free fertilizer for the greenhouses – an added benefit.

Plastic Sheet

One of the fascinating things I observed while with MacKenzie was the manufacture of the extremely thin and almost transparent sheet plastic used in their greenhouses and as windows in their maternity huts. I had seen it elsewhere on Schwarzvaal, of course, but one of MacKenzie's lieutenants has perfected a means of mass-production, involving an extremely simple process and some parts looted from New

Windsor's abandoned factories. As it is everywhere on Schwarzvaal, the sap of the ruba tree is used, but must be thinned to a watery consistency using one of several natural solvents extracted from other plants. The thinned sap is poured onto the surface of a pan filled with an inch or two of water, spreading out in a very thin layer, and the solvent allowed to evaporate. When the solvent is gone, the thin sheet of plastic is cut loose from the edge of the pan, removed, and the process begins again. It is a slow procedure and can only produce sheets a meter or two square at the largest. MacKenzie's man invented a system for producing rolls of infinite length using machinery. The process requires a long, narrow pan (half a meter wide) with an inch or so of water in it, sloping gently downwards. Heated water is added to the pan at the top and allowed to flow downhill, with the thinned sap poured in at the top end from a wide trough that delivers a continuous thin sheet to the surface of the water. As the thinned sap spreads out on the surface, the movement of the water pulls it along, and it is replaced by more sap. As the sheet moves along the pan (workers keep it from sticking to the edges), the hot water speeds the evaporation of the solvent, and the sheet begins to solidify about the time it reaches the end of the pan. When this occurs, a worker takes the end and feeds it through a pair of metal rollers (oiled to prevent the sheet from sticking) and moved into the next pair of rollers, a meter or so along, and so on until the plastic has hardened. The rollers gently pull the sheet along, and once the process is started, a continuous sheet is produced for as long as the raw materials are available. It is similar to the process used for making rolls of paper, but much less sophisticated, although it gets the job done and produces roll after roll of the material. MacKenzie started with a single machine, but soon built others when he discovered he could trade the resulting rolls to other tribes. He has begun, in his own unsophisticated way, to create a manufacturing center and a product he can trade for things he cannot grow or make himself.

Weapon Shops

During our visit, MacKenzie trusted us enough to tell us a little about one of the greatest secrets on Schwarzvaal. Brunswick contains exploitable deposits of iron and other metals, and many of these areas are occupied by tribes and clans allied with MacKenzie and his people. Using knowledge passed down from generation to generation, some of the tribes have learned to mine, smelt, and work the iron deposits into steel, and have recently begun manufacture of weapons. I was astounded at the level of sophistication that a well-trained artisan can achieve with hand tools. MacKenzie showed us two: the first a short, stubby-looking weapon which I later learned was a submachinegun similar in design to an old Earth weapon known as a Sten Gun. The second was an automatic rifle which is descended from a design by a Russian named Kalishnikov. Using hand tools, dozens of local blacksmiths are turning out weapons, one by one, to someday be used against Olowabi's patrols and any tribes allied with them. The main holdup is ammunition – the submachineguns used a common pistol round, the Kalishnikov a rifle round, both of which require machinery to manufacture in quantity. MacKenzie told us he wanted to contact someone offworld who would give him the knowledge and tools necessary to begin large-scale manufacture of both weapons and ammunition. He knew enough to know that while he could make small numbers of the cartridge cases by hand, and load them with homemade propellant and primers, he could not possibly conduct any significant campaign without much more ammunition than he can manufacture on his own. He is also aware of the other drawback of the "individual craftsman" method of manufacture: parts are not completely interchangeable. Should an extractor or a firing pin break, the replacement must be filed and fitted into place by an armorer whose skills must be almost as great as the original maker of the weapon.

Departure and Capture

After a week with MacKenzie, we had completed our interview, and taken

hundreds of photographs. It was time to return to Borstel am Zee. For our return trip, we decided to take a slightly different route so as to see and photograph more of the countryside – this decision was to prove disastrous.

Our new route took us through a region newly populated by a band of brigands working as smugglers – ironic, in one sense, because we ourselves had smuggled medical supplies to Colin MacKenzie. Neither our bodyguards nor the guide MacKenzie sent along with us knew of the presence of this group, because they had newly arrived in the region.

Despite our bodyguards' superior weaponry, we were taken by surprise and captured, although our men gave good account of themselves before being forced to capitulate. Two of them were badly wounded, and one was killed by one of the smugglers. I do not know precisely how many casualties they inflicted on the smugglers, but they gave better than they took.

Our equipment and baggage was confiscated, including Moreau's cameras. Fortunately, all of the photographs he had taken of MacKenzie's encampment had been uploaded to the computer system carried by the portion of our party that had sought asylum with Xing Cheng (through Schwarzvaal's comsat system).

Imprisonment

The smugglers were bringing weapons and ammunition to Steinberg, one of the German warlords on Brunswick who has yet to decide whether or not he supports Robert Olowabi. The surviving mercenaries had "blood chits" – documents in several languages attesting that offworld supporters were willing to pay ransom for their safe return. Sadly, this was one aspect of our journey we had not prepared for, and seems a serious error in retrospect. We did manage to convince the smugglers to take us to Steinberg, in the hopes that we could arrange for ransom through either the Xing Cheng or Altiplano consulates.

We were taken to Steinberg's camp, and handed over to him. Like most warlords,

he wasn't set up to handle prisoners – few warlords have a penal system set up – and we were a slight problem to him until he decided to evict a family from a stone hut and use that as our prison.

Rescue and Aftermath

During our imprisonment we were fed solely on local foods. Fortunately, we had been allowed to keep our supplies of anti-allergen medication, and did not suffer too much. Moreau suffered occasional asthma attacks, but they were minor, and we were all used to helping him deal with them.

Our mercenaries were taken from camp, and we later learned that they were indeed repatriated without any complications. I doubt I will ever return to Schwarzvaal, but if I do, I will make arrangements for the entire party to be covered by "blood chits" – the name sounds horrendous, but evidently the principle has a long and well established history.

After nearly two weeks of imprisonment we were told that we had been ransomed, and were to be released. To our chagrin, we discovered that we had been ransomed by the Brunswick representative of Robert Olowabi, and were to be handed over to a party of his thugs. We were very concerned at this development, because we knew of Olowabi's dislike of anyone who threatened his monopoly on pre-natal and pediatric medical care on "his" turf. We were turned over to half a dozen armed men, who seemed to be more disciplined than most of Olowabi's thugs, and wore what could be called a uniform, in that all of them were dressed very much alike. We left Steinberg's encampment shortly after dawn.

It seems almost anticlimactic, but two days later, on the way to Columbia City, we were rescued. The activation of our bodyguards' "blood chits" had alerted the magazine to the fact that we were in jeopardy, and a mission was mounted to locate and rescue us was mounted by the Xing Cheng consulate.



Biology of Schwarzvaal

The lifeforms of Schwarzvaal show the characteristic mix of unicellular and multicellular degrees of complexity. In comparison to the diversity of other worlds however, the diversity is depauperate. The reason for this limited diversity remains a topic of hot debate. The low level of radioactive content in the continental basalts may have something to do with it, but this is by no means proven or the sole cause. The ecological indicators point to a system under stress that has failed to recover from a past bottleneck, or is in the throws of a climatically driven constriction. The presence of large quantities of sulfur in the ecosystem has some effects (such as the inhibition of carbonate shell formation in marine animals), but is not a major factor other than the pervasive odor that it leaves in the atmosphere (which most inhabitants eventually stop noticing), and the effects that sulfur dioxide and other sulfites can have on those sensitive to it. Perhaps the biggest indicator of the degree of environmental change underway on Schwarzvaal is the slow disappearance of the bogs. While there is no doubt that the natural bog process of terrestrialization is simply reaching completion in some locations, this alone does not explain the widespread decline in the extent of Schwarzvaalen bogs. The other major mechanism is a regime shift. Triggered by reducing precipitation (which can no longer maintain the bogs at their greatest extent), the composition of the dominant floral communities shifting to more open ground cover. In turn, this allows trapped water pockets to evaporate, destroying bogs maintained by paludification. This shift in flora is also leading to a subtle change in overall albedo that is acting to accelerate global cooling. Now that this has been realized there is widespread concern about where this positive feedback system may lead.

Subterraneanly, things are more positive on Schwarzvaal. Thermophilic endolithic life, mostly (but not completely) unicellular, exists in the interstitial spaces in the megaregolith crust to considerable depths and pressures. While such subterranean communities are actually present on all known life-bearing worlds, the magnitude of Schwarzvaal's (in terms of biomass) marks it out as one of the greatest divergences from the biosystems of other worlds.

BIOCHEMISTRY

The most distinctive feature of life on Schwarzvaal is that fact that genetics are mediated by PNA (peptide nucleic acids) instead of DNA. This fact, in and of itself, is of little interest to anyone but xenobiochemists. Other aspects of the local biochemistry are more important to the inhabitants of Schwarzvaal. The world's ecosystem has over seventy amino acids, and new ones are detected from time to time. Most of the amino acids necessary for human nutrition are present and those that aren't are easily found in the crops and food animals introduced to the world, but some of the surplus amino

acids have caused immense problems for the colonists. With such a large selection of foreign proteins in the ecosystem, it was inevitable that some would interact with the human biochemistry in unpredictable ways. While there is little protein chirality in the local ecosystem (meaning that the vast majority of local proteins are digestible to humans) the human body cannot use all of the amino acids present in the local diet. This is not in and of itself uncommon. Humans cannot use all of the proteins in the Terran ecosystem either. The human body disposes of unused amino acids in various ways, usually without difficulty.

The greater percentage of oxygen in the atmosphere means that book lungs and other less-efficient forms of respiration will work for larger organisms – most Schwarzvaalan fauna would die of suffocation within minutes of exposure to an Earth-normal atmosphere. The copper-based hemocyanin compound, common among arachnids and mollusks on Earth, is the usual oxygen-carrying agent in Schwarzvaal bloodstreams. Hemocyanin binds to oxygen more tightly than hemoglobin (which is unknown in Schwarzvaalan organisms), and thus is more useful as an oxygen storage agent than for the rapid release at the tissues. Schwarzvaal life is thus capable of spectacular bursts of activity, but has low stamina compared to Terran vertebrates.

ECOLOGY

In contrast to many other worlds, the marine and aquatic zones of Schwarzvaal are more prolific than the land masses. They support higher biodiversity and early studies suggest, may even support greater total primary productivity. On land, the most productive areas are riparian, hugging the edges of the major river systems, deltas and coastal plains. The interior of the continents are dominated by xeroscapes (cold deserts), where the diversity of life is much lower.

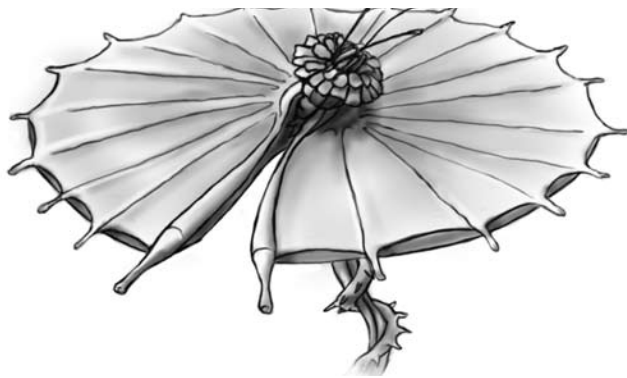
FLORA (PHOTOHETEROTROPHS)

Schwarzvaal plants reproduce sexually and asexually, in an astonishing array of techniques. In this and in many other ways these plants are suggestive of Terran pin-molds.

The flora of Schwarzvaalan are thermotrophic, which means they use heat differentials to generate sufficient energy to catalyse simple photosynthetic reactions. The chemicals involved have given the plants very deep hues, maroons, midnight blues, deep purple and inky browns. From a distance this makes the vegetation look black. Aquatic species often have large floating fronds, while fully terrestrial species show typical xerophyte

*by Loren Wisemen
and Beth Fulton*

features (needle-like forms, rolled leaves, coverings of fine hairs, dense bodies with scale-like leaves). Many also have defensive structures, such as thorns and stinging hairs. Few of these species grow to great height, with the tallest reaching only a few metres (if that). The majority of the native vegetation really does not grow much beyond 1.5 to 2 metres and significant tracks of bog, moorland and steppe-like areas stretch across the more fertile areas. As herbivory is widespread, the vegetation on Schwarzvaal has developed hydrocarbon-based allelochemicals. These highly flammable chemicals facilitate seasonal firestorms that are needed for germination in many species. While intense these fires do not naturally cover extensive areas in a single season and so do not pose an overwhelming threat to the human inhabitants (it is by no means any easy place to live, but its not impossible either). A human industry has grown up around the processing of Schwarzvaalen plants for oil and bizarre complex hydrocarbons.



The most common plant of Schwarzvaal is the Torf Löwenzahn (or “peat dandelion”, aka bogweed), with large, but highly internally partitioned floating leaves, superficially like water lilies in appearance. The leaves are a deep purple (only a shade away from black), and have a centimeter thick heat engine layer between the hot black top and the icy waters they float on. Related species have clusters of concave petal-shaped “collectors” that are arranged around the leaves. These collectors are actually highly modified (reduced and concave) leaves that are coated with a waxy cuticle and minute hairs, giving them a highly reflective coating. Epiphytic species can often be found growing on the body of the peat dandelion - in fact the yellow flower commonly found on this species (and the genesis of its name) is that of a parasitic epiphyte not the plant itself (which has small blue feathery reproductive fruiting bodies).

Of economic significance is the black sugarmoss, which has a famed delicate flavor and being non-chiral, is non-fattening. Another sought-after delicacy is the veldt truffle.

Around settlements invasive Terran grass species may spasmodically compete with Schwarzvaalen vegetation, creating mosaics. Nevertheless none are capable of supplanting Schwarzvaal's surface plant life in the medium to longterm as

they are not capable of withstanding the combination of the Schwarzvaalen fauna and environment. Those species that have internal silica crystals, making them less palatable are in capable of withstanding the quick succession of fire and ice scour typical in many areas of Schwarzvaal. The only Terran species making any inroads on Schwarzvaal are alpine Eucalypts, which have faced similar evolutionary pressures. Moreover, whereas these Eucalypts grow as sparse woodlands on Earth they form dense, almost impenetrable thickets on Schwarzvaal. This makes them unsuitable as forage for many of the local herbivores, and those species which can access them are only slowly acclimating to the new range of allelochemicals presented by the Eucalypts.

Fauna

One of the most striking features of the biodiversity crisis on Schwarzvaal is that does not support as many different bodyplans as seen on most other worlds. The dry conditions on Schwarzvaal mean that water conservation is a driving force on the ecology. As a result, armored forms are common on terrestrial surface dwellers and in secondary invaders of the oceans. These moult soon after major burns, when growing conditions are at their peak. Hence, the majority of Schwarzvaalan land fauna are a superficially arthropod-like. They are characterized by exoskeletal segmented bodies (at least at some point in the life cycle), though the number of segments is often limited.

The blind megalotectitheres dominate the mid- and low-latitude grazing lands. These have a roughly “merostomoid” form, with large rounded or triangular head shields, segmented body with dorsal plates, short tail spine, multiple ventral shuffling columnar legs and a pair of anterior pentaramous appendages. These forward appendages are strikingly unusual. At their base (where they attach to the underside of the head shield) they are quite stout, half as wide as the animal at that point. The first two segments of this section tend to project ventrally and then there is a flexible joint segment that allows 270 degrees of flexion dorsoventrally and 180 degrees laterally. From this joint there are three more stout but tapering segments, the last tipped with an elongate segment that tapers almost to a point. The top of this final segment has a fork-like clawed tip as well as the basal connection points for 4 annulated whip-like structures that are as long (or longer) than the entire robust portion of the appendage. These structures are used for a wide variety of purposes, including: antenna-like sensory detection; grasping food and passing it to the mouth (which sits at the end of a short flexible snout located in behind these forward appendages); sweeping of the substrate during nesting and courtship displays; probing the ground ahead of the animal to check for sediment stability; and reaching back to clean the animal's dorsal plates. The Krebspinne (or Crabspiders) are the most common of these grazers.

Predatory forms include seasonal species that incubate, encyst or go into torpor through the dry winter and hatch with the fire storms to feed on the vulnerable moults. Others have beaks and claws with immense pressure capacities (they can easily puncture things humans consider well armored). While

attacks on humans are not unheard of they are not exceedingly common. Those predators on Schwarzvaal large enough to pose a real threat to humans in normal circumstances, usually find humans to be unsuitable prey (they are of the wrong shape, move too quickly, and smell repulsive). The most aggressive predators on Schwarzvaal are all forms of keradactyls, commonly called Mantis Stalkers. The basic bodyplan of these exoskeletal species is: a barrel-shaped body, with heavy overlapping dorsal armor plates; short tail (often scythed, with two horny spines arcing forward off the tip); beaked semi-translucent upper head shield (that articulates with the large forward back plates); large v-shaped mouth lined with tiny needle-like teeth; and six limbs (in an arc from the medial point of one side, round the rear of the animal to the median point of the opposite side). It was originally believed that these species were blind, relying entirely on seismo- and chemo-reception. However, careful observation and later dissections showed that a highly developed compound eye sits under the head shield. The covering protects the eye from damage and desiccation. The keradactyls have excellent depth perception despite their single eye. This is due to their ability to independently control different areas in the eye, functionally making it an array rather than a single receptor.

There are dozens of marine phyla. Marine fauna have more varied body types, though even here hard-bodied species dominate. Radial symmetry, segmented and unsegmented vermiform bodyforms are also found in reasonable densities, however. Those species with hard teguments appear to be secondarily adapted to a marine existence. Many other species have flexible scutes that may have once been hard in ancestral species. The low ambient temperatures typical of much of the oceans have led to gigantism. Species living near the poles have also incorporated anti-freeze into their circulatory systems.

Sexual reproduction is widespread, particularly amongst the land-dwelling megafauna, with most animals having at least two sexes. Most species are oviparous, with some hatching the eggs within marsupium located on the body of the brooding adult. Hermaphroditism is widespread, particularly amongst the marine life of the deep abyssal regions of the world's single ocean, but sequential (socially induced) hermaphroditism is common in many of the moorland megafauna.

Underground Fauna (chemolithotrophs)

There are quite extensive subterranean communities, ranging from microscopic interstitial and endolithic fauna to the foot long blind "regaloids". Some of these subterranean species are segmented and hard-bodied, like the above ground fauna, but the regaloids are soft-bodied and blind.

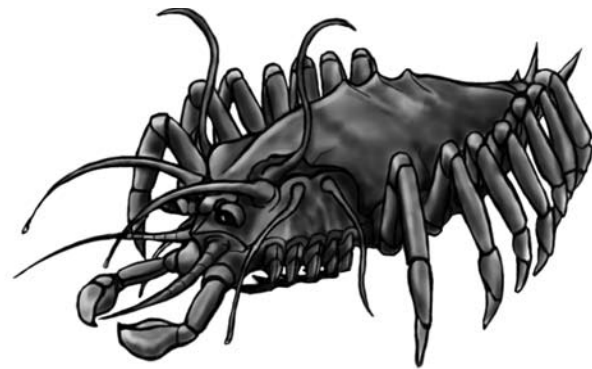
Regaloids are the only known Schwarzvaalen chordates. Some are solitary and sift the regolith for detritus and small bodied fauna, but others can form large colonies. For instance, the herbivorous colonial species form enormous colonies with extensive tunnel networks that can be many 100 square kilometers in extent. These colonial species also cultivate small gardens, using the root stock as their staple food source.

Regaloids are unarmored, but still well defended – exuding oozes or expelling noxious tubules.

EQUATORIAL LITTORAL ZONE

This zone encompasses the coastal regions of the equatorial islands and the equatorial areas of the continents of Praetoria and Brunswick. It includes land and water – including inland tidewater regions as well as the shallows several miles out to sea, although not always to the limits of the continental shelf. Many littoral lifeforms spend part of their life cycles in water and part on land, other are restricted to one or the other.

Black Crab



The Schwarzkrab (Black Crab) is a type of shore crawler, very like a crustacean in general form. It has a head bearing six pairs of jointed uniramous antennae – five thin and of various length and the sixth short, rotund with tiny claws at the tip. The head also bears stalked compound eyes and five pairs of small feeding appendages. Behind the head sits a long segmented thorax, each segment bearing a pair of biramous walking legs, associated gill flaps tucked under the main segment of each leg. A posterior segmented tail ends in a terminal segment that is very telson-like – rounded, and spine-bearing (the two largest spines measuring as much as 3cm in length). The head and first two-thirds of the main body of the animal are partially covered (dorsally) by a bivalve chitinous shell (or carapace).

Black Crabs are scavenging omnivores that tend toward herbivory. They feed by scraping the surfaces of rocks with their feeding appendages. Black crabs reproduce sexually and while they build nests they do not brood their offspring. Gravid females excavate shallow spawning hollows in coastal sands before laying a cluster of hundreds of eggs into the depression. The courting male fertilizes the eggs and covers them – mainly for protection from the elements and predators. As serial spawners the reproductive adults repeat this process throughout the spring and summer. The nests are abandoned soon after construction and the adults take little notice of the eggs or the fully-formed hatchlings. Juveniles are amphibious, moving to the fringes of major water bodies to feed on vegetation lining the waters edge. Four genera and sixteen species have been classified.

Although their shells must be discarded, the meat of Black Crabs is digestible by humans, and is quite palatable when cooked, making them highly sought after as food. Black crabs were exported to other worlds as a delicacy until the reproductive problems caused by consumption of some Schwarzvaalan life were discovered, after which offworld demand plummeted. The blue blood (hemocyanin) of the Black Crabs causes no dietary problem by itself (human digestive tracts can deal with terrestrial seafood, after all) and their primary amino acid content is generally harmless, although it may provoke allergic reactions in non-acclimatized individuals. It is the trace element content of Black crabs that many prove harmful to pregnant women and infants – adult humans (including non-pregnant women) may consume this species with impunity. Black Crab flesh forms a staple of the diet of almost all coastal-dwellers on Schwarzvaal.

Masterson's Bogcroc

More formally known as a hygrobryodont. This dorso-ventrally flattened animal can reach as much as two metres long. Land-dwelling and sea-going species exist. The head is shield shaped and fused. The terga of the thoracic and abdominal segments are partially fused and project laterally. All but the first and second abdominal segments are fused with the terminal tail fins to form a large plate. As the abdomen is as wide as the thorax, these two regions may not be clearly demarcated. The thoracic legs are fine and used for walking, while the rear head limbs have been modified to form semi-enclosed ventral gills. The rear legs of female bogcrocs are broader, and modified for scooping out nests in the bogs. Bogcrocs have a large pair of pincer-like mandibles that sit dorso-ventrally rather than laterally (giving these large predators a vaguely crocodilian appearance). Quite unusually their small eyes are located between the mandibles. Two small sensory uniramous antennae extend from the lateral hinge of the basal disc of each mandible. The mandibles are used to seize, crush and shred prey (or the limb of an inattentive human). Two genera and four species of bogcroc have been classified – the four land varieties are found in the littoral zones everywhere on Schwarzvaal, except for the northern polar coasts (which has no large fauna).

Terrestrial bogcrocs reproduce sexually, with internal fertilization. The embryos are aggressive and feed on their siblings in utero, with only a small number of the initial clutch reaching maturation and birth. The adults of both sexes will protect the territory containing their young, but do not give direct parental care to their offspring. The young are only a few centimeters long at birth and amphibious. They spend much of their time in or around water or moist ground and foliage, eating and shedding their exoskeletons. During this period they are especially vulnerable to predation. Outside the breeding season adults are solitary hunters. They are a major predator in some regions, and represent a constant danger to livestock and isolated farmsteads.

Hopping Cirripeds

The Hopser Entenmuschel, or Hopping Cirriped is found in littoral communities worldwide. While they are named for their

superficial resemblance to Terran barnacles they have a flattened and conical body, which is covered with radial, ventral and rostral sulphate shell plates. They are commensal or free-living and can be found clinging to large marine fauna, rocks (and ship bottoms) everywhere. The creatures feed by sweeping the water with their relatively long muscular multi-purpose limb. This sets up turbulent vortices, which are used like nets to trap their small planktonic prey. Feeding palps are then used to strain the plankton from the water. Unlike their Terran namesakes, Hopping Cirripeds can detach themselves and move. The ventral disc simply rests on the substrate and is not fixed. When they have depleted their local environment they invert, extends its muscular limb and swim, crawl or hop to a new location. This muscular limb is also used for hermaphroditic insemination during sexual reproduction. The larvae are internally brooded until they reach their third moult and then they are released into the watercolumn. They settle quickly however, metamorphosing into their juvenile form within hours and living off their fleshy yolk until the protoplates have formed. Three genera and five species have been classified.

Sea Hog

Free-swimming, found in all oceans except the littoral regions of both polar continents, the Meerschwein ("Sea hog" aka marine terrapin) has an elongated body covered anteriorly by pairs of overlapping large rounded plates and posteriorly by a single series of hardened plates. The meter-long sea hogs have a single pleopod at the join of each plate. When under threat they can roll up, but when at ease swim by flapping their pleopods vigorously. They have a segmented and cruciform snout, with small tusks. Small eye spots are found on each segment. They feed by trapping their prey between or on their tusks. Sea hogs spawn into the water column, but use their pleopods to push the fertilized eggs into their marsupium (located on the ventral side of the upper body with an anterior opening below the snout). The hatchlings swim from the marsupium at about 4cm length. The location of the marsupium leads to the initial belief that the species were gastric brooders. They are not generally dangerous, except to fishermen, who sometimes trap them in their nets – the mouthparts can snip off a finger or even a hand from the unwary. Quick action with a harpoon or schucking knife can dispense this threat. Sea hogs are edible, although they contain allergens which are hazardous to pregnant women and the very young. Fishermen often roast them upside-down on an open fire after cracking the connective tissue on the ventral side of the body; opening the bottom of the shell and stuffing the body cavity with black crabs and the legs of the terrapin. Two genera and six species have been classified.

Bogweed

Bogweed is ubiquitous throughout almost all regions of Schwarzvaal – variants are even found at the edges of the polar icecaps. Also called the Torf Löwenzahn (or peat dandelion), the plant has the typically thick chemitrophic leaves of most Schwarzvaalan plants, clustered around a central stem in radial fashion. The large floating leaves are deep purple and are associated with clusters of highly modified leaflets that are waxy and reflective. The plants fruiting bodies are small, blue

and feathery. The flowers commonly found on bogweed do not belong to the plant itself, but rather to the various epiphytic species that grow on the body of these species. Three genera and ten species of bogweed have been classified.

Black Sugarmoss

Black sugarmoss (Schwarzucker Moos) are widespread and found in many of Schwarzvaals biomes. Initial surveys assumed this moss-like growth was an independent species, but later botanical studies showed it is actually the juvenile form of the Mitternachtfeder (Midnight Quills) that form much of the moorland cover on Schwarzvaal. The black sugar moss was so named as it resembles some of the desert parasitic plants from North America and because it forms small sweet crystals along the central core of each of its fine stems. It forms after the seed of a Mitternachtfeder lands on an established plant (there appears to be no species specificity in the establishment, though peat dandelions seem particularly susceptible). The young plant embeds in the tissue of the host and quickly spouts a ball of feathery stems. It lacks chlorophyll and is dependent on the host plants for life support. Once the ball is approximately fist-sized it drops off and is blown before the wind. If it comes to rest in bare soil it will take root and establish an adult plant. The adult plant is somewhat different in appearance. A single one of the juvenile feather stems elongates and strengthens to form the central axis (the final plant growing to a maximum of 40cm in height). The base of this axial stem swells to form a bulb that anchors the plant. The other juvenile stems sit around the base of the plant or may be buried or wither with age. The branching is highly regular, perpendicular to the main axial stem and symmetric. Small round scaly leaves bud from these branches. From a distance the form of these plants is much like a Terran sea pen or something like antique Terran quill pens – giving them their name.

Sugarmoss was cultivated on Schwarzvaal because it's non-chiral properties makes it digestible by humans, the central sugar backbone giving it a highly pleasing sweetness. Sugarmoss can be grown very rapidly, and is easily adaptable to intense cultivation by small family farms without the need for expensive equipment or complicated processing. It was of considerable economic importance to Schwarzvaal, since it represented one of the first exportable crops and brought in much-needed income for the struggling colony. When the export market for sugarmoss collapsed, the fledgling petroleum and manufacturing industries were still given time to grow – the dislocation limited to the sugarmoss farmers, who were forced to switch to other crops. Sugarmoss is no longer cultivated, since it has no nutritional value. It has become something of a pest in many farming areas, and must be cut back to prevent it from taking over land and draining the vitality of desperately needed nutritious crops. Two genera and eleven species have been classified.

Ruba Trees

These grow almost everywhere on Schwarzvaal, and are short, shrub-like trees (varieties vary from five to ten meters in height) that produce a polyvinyl-like sap, much like terrestrial rubber



trees produce rubber, hence the name. Ruba trees were of tremendous economic significance because they represented a cheap means of manufacturing polyvinyl products that did not require the use of petroleum. Several variants were created by plant breeders, concentrating on producing the greatest quantity of sap. The trees were cultivated in large plantations all over Schwarzvaal, and remain important as a source of the transparent sheets used to roof maternal supply greenhouses.

The sap is collected by cutting several slashes in the bark of the trunk, and catching the sap in buckets before it has a chance to dry. To prevent the sap from drying, it must occasionally be sprayed with an organic solvent, which dissolves the sap, but which evaporates quickly. Four genera and nine species have been classified.

EQUATORIAL PELAGIC ZONES

These regions comprise the deep ocean areas along the equatorial band and are characterized by free-swimming fauna and buoyant plankton in the upper layers (the photosphere). Light can only penetrate a few hundred meters, and photosynthesizing lifeforms are not present in the abyssal depths.

The lifeforms of the abyssal depths are poorly studied, but most specimens collected so far have been essentially vermiform. They are uniformly blind and no organism has been found to have light producing organs, which is quite a surprise considering the advantages conferred by such things. With a few rare exceptions, these organisms are hermaphroditic, reflecting the immense difficulties the environment imposes on finding a mate. Some feed within the water column, but the majority are bottom-feeders, grazing on carcasses and organic ooze on the ocean bottom. This ooze is derived from marine snow that is deposited in a slow rain from the higher waters as the creatures of the upper layers die and drift downwards.

Bärfälle

The most prolific benthic fauna are the Bärfälle Korallen (Bear-trap Corals). These grow in multi-layered mats and coat most submerged marine hard substrata on Schwarzvaal - and can even be found on the more stable soft sediments. The individual Bärfälle is less than 10cm in height (typically smaller than 3cm) and consist of interlocking carbonate and silicate matrices coated with a thin layer of living tissues. They have a basal holdfast which supports a pair of hinged and clawed arms that resemble giant pedicellariae. The animal feeds by sitting with arms open and snapping shut on anything the brushes past – regardless of size, as pieces are torn from larger prey even if they are far too big for the Bärfälle to consume whole. Any food items captured are deposited in the mouth, which sits on the dorsal side of the central hinge. Bärfälle are not symbiotic, but can still be highly coloured – often in deep reds and oranges. When under stress the Bärfälle secretes a coating of mucous that covers its entire body – the purpose of which puzzled scientists when the first specimens were collected. Similar secretions are used to form protective chemical coating for the gametes, which are broadcast into the water column daily at dawn through out the spawning season. Seven genera and twenty four species have been classified.

Helmeted Lancer

The Schwarzvaalen “trophy fish” is the Belhelmt Lancier (“Helmeted Lancer”). The juveniles are collected (fished) in shallow coastal inlets when they are about 8-15cm total length, but the adults (which may be as much as 2.5-4m in total length) are prize sport fish. The body of these animals is actually relatively small – only about a fifth of the total length, it has a pair of ventral walking legs and six flexible tentacle-like swimming legs on each side at the anterior end of its short, paddle-like tail. A rostral snout is tipped with chemosensory feelers and primitive eye spots sit on patches on either side of the body (most heavily concentrated anteriorly). The underside of the Lancer’s is protected by chitinous (but flexible) scutes, while the dorsal side sits in a hardened armored sleeve. The outstanding feature of these species however is its dorsal spine, which sits on top of the dorsal armor ridge and extends three-body lengths forward of the rostral snout and another body length back past its point of connection with the top of the tail (which hangs down below this rear spine-tip). Two genera and five species have been classified.

Marine hygrobyodonts: These are open water relatives of the amphibious Masterson’s bog croc. Their main modifications have been behavioural, nesting in sand or floating weed mats rather than boggy ground. Physically the mandibles are longer and thinner than those of the Masterson’s bog croc. The legs are also flattened into paddles, and the tail is broader and more fluke-like. The book-lungs have also taken on secondary gill rakes, but still require periodic surfacing for oxygen supplementation. Two genera and four species have been classified.

Maripterygion

Locally known as Seeschmetterling (“Sea Butterflies”), these species have been described as floppy crayfish with wings. They have a short banded thorax, with truncated tail – both of which only have a minimally strengthened exoskeleton. The carapace, if it was ever a true carapace, has been reduced to two small dorsal ridges (used to anchor sexual ornamentation) and the telson (or terminal tail segments) has been heavily modified to form wing-like flaps. These flaps have become laterally attached to the posterior end of the thorax, with the attachment running laterally along the length of the tail, tapering to points posteriorly. Two short antennae sit in front of the eyes, which are covered by a three pronged rostrum. All limbs hang from the ventral side of the thorax and are whiskery or antler-like and are gill bearing. All locomotive power coming from the wings; much like Terran sea hares, Schwarzvaalen sea butterflies swim upside down, using their “wings” as long rolling paddles that fold back over the body with each stroke. These free-swimming planktotrophs extend large comb-like pedipalps to sieve plankton, with modified tongue flaps wiping their catch from the combs into the mouth. Sea butterflies swim in schools of hundreds of individuals, often forming large feeding or spawning aggregations. Sea butterflies reproduce sexually, males fertilizing females during a complex mating “dance” that has only been observed directly a few times and only captured on film twice. The song that accompanies the courtship dance can be somewhat eerie when amplified through the bottom of a boat. They are of little economic significance, since there are totally indigestible by humans. Three genera and twenty seven species have been identified, and they are found all over Schwarzvaal.

Plankton

Microscopic plant and animal life that floats in the photosphere. The name plankton is not a taxonomic classification, rather a classification of ecological role and lifestyle. As on Earth, these species are abundant, often producing more than higher grazers can consume. The plant forms (phytoplankton) photosynthesize taking up nutrients from the water and using the sunlight that penetrates the surface of the water column. Water absorbs light relatively quickly, and insufficient remains to support photosynthesis after a few 10s to 100s of meters (this is known as the photosphere). If the surface waters are not mixed well with deeper underlying waters, the phytoplankters may be further constrained by the depth of nutrient and mixed layers.

Zooplankton can either graze the phytoplankton (making them herbivorous), or on other (smaller) zooplankton. Larger species tend to occupy the more carnivorous niches, as do larval forms of species that will eventually become macrofauna (e.g. Sea Butterflies). The same range of hunting strategies observed in larger species are seen among these microscopic denizens of the oceans. Stalking, ambushes, netting, pursuit are all used, microscopic life is far from the passive existence often imagined.

Nearly a hundred species of unicellular and near microscopic life have been classified, in various genera, families, and classes. This is only a tiny percentage of the immense number of species actually making up the plankton on Schwarzvaal. Once

microbial life from the decomposing foodwebs also come under intense scrutiny the true diversity of the plankton will become apparent. Early indications are that, in line with the macro- and megafauna of Schwarzvaal, it is still likely to be limited in comparison with other worlds.

NORTHERN AND SOUTHERN PELAGIC ZONES

The lifeforms of the abyssal depths are identical throughout the world, but there are some variations in the photosphere layers. The waters north and south of Schwarzvaal's equator are more temperate. The flora and fauna of this zone are generally rather sparse, though in the vicinity of upwellings they can form the most productive areas on the planet. Fragments of subterranean species found in deep probes of the ocean bottom, show that fissures sometimes allow life from the megaregolith to penetrate to the substrate.

EQUATORIAL ISLAND ZONES

The smaller islands of the equatorial belt on Schwarzvaal are part of the littoral zone, and all have nearly identical lifeforms. The larger islands have interior ecological zones would show considerable bio-diversity on any normal world, being isolated from evolutionary developments in other areas. This is not the case on Schwarzvaal, however, where most of the inland life of the larger islands is very similar. It is unclear whether this is due to past ubiquitous coverage or whether it is a result of more recent invasion by extant species.

Steinlaus

The Steinlaus ("Rock Louse") is a smaller version of the more impressive Rotlaus ("Red louse"). This tiny creature is about 12mm long. Like many other Schwarzvaalen species it superficially resembles an arthropod. It is exoskeletal and segmented, but curiously these segments run the length of the body rather than transversely; as if the entire body has undergone incomplete torsion. Interestingly, the eye spots sit along the sides of the body and the animal creeps to the side. It feeds primarily on detritus and microbes. Four genera and twelve species have been classified.

Petrobryodont

This is an upland primarily land-dwelling version of the hydrobryodont. It is smaller (less than a meter long) and is more elongate than the better known bogcrops. Its walking legs are more robust than in amphibious species, and their nests must still be made in moist ground. Of all species these upland species show the most parental care. Small juveniles can become quickly dehydrated and often associate with adults, who use fluids from special ventral caecum to rehydrate begging young. One genus and two species have been classified.

Ilanga isilwanyazane

The Ilanga isilwanyazane ("Sun Mite" or more literally "Sun insect") is superficially similar to the rock louse in overall appearance. Though they are fleshier and their exoskeletons not as rigid. It is a burrowing ectodermal parasite that infests larger species. It uses acids to break through the exoskeleton and make

a feeding pit, though it prefers to make use of natural damage and eat dead flesh and broken exoskeletal patches. Sun mites derive their name from their habit of exposing themselves to the rays of the sun at every opportunity. They rely on solar energy to initialize their diurnal metabolism (going into torpor each evening). One genus and five species have been classified.

Rotssprong

An upland version of the (bog bunny), the Rotssprong ("Rock leaper" or more colloquially the rock bunny) is slightly larger, and has a denser coat of the fungal "fur" that is characteristic of this creature. Schwarzvallen children sometimes keep rock bunnies as pets, because they are easily tamed and can be trained to do simple tricks. Two genera and six species have been classified.

Bog Daisy

The Sabco Bush, also known colloquially as the bog daisy, has a rosette of fleshy and fibrous leaves and a central flowering stem (reaching a metre or more in height). The flowering stem, is branched and the flowerettes almost leaf-like from a distance. The sugary syrup extracted from the upper flowerette bearing parts of this plant is fermented to make a local liquor. Bog daisies were sometimes used as ornamental plants in Schwarzvallen yards until the *Garibaldi* Incident made most people give up such pretensions. One genus and four species have been classified.

Schwarzblume

The Schwarzblume ("black flower") is a very bizarre looking plant. It is one of the tallest of Schwarzvaal's plants (at 2m). It grows in clusters, often amongst smaller shrub vegetation (which serves to shelter the young plants and so facilitates their establishment). During the most inclement weather the Schwarzblume is a dormant leafless spike, somewhat like a giant taproot turned on its head. The main stem contains succulent tissues, which are protected from desiccation by thick epidermal layers. In the growing seasons, thin pencil like secondary stems sprout along the main stem, each tipped by a small spearhead shaped fine papery leaf – this gives the plant a furry or spiny appearance. These secondary stems wither and are shed when conditions become limiting again. While the roots of these plants can be very long lived (as much as 300 years), the above ground parts are not particularly robust, though they quickly re-grow after fire. In a sufficiently old plant the main stem can branch (though reaching this age is rare), forking at the top of the plant. The individual branches often lack the structural support necessary to hold up their weight and end up forming contorted shapes, even bending down to touch the ground. The Schwarzblume often forms mixed stands with the bog daisy. Three genera and eleven species have been classified.

BRUNSWICK INTERIOR ZONE

This region covers the continental uplands of Brunswick, and the lifeforms inhabiting the zone are relatively consistent regardless of latitude.

Crabspider

The Riesennashorn Krebspinne (Giant Rhinoceros Crabspider) is the largest keradactyl grazer in these areas and grows to 1.7m in height and 2.5m in length – its anterior appendages reaching out a further 80cm. It is named for the spine on its nose, but its body is also dotted with tubercules and spines. The largest individuals (which have a dominant sexual role within the local populations) also have pronounced dorsal ridges on their first three body plates. The smaller Riesenglatt Krebspinne (Smooth Giant Crabspider) only reaches 90cm in height and 1.5m in length (with the anterior appendage reaching out another 50cm). Rather than the highly decorated carapaces of the Riesennashorn Krebspinne, the Riesenglatt Krebspinne has little carapace ornamentation beyond a small dorsal hump. Its legs also have overlapping ovate shields, one to the front of each leg, giving the animal a skirted appearance. Moreover, whereas the Riesennashorn Krebspinne depends on its body form to provide protection, its small feeding aggregations remaining loose for much of the year (only forming more cohesively in the post-moult and pupping season); the Riesenglatt Krebspinne forms extensive herds, which can prove a problem when they interact with farming communities. Three genera and twelve species have been classified.

Rotlaus

The Rotlaus (“Red Louse”) is a cousin of the Steinlaus (“rock louse”). These creatures are omnivorous, though primarily feeding on vegetation and detritus. They may reach 3cm in total length and their exoskeleton is highly ornamented, with spines and ridges completely covering its dorsal and lateral plates. Its bright red coloration is probably not as striking to the local fauna as to human eyes, but would nonetheless be very noticeable. Its toxic levels of sequestered allelochemicals (accumulated from its vegetative food sources) suggest the coloring as aposematic (warning its potential predators of its lethal internal cocktail). Rotlaus inhabit cracks and fissures within two meters of the surface in many areas on both Brunswick and Praetoria. Three genera and nine species have been classified.

Tusked Abasi

The smallest keradactyl, the diminutive Tusked Abasi (literally “stern” in Swahili) grows to about 25cm in height and has two large forward pointing tusks in its lower jaw – used in jousting displays and when excavating its preferred prey species (including Rückgrat Kiefernzapfen). Its four rear limbs are robust with thick nail-like soles. The anterior limbs are used in raptorial feeding and a spear-like or shaped-like a knife blade (depending on the sub-species). These limbs can be folded back into a groove that sits transversely across the ventral side of the trunk, between the strong but flexible gut-plates. These species are often richly coloured, which deep purple plates over even deeper red intersegmental tissues.

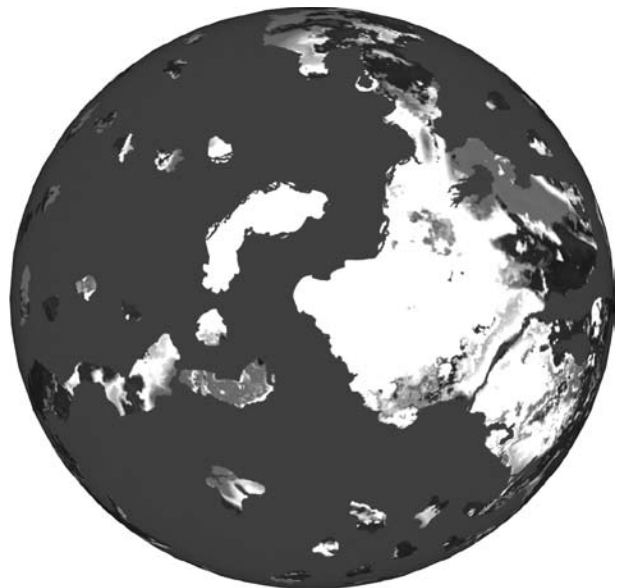
NORTH LITTORAL ZONE

The north littoral zone consists of the tidewater areas and shallows along the continent shelf of Praetoria. While not completely devoid of macrofauna, the abundance of mega fauna

is extremely low. The ultimate cause of this is not absolutely clear, but may be due to the level of allelochemicals and frequency of ice scour in this area.

Northern Bogweed

The north polar version of bogweed (formally known as Norden Torf Löwenzahn) is larger than its more temperate counterparts, with thicker more numerically profuse leaves and denser clusters of “collectors”. This extra bulk is needed for heat retention and insulation. It also allows for compartmentalization of the primary heat exchange tissues, so that frost or ice scour damage does not destroy all of the plants productive apparatus. The plant also differs from southern varieties in having a natural “antifreeze” compound in the sap. One genus and four to six species have been classified (there is debate among xenobotanists as to the exact classification of two recently discovered partial specimens from an earlier survey).



NORTH POLAR ZONES

The northern polar region of Schwarzvaal is almost devoid of the largest lifeforms, though moderately sized ones are still relatively abundant. All fauna that are found in these northern polar climes have a white phase for winter camouflage.

Geloaranha

Geloaranha (“Ice spiders”) are eighteen-legged creatures that are five to fifteen centimeters across (including the leg span). The thick body is divided into two segments, thorax and abdomen. All other segmentation has disappeared. In addition, a single sclerotized shield (or carapace) covers each section of the body. The limbs project anteriorly (five pairs) or posteriorly (four pairs), rather than laterally. The second anterior pair (counting from the midline of the animal), are much longer than any of the other pairs and used as probes to check the stability of the terrain ahead. All the legs are segmented and robust, for walking, though the terminal segments have become flattened

and pad-like to disperse the weight when walking across fresh snow. Small sensory hairs cover the body, but do not have any insulation related role. Geloaranha have no obvious chelicerae, with their teeth hidden behind an oral plate. The other orifices are also covered by sealable plates. Geloaranha inhabit all parts of the continent except the most extreme parts of the icecap. They can operate in extremely low temperatures due to an internal “antifreeze” compound in their blood. Two genera and three species have been classified.

Sneeuwenmijt

Sneeuwenmijt (or “Snow Mites”) are small creatures (a few mm in diameter and 5 to 20 cm in length when uncoiled) that live amongst the polar bogweed stands, taking shelter from the polar temperatures by burrowing into the surface layers of their leaves. They are usually tightly coiled, and cover themselves with a gelatinous mucous that looks shell like once it has been frozen or exposed for any length of time. Long setae anchor the snow mites within their burrows. Their presence does not usually cause gall formation and the plant benefits as they eat the spores and juvenile stages of potentially harmful fungal and microbial growths, preventing damage to the bogweed plants. One genus and two species have been classified.

Polar Bogweed

Polar bogweed (Eistorf Löwenzahn) is similar to Northern Bogweed, but has milky white rather than blue fruiting bodies. Epiphyte growth is also minimal on these species (these parasitic plants are unable to survive frequent freezing). One genus and two species have been classified.

PRAETORIAN EQUATORIAL AND TEMPERATE ZONES

Praetoria's inland regions are divided into two general life zones, equatorial and temperate. There is little difference between the two from a biological standpoint.

Veldtschildkröte

The Veldtschildkröte (“plains tortoise”) is a large creature. It has a heart shaped dorsal shield, with a broad anterior and pointed posterior. There is some suggestion of segmentation on this shield (and in the body), but it does not reach the lateral margins. The margin is also entire and unadorned, bearing no indents, spines or serrations. The head is covered, but two stalked ventral eyes (attached to the anterior lobe) extend out from under the shield. The eight legs are concealed under the body and are not particularly visible, even when the creature is moving. The mouth and genital pores are located in the centre of the legs and are surrounded (and partially covered by lip-like labrum). When under threat the animal closes the small gape between its body and the ground and scrapes out a shallow pit beneath it lowering itself still further into the substrate and making it difficult to dislodge. Reproduction is asexual, the female lays the eggs in an underground lair (usually a cave or other natural formation) and both parents guard them until they hatch. Three genera and four species have been classified.

Ohininaju

The largest keradactyl is the Ohininaju (“Chief young bull”) that can weigh in at 2 tonnes. It has the typical keradactyl body-form, with the addition of spines on its dorsal plates (in three lunate arcs, one on each side and one across its posterior). Like its smaller relatives, it has raptorial anterior limbs. In addition the Ohininaju's medial limbs have also become raptorial. It also sports spines on the posterior edge of all its limbs – these may be defensive in juveniles, but are used in displays and ritual sparring in mature adults. When moving slowly the Ohininaju will use these spear-like limbs as walking (stilt-like) legs, but when it is moving at speed (during lunging attacks) the four raptorial limbs are folded back along the body and only the rear-most limbs are used for propulsion (making it temporarily bipedal). The slightly smaller coastal Jelani has large claws in place of the Ohininaju's medial stabbing limbs.

Sumpfsprong

Sumpfsprong (“Bog leaper” or Bog Bunny) are a close relative of the Woonstelsprong (or leaper) and Rotssprong (Rock bunny). They have the basic leaper bodyform, but have developed a symbiotic relationship with a fungal growth that covers them in what appears to be (at first glance) almost rubbery fur. This fungus is intricately associated with epithelial cells of the animal and will not survive in isolation. The main body of each fungal fur stem is erect, with fine lateral branches. Growth of this fur is quite rapid in juveniles or seasonally, but once past a critical thickness it slows. Growth can be slowed still further when the animal is under stress or in abrasive habitats, as it takes place at the tips. The initial sightings caused some excitement, as they indicated mammal-like creatures might be present on Schwarzvaal after all, but the first specimens to be examined corrected this erroneous notion. Bog bunnies are about 20cm in length. Their small size and relatively placid nature means they are often tamed and kept as pets by Schwarzvaalan children. Two genera and eleven species have been classified.

Veldt Truffle

The Veldt Trüffel (veldt truffle) is a wide spread plant with deep purple and brown-black colouration. In appearance and growth-form it is somewhat like the “living stone plants” (Lithops species) native to South Africa and Namibia. The veldt truffle grows in dry water courses, amongst rock outcrops and generally in the most inhospitable areas of the most open Schwarzvaalen expanses. They are succulents, which store water and a syrupy sap in their fleshy leaves. Their delicate flavour has made them a quickly sort after local food item for the human settlers. They are typically small in size (less than 5cm in diameter and less than 4cm in height). Giant relatives do exist, for instance the Boulder Grape, but the membranous tissue dividing their fleshy leaves makes them too fibrous for preferential human use. The body of the plant is below ground, with only the surface of the single pentilobe leaf exposed above ground. A new leaf forms each growing season, absorbing nutrients and moisture from the old leaf which shrinks and splits around the new leaf as it forms. Many of the veldt truffle species have highly patterned surfaces that can refract light in shimmering and fractal-like patterns that are deep blues and reds. This patterning seems to have a

two-part camouflage and thermoregulatory role. Veldt truffles were exported as a luxury food item until the reproductive crisis ended its economic usefulness. Three genera and six species have been classified.

SOUTH LITTORAL ZONE

The south littoral zone consists of the tidewater areas and shallows along the continent shelf of Suideland. The shelf drops off very gradually, and the oceans near Suideland are shallow for a considerable distance out to sea. This creates a sea bottom environment that receives enough light for a few plants to live on the substrate, and this forms a part of the zone as well.

Nasutus ibhungane

The *Nasutus ibhungane* (or *Nastus beetle*) is a land-based creature. A relative of the crabspiders, it is small in comparison (specimens range from 10 to 35 cm in length). It has the basic keradactyl form, but is the most ornately sculptured species within the group. Typically the lateral margins have spinose and leaf-like outgrowths; and two (or more) size classes of granules or tubercles cover the surface of the dorsal armor. The anterior plates are also criss-crossed with sunken suture lines and short genal spines edge the front of the first plate. This small herbivore has a special attraction to terrestrial crops and is a major pest in agricultural areas. Two genera and nine species have been classified.

Lešikahlaba khukhuna

The *Lešikahlaba khukhuna* ("Sand Crawlers") are another group of keradactyls. The bulk of their life history is spent in or on loose soils and sands. As a result their body has become broad and flattened and the armor more tightly overlapping (to avoid sand getting caught between the plates and causing abrasion). The tips of their limbs are also splayed or feathery, to prevent sinking in the loose substrates. *Khukhuna* range from 10 to 120 cm in length, though tend toward the smaller to moderate lengths. They are edible by humans, although there flesh is associated with the typical allergen problems resulting from the consumption of Schwarzvalla life. Six genera and nineteen species have been classified.

Lewatlê phaephe

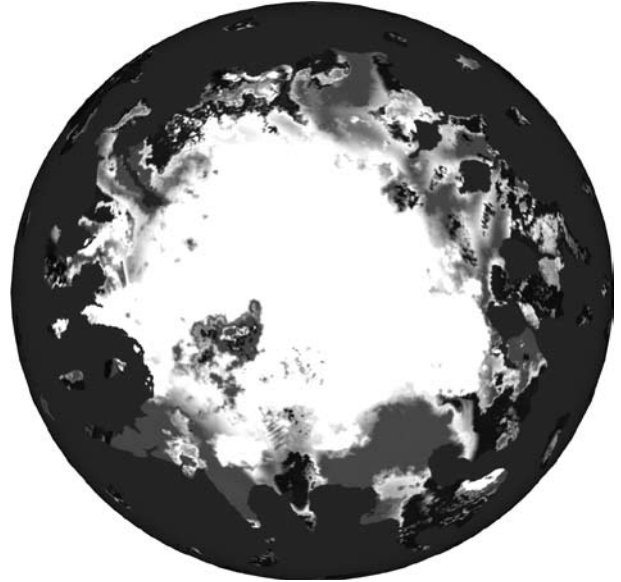
Lewatlê phaephe ("Sea tubes" or more commonly sea cucumbers) are slow moving marine life that look a lot like *Holothurians* on Earth. While no relative of their Terran namesakes they share many features. A good example of convergent evolution in action. Two genera and three species have been classified.

Mêêtse semela

The local name for a form of marine flora, which may be colloquially referred to as sea weed. These species grow in thick clumps in relatively shallow coastal waters. They are rooted in the substrate and grow toward the water's surface, stretching up to five metres in height. It was hoped initially that they used photosynthetic pigments more palatable to humans. These hopes were dashed however, when it was realized that these species also use thermotrophic catalysis to support their photosynthetic apparatus. Worse still the reactions are

constrained to the marginal lip of the long leaves, with the central leaf used as a structural support, float and storage location for excess trace elements and gases (that are usually released back to the environment in the land-dwelling flora). Four genera and five species have been classified.

SOUTH POLAR ZONE



The south polar zone is interesting for the wider variety of large fauna present in the border areas with the icecap (sometimes called the tundra, although this does not have the same meaning as on other worlds). The plant life of the south polar zone is very similar to the plant life of the north polar zone, and all genera are present in both places.

Escuro Ácaro

The *escuro ácaro* ("Dark mite") is a cold adapted form of the equatorial Sun Mite that can be found in the "tundra" (though not on the true ice fields). Like most polar life on Schwarzvaal, its blood contains a natural "antifreeze" compounds. In addition to such biochemical modifications, the metabolism is modified (making heavy use of overwintering via dormancy and suspended development within insulated microenvironments) and . One genus and two species have been classified, but others doubtless exist.

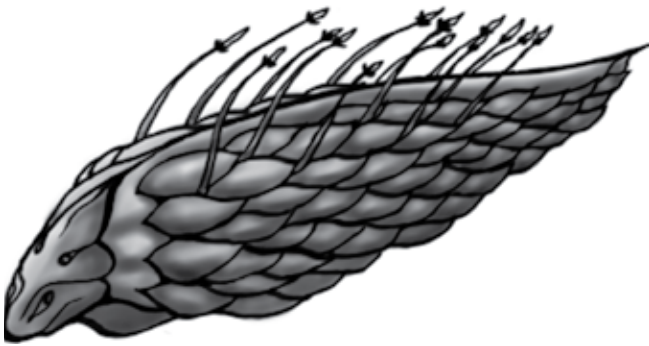
Woonstelsprong

Woonstelsprong (or *Leapers*) were described by the first settlers as what happens when hares and insects marry. These creatures are deep-bodied and laterally flattened. They are roughly the size of a rabbit and have either a smooth exoskeleton or small exoskeletal scales and are an inky rusty brown. Their rear legs are enlarged and elongate and used for propulsion by jumping. The Leapers also have 3 pairs of broad, flattened and semi-fused antennae that may be mistaken for rabbit-like ears (by the inebriated). Most Leapers have a single annual generation, showing phenomenal growth (going through a series of rapid molts throughout their life). They achieve this by putting all

their energy into growth and reproduction and neglecting cellular maintenance. Consequently, after the eggs are laid in the autumn, the adults die, their bodies a mass of weeping lesions. The eggs overwinter in the soil or under vegetation. With the spring thaw they hatch out as tiny nymphs that look a lot like miniature adults. The nymphs graze on the youngest tips of the local flora. These strange creatures can leap as much as six or seven meters and are the closest thing Schwarzvaal has to a flying creature. They are closely related to the bog and rock bunnies found elsewhere on the world, but lack the fungal symbioses that make those species appear furry. Three genera and five species have been classified.

Kiefernzapfen

The Rückgrat Kiefernzapfen (Spined Pinecones) are a smaller herbivore that dominates in the more marginal high latitudes and drier semi-deserts of the southern continent. The dorsal



surface is covered with small, flat, overlapping sclerites; each of these scales attached with a root-like base allowing for moulting and replacement of these plates on an individual basis. There are no plates ventrally and the animal creeps along on a muscular foot (typically pushing through upper soil layers). There are also two long rows of dorsal spines that are used for water collection and protection from rooting predators. The Rückgrat Kiefernzapfen sit just under the soil's surface and stick their spines up into the atmosphere as condensers during the night. They also show indeterminate growth and can shrink under starvation as they reabsorb tissues and plate materials.

DEEP CRUST MICROBIOTA

The organisms living within a few hundred meters of the surface are poorly studied because they are so hard to get at. The vast majority of these thermophilic chemolithotrophs are single-celled organisms living off organically and inorganically derived hydrogen in the megaregolith layers. A few multicellular but still microscopic organisms have evolved to feed on these organisms. These lifeforms are primarily known from drill cores, mines, and excavations for extremely tall building foundations.

Carimo's Rock Louse

These are very small (0.5-1.5mm in length) arthropod-like creature dwelling in the interstitial spaces of the megaregolith. Rock lice have twelve pairs of legs and thin, cigar-shaped bodies made up of a number of very flexible overlapping strips of

chitinous material, resembling a terrestrial centipede in overall body design. Reproduction is sexual: the female lays thousands of eggs in the spaces that form the creatures habitat, the male follows along and fertilizes them. Hatchlings are left to fend for themselves. One genus and six species have been classified. These creatures are believed to have descended from one of the surface-dwelling forms of rock lice.

Stoneworms

Stoneworms (or geoneme) are small, minimally segmented chitinous creatures that dwell deep beneath the surface in the interstitial spaces of the megaregolith. The body is banded with a series of citellum. Secretions from these bands are used to lubricate the soil, which is processed using an anterior prostomium. During thaws or volcanic events they may be flushed temporarily to the surface or lower layers of the soil. They are most often encountered during especially deep excavations, but occasionally infest underground structures such as pipelines. They are scavenging, but if swallowed can become parasitic, by attaching to internal linings or vesicles. They are not especially dangerous except to very small animals, but can be a nuisance if they clog pipes or filters. Two genera and twelve species have been classified.

Chicha

This regaloid species gets its name, because it looks like grated coconut. It has an elongate body, with thickened anterior ridges. The Chicha are a few millimetres long and very pale brown or white in colour. Under a microscope it becomes apparent that they retain reduced limbs – two pairs immediately behind the mouth, another pair approximately a third of the way down the body and another pair posterior of the anal slit. The Chicha feed by attacking the anchoring and root systems of the Schwarzvaalen flora, rasping the surface until the more succulent tissues are exposed. Only one species has been identified to date and it appears to be pathenogenic.

Harith

The Harith ("cultivator") is a fairly typical regaloid species. The Harith also have a vermiform body with anterior ridges. They are some of the largest regaloids, reaching as much as 5cm. Harith lack even remnant limbs, and tend small gardens - either subterranean or in the mouth of the burrows created by larger species, like the Rückgrat Kiefernzapfen. The Harith come in a wide range of colors. Those that are burrow dwellers shift their coloration (within a matter of hours) to match local soils (probably for camouflage). While relying primarily on their cryptic coloration and distastefulness, Harith also have strengthened dorsal ridges or small sail-like spines, which makes them difficult for the soil dwelling predators to consume. The Harith is also a single sex taxa that reproduces asexually, but requires pseudo-sexual triggers (courting without gamete transfer) before egg laying can begin. Two genera and fifteen species have been identified.



Geology of Schwarzvaal

Schwarzvaal has not been subjected to the intense scientific scrutiny of some other worlds – the initial scientific surveys focused on locating exploitable resources, and in recent times have taken a back seat to more fundamental aims. Nevertheless, some basic information is known.

Schwarzvaal is a terrestrial type planet with a cool but habitable ecosystem. There are three basaltic continental land masses (two with significant icecaps) and an aerobic circumequatorial ocean covering sixty-two percent of the world's surface. In the continents, the basaltic layer is overlaid with a highly porous megareolith crust several hundred meters thick covered with sedimentary layers and occasional volcanic deposits consisting of both lava and ashfalls.

The lack of a real continental crust means that felsic rock types (light colored igneous rocks such as mica, quartz and feldspar) are less common than mafic rock types (dark colored igneous rocks such as basalt, that contain high levels of iron and magnesium). What crust exists has significant silicate mineral presence due to the 2x to 3x silica to oxygen ration. Sodium is present in large quantities, with the result that sodium feldspars are more common on Schwarzvaal than potassium feldspars.

As such, most igneous formations across the planet have a much higher mafic content overall while still maintaining a moderate abundance of quartz. Magnesium replacement of aluminum in the aluminosilicate minerals, including many of the feldspars, is common. There also exists a tendency towards a higher than Earth level of ultra-mafic rocks, but nowhere near to the extent that is found on Refuge.

The sedimentary rocks of Schwarzvaal are primarily shales. Limestone is almost unknown except for a few deposits on Praetoria and Suideland, and large sections of the ocean floor, where it is abiotically formed from carbon dioxide washed from the continental interiors. This has led some scientists to believe that the continental deposits represent ocean floor uplifts of some kind, but the level of tectonic activity to create such uplifts is not present, and no other mechanism has yet been discovered. The origins of the continental limestones remain a mystery.

Volcanism

Schwarzvaal is relatively inactive geologically. Tectonic movement is non-existent – experts cannot agree if there are any tectonic plates at all, let alone where they might be – which means that earthquakes are very rare, and volcanism is moderate. Since there are no plate created ridges and troughs for volcanoes to form along, Schwarzvaal's volcanoes are distributed pretty much at random as weak spots form in the crust. Gas pressures during eruptions are very high, resulting in pyroclastic eruptions – sheets of superheated gas and debris flowing laterally to the surface at speeds in excess of 500 kph.

This makes the area surrounding volcanoes uninhabitable and virtually deserted except for mining operations.

Without plate tectonics, the general topology of Schwarzvaal is flat, with the occasional volcanic or impact crater. Mountain ranges are virtually non-existent, except for chains of volcanoes. Precipitation induced erosion tends to smooth the terrain out, and the rivers are generally shallow, slow-moving, and meandering. Large areas of both Praetoria and Brunswick are low-lying and swampy.

Praetoria and Brunswick

These two continents are very similar in their overall geologic makeup, and were doubtless formed by similar forces. Brunswick has more exploitable mineral deposits, while Praetoria has more exploitable petroleum deposits.

Suideland

Suideland consists of a large plateau which is relatively devoid of impact craters, unlike the other two continents of Schwarzvaal. Volcanic activity occurs with the same frequency as elsewhere on the world, even under the icecap (which can create some strange landforms). A great flooded impact basin has excavated a significant fraction of the northern highlands. Interrupting the southern plains is the vast Trekker plateau, irregularly dotted with basaltic volcanoes.

Equatorial Islands

The equatorial islands are a mixture of normal continental formations and volcanic cones. The extremely hazardous nature of Schwarzvaal's volcanoes means that the latter are almost completely devoid of human habitation. The continental islands have distinct advantages, however, given the current situation. The only people who can get to the more remote islands are the military forces of Xing Cheng or Altiplano – bandits, thugs, and looters do not travel very far over water. Islands large enough to support a few farming families are quite secure from attack.

Oceans

The abnormally high levels of sulfur that result in the abundant iron pyrite deposits on land makes Schwarzvaal's oceans fairly acidic. Some areas are more acidic than others. In areas where evaporation has concentrated the salt contents PH is as low as 4.1; microbial and some worm-like and small-bodied life are found in these waters, but it is an exceptionally harsh environment. The bulk of Schwarzvaal's open ocean is a more moderate, ranging between 6.9 and 7.7. This is still much more acidic than the 8.1-8.4 of Earth, and has meant that marine life using simple carbonate shells or structures are non-existent. The Bärfales can only make use of carbonates by also incorporating silicates in their skeletal structures, but more importantly by coating their body in an alkaline mucus that makes carbonate lay-down easier. Rather unpleasantly for humans, the chemical

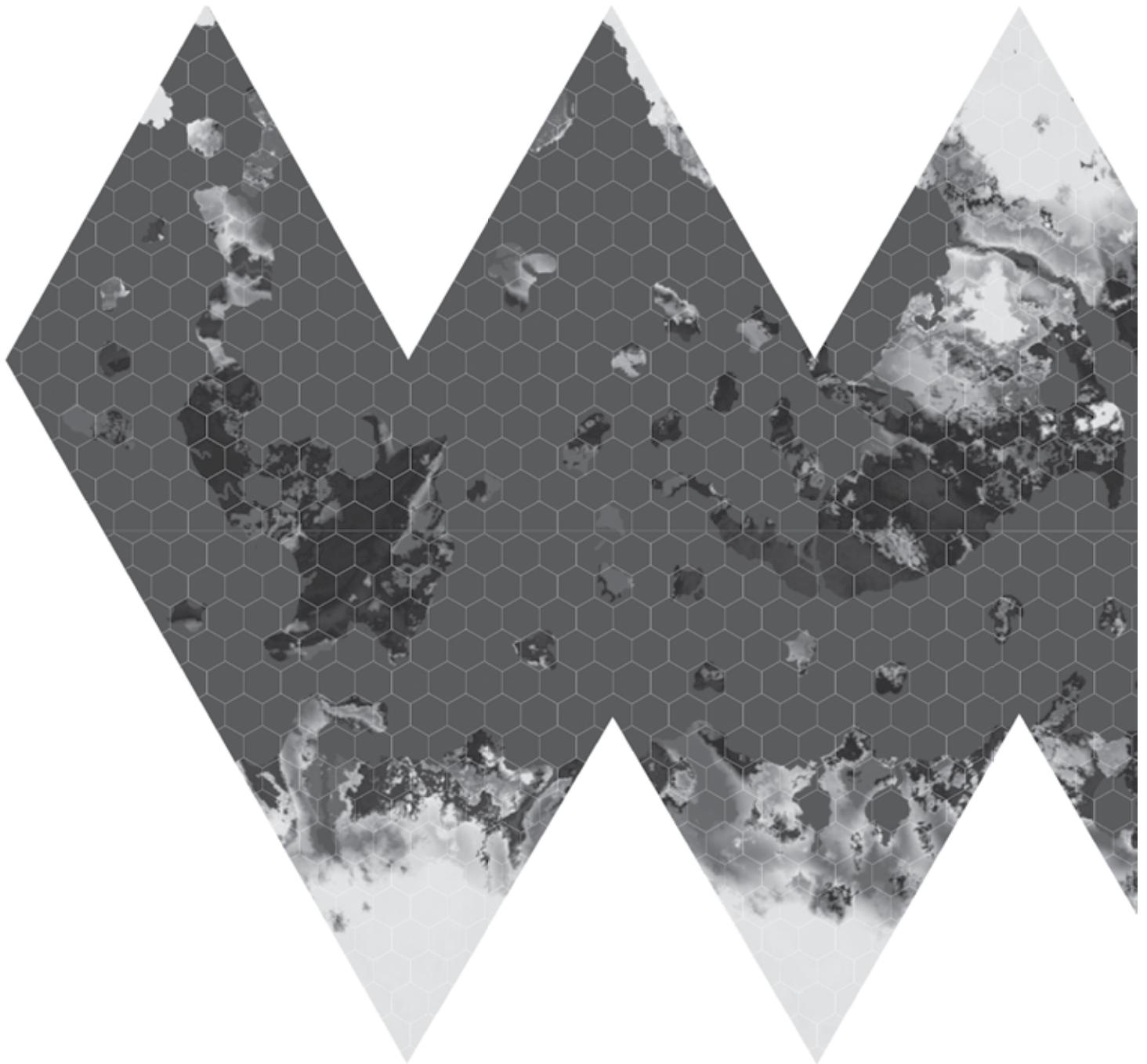
make-up of Schwarzvaal's oceans also taints the air, giving the place the faint rotting aroma.

Climate

Schwarzvaal's atmosphere consists of a nitrogen/oxygen mixture with a surface pressure of 113 kPa. Trace gases form less than .01% of the atmosphere, and are of little importance overall, with the exception of assorted sulfur compounds which give the whole planet a peculiar smell that locals no longer notice. The atmosphere contains 31kPa of oxygen, which is nearly half again as much as Earth, but is breathable without supplementary equipment. The higher percentage of oxygen

in the atmosphere is partially offset by the slightly lower than Earth normal atmospheric pressure. The oxygen itself is generated by the peculiar "heat engine" phototrophic plant life and heliobacteria present on Schwarzvaal.

Greenhouse Gasses: The atmosphere contains 8 Pa of CO₂ (0.0073%) and 2% water vapor and falling. (Earth is 30 Pa and 3%). Without plate tectonics to recycle carbonate rocks back into carbon dioxide, the planet's carbon supply is being washed into the ocean where it abiotically forms limestone. Limestone-eating and soil-forming microbes return some of this carbon to

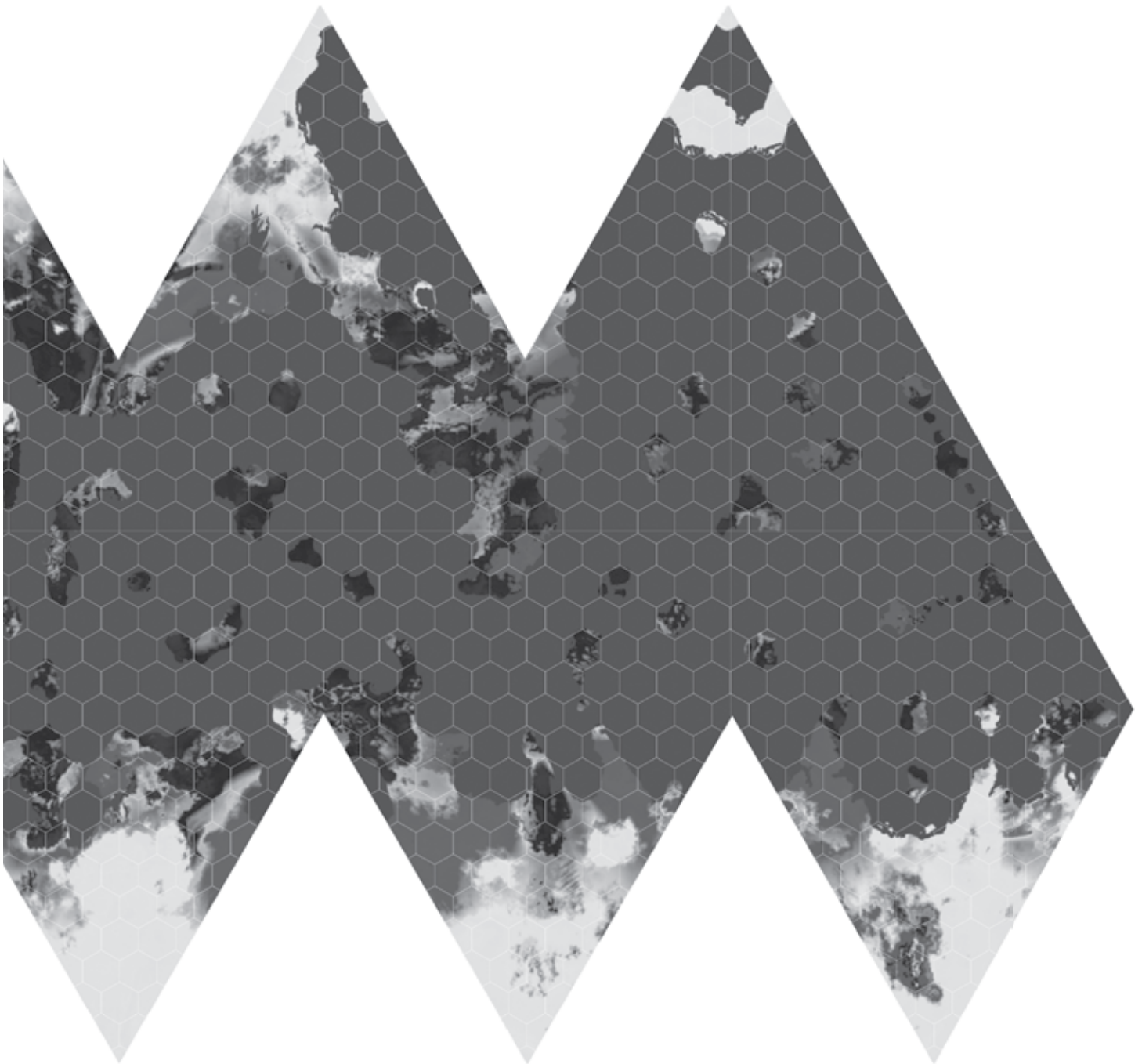


the atmosphere, but still the planet gets colder as its greenhouse continues to drop.

Schwarzvaal has a 31.6 (terrestrial) hour day, and a year of 274 Earth days. Seasonality is high, and the two polar caps of Schwarzvaal wax and wane considerably with the seasons.

The climate is generally cold and dry, and getting colder and drier. Like earth, the Schwarzvaal atmosphere is mostly nitrogen with an admixture of oxygen. The thickness of the atmosphere provides substantial greenhouse warming from absorption of upwelling infrared radiation. Temperature variations are modest

and center on a chilly 14°C (57°F) at the mid-latitudes. Water vapor is scarce in Schwarzvaal's clear atmosphere, wind is a pervasive agent of erosion. Schwarzvaal's albedo is 0.22 (Earth is 0.39), cloud cover is 32%, mean surface temperature is 287 degrees K (Earth is 293°K).



Orbital Mechanics Rules for AV:T

(C6.0) ORBITAL MECHANICS:

All movement in Attack Vector: Tactical is movement in an orbital reference frame – usually the fight takes place in a reference frame where the ships are orbiting the system primary. On this scale, the effects of conservation of angular momentum are minimal, and can be safely ignored in a tactical context.

This is not the case when the ships are in close orbit around a planet. In addition to the ship's velocity, the amount of angular momentum that is changed relative to the center of mass of the planet will impact maneuver. The rules presented below are a very rough attempt at making this playable in an AV:T reference frame, and they are incomplete. (Notes on what they don't cover are at the very end)

It is our hope that someone who understands both AV:T and orbital mechanics can take this rules set and find the places where we can benefit from a few simplifying assumptions and show us how to make them better.

(C6.1) KEY CONCEPTS

(C6.11) ORBITAL REFERENCE FRAME: The key to making orbital mechanics workable in game scale is to use a rotating reference frame. The map itself is moving at the defined orbital speed for the altitude over the planet. Think of the map as being a cylindrical tube around the planet, sort of like a tennis ball can holds tennis balls. Everything orbiting the planet is moving at a defined velocity relative to the surface of the planet; for low earth orbit, this velocity would be 46 hexes per turn. You can imagine that the tennis ball can is spin-

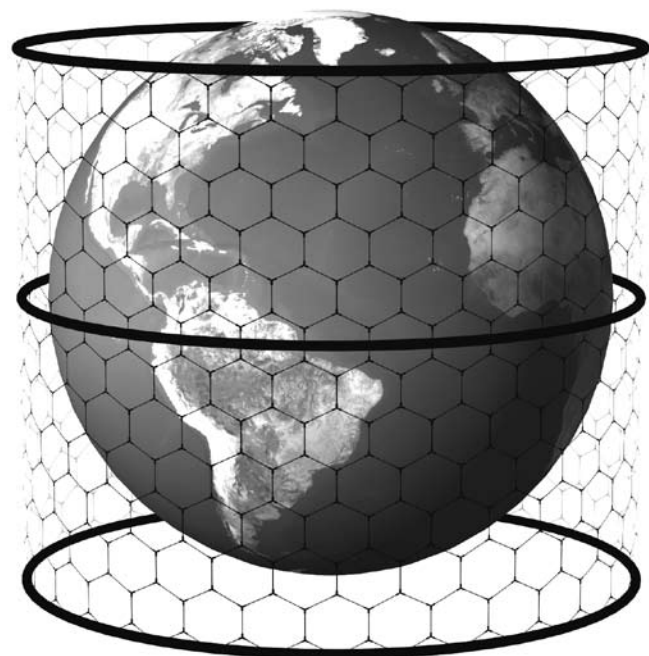
ning rapidly around the tennis ball itself, and the map is printed on the outside of the can.

(C6.111) In the same way that we use (C2.36) to cancel out vectors shared by multiple ships by assigning their vector to the map, we assign this orbital velocity to the map. A ship with velocity sufficient to remain in orbit at the established altitude and velocity is at rest relative to the orbital reference frame map.

(C6.12) REFERENCE FRAME MARKER: It will be necessary to show a ship's velocity relative to that of the reference frame, and for this, we place a reference frame marker on the map at altitude zero, with a velocity of zero. This reference frame marker defines a point in a circular orbit around the equator of the planet. Continuing the visualization from above, this would be a circle drawn around the outside of the tennis ball can, right around the equator of the tennis ball.

(C6.121) Velocity in direction A is prograde. Velocity in direction D is retrograde. Velocities in prograde, +, retrograde and – get translated into forces (C6.2) which act on the ship.

(C6.13) PLANETARY DATA TABLES: At the end of this rule are planetary data tables for the habitated planets of the Ten Worlds. The planetary data tables showcase a number of variables.



*by Brent Werness
and Ken Burnside*

(C6.131) TRANSLATION VELOCITY: This number is the amount of velocity needed in directions A, +, D or - to translate into a force in the direction rotated 90° to clockwise (velocity in A generates a force in +, a sufficient velocity in + generates a force in D, and so on.)

(C6.132) ALTITUDE: A number of variables are dependent on the altitude of the ship relative to the reference frame marker. Going below the lowest altitude on the chart means you've run your ship into the atmosphere, and it's destroyed. Going above the maximum altitude on the charts takes you into the Van Allen belts, and it's assumed your ship has disengaged from the fight by doing so.

(C6.133) VERTICAL FORCE: This will be presented as a value between 0 and roughly 2, in direction + or -. So long as the ship is at the altitude specified, it will always have this vertical force acting on it.

(C6.134) LATERAL OFFSET: This is the separation (in directions E/F or B/C) from the reference frame marker before an offsetting force is generated.

(C6.135) WRAP DISTANCE: This is the "half orbit" distance. If you get this many hexes away from the reference frame marker, you're halfway around the orbit, and it will transition from "behind" you to "in front of you".

(C6.136) ESCAPE VELOCITY: This is the velocity in excess of the reference frame orbit the ship needs to have to escape orbit, which will take considerable time. It is mostly used as a means of tracking delta v needed. Exact rules for transitioning into and out of orbit are still in development.

(C6.137) ORBITAL VELOCITY: This is how rapidly your ship is orbiting the planet in the reference frame orbit. In practice, it's how fast the surface of the planet is scrolling past under the map, going from direction A to direction D.

(C6.138) ROTATIONAL VELOCITY: This is how fast the planet is rotating on its axis. This is used, in conjunction with the orbital velocity, to determine how quickly a ground installation tracks past the battle map. It is treated as a separate quantity to facilitate orbits that are retrograde relative to the planet's rotation axis, and polar orbits.

EARTH

Translation Velocity = 7

Orbital Velocity = 46

Escape Velocity = 19

Planetary Rotational Velocity = 3

Altitude	Vertical Force	Lateral Offset	Wrap
115 or above		disengaged	
110 to 114	2.0(+)	156	1580
74 to 109	1.5(+)	125	1467
42 to 73	1.0(+)	101	1366
14 to 41	0.5(+)	82	1277
-11 to 13	0.0	75	1237
-33 to -12	0.5(-)	68	1199
-52 to -34	1.0(-)	57	1130
-63 to -53	1.5(-)	48	1069
-64 or below		destroyed	

(C6.14) ORBITAL MECHANICS WORKSHEET:

Provided in the back of these rules is an orbital mechanics worksheet. It is shown below.

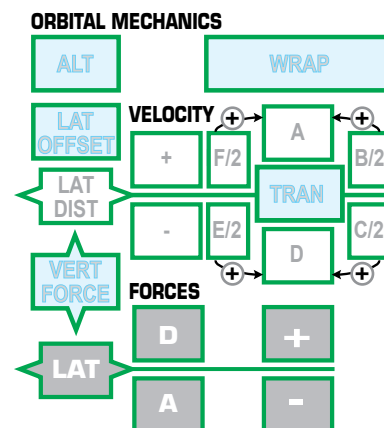
(C6.141) The boxes labeled ALT, VERT FORCE, WRAP, LAT OFFSET and TRAN are used to record the Altitude, vertical force, wrap, lateral offset and translation velocities for the planet your ship is orbiting; this is pulled from the planetary data table (C6.13). In future printings of the play aid, they will have a light blue fill in the boxes.

(C6.1411) The VERT FORCE box has two tabs, pointing up and down, corresponding to forces in + and -. If your altitude gives you a vertical force in +, fill in the top tab. If your altitude gives you a vertical force in -, fill in the bottom tab.

(C6.142) Your ship's vectors are recorded in the white boxes. Vectors in F and B are halved (divided by 2) and added to the vector in A before checking for translation into forces. Likewise, vectors in E and C are halved and added to the vector in D.

(C6.143) Lateral distance from the reference frame marker is recorded in the LAT DIST box. The box has two triangular "tabs" poking out to the left and right. Use these to remind yourself which direction the offset from the reference marker lies in. For the Green SCC, an offset in E/F would have the left-pointing tab filled in. For the Red SCC, an offset in E/F would have the right-pointing tab filled in.

(C6.144) At the bottom of the play aid are five boxes filled in gray, with white lettering inside



them, just like the thrust containers on the AVID. When a velocity or offset is translated into a force, the force will be placed in the box with the same corresponding position. Thus, a velocity in + translates into a force in the gray box marked D.

(C6.145) The LAT force box has the same two triangular offsets as the LAT DIST box. Fill in the one corresponding to the force in the OPPOSITE direction as the direction of the offset. Thus, if your offset is in E/F, the force will be in B/C.

(C6.2) MECHANISMS AND PROCEDURES

(C6.21) FORCES: AV:T uses very specific terms for game mechanical reasons (for example, thrust activates the engine, which generates acceleration and displacement), we have to break with some of the conventional usages in physics to maintain maximum clarity. Orbital mechanics translates certain things (velocities in specific directions, certain positions relative to the reference marker) into *forces*. A force acts like thrust from the engine, and uses the Thrust Chart for its effect on maneuvers.

(C6.211) Acceleration and displacement from forces are accrued during the Resolve Thrust Step of the Sequence of Play, just like thrust from the main engine is.

(C6.212) While forces obey the general rules of Thrust Break Conditions (and their thrust break conditions happen at the same point in the Sequence of Play). Forces DO NOT have a Thrust Break Condition when a pivot completes, or when the thrust of the main engine is set to zero. Thrust break conditions DO apply when the force is set to zero, or when the end of the thrust chart is reached.

(C6.213) Forces do not require that the ship spend fuel.

(C6.214) Lateral forces (gained in direction B/C and E/F) use the normal procedure for bias directions (C2.233).

(C6.215) Acceleration dots gained from forces are consolidated normally with existing vectors when the Thrust Break Conditions are met. Because thrust (from engines) and forces (from velocities) happen independently of each other, thrust breaks for forces and engine use will remain separate from each other, and may happen multiple times per turn.

(C6.216) Displacements gained by a force are always used, even when the ship is pivoting (and would otherwise ignore displacements).

(C6.217) When a ship is experiencing forces and also under thrust, mark the cells of the thrust chart with diagonal lines in one direction, and from forces going in the other direction.

(C6.22) COMBINING FORCES: Forces in opposite directions cancel. If your ship has a vertical force of 1 in – due to the altitude below the reference frame marker, and a force of 0.5 in + due to velocity in direction A, the net force is 0.5 in –.

(C6.221) This also applies when combining forces with thrusts. If your ship is thrusting in B/C at thrust 2, and has a force in E/F of 1, the net thrust is 1 in direction B/C.

(C6.23) TRANSLATING VELOCITY INTO FORCES: Whenever a Thrust Break Condition is completed, copy vectors from the AVID to their corresponding boxes in the orbital mechanics play aid. Vectors in B and F are halved and added to the vector in A, vectors in C and E are halved and added to the vector in D. Retain any fractional vectors for this play aid only.

EXAMPLE: A ship with vectors of 11 in A, and 3 in F, after all (C2.3) consolidations are done would record $3/2$ (1.5) in the box labeled F/2, and 11 in the box marked A. The 1.5 would be added to 11, leaving 12.5 in A.

(C6.231) Divide the vectors in A, D, + or – by the number in the TRAN box, rounding fractional results normally. The result of this division is the force to be recorded in the corresponding box in the forces portion of the play aid. The boxes are positioned so that a velocity in A gives a force in +, a velocity in + gives a force in D, a velocity in D gives a force in – and a velocity in – gives a force in A, following the “right hand rule” of conservation of angular momentum.

EXAMPLE: The ship in the previous example, with a velocity of 12.5 in A is orbiting Schwarzschild, which has a Translation Velocity of 6.5. Dividing 12.5 by 6.5 gives 1.92, which rounds to 2, which is recorded in the force box of +.

(C6.24) TRANSLATING VERTICAL OFFSETS INTO FORCES: Physical distance from the reference frame (both in the vertical plane, and orthogonally to the prograde/retrograde axis) will translate into forces acting on the ship.

(C6.241) On the planetary data table, the ship's altitude will correspond to a Vertical Force. So long as the ship remains in that altitude band, that vertical force will apply to it. Record the magnitude of the vertical force in the VERT FORCE box, filling in the up or down tab to remind yourself of its direction. Copy that force into the appropriate + or – force container, adding it to any existing forces there, or subtracting it if it's opposed.

EXAMPLE: Continuing with the ship orbiting Schwarzvaal, the ship is at altitude -9, and has a VERT FORCE of 0.5 in -. This combines with the force of 2 in + in the prior example for a final force of 1.5 in +.

(C6.242) VERT FORCE, combined with translation of velocities to forces, can be used to make a circular orbit at any altitude. Multiply the TRAN value by VERT FORCE, and round up. The result is the velocity in A (for low altitudes) or D (for high altitudes) needed to cancel out the VERT FORCE for a given altitude.

EXAMPLE: If the TRAN value is 6.5, and the VERT FORCE is 0.5 in -, multiplying 6.5×0.5 gives 3.25; a velocity of 3.25 or greater is A will translate to a force of 0.5 in +, which will cancel out the VERT FORCE. This will cause ships at different altitudes to orbit the planet at different rates, in accordance with physics.

SCIENCE BEHIND THE RULES: CONSERVATION OF ANGULAR MOMENTUM: Building on the visualization of the tennis ball in the tennis ball can, it's useful to imagine that your ship is a small ball that's being swung around the can on a rubber band in the plane of the equator of the tennis ball. As you swing the ball faster, the rubber band stretches, and it gets farther away from the can. As the frame of reference of the orbit is the surface of the can, this means that as you go faster in a prograde direction, your altitude increases. As you slow down, your altitude decreases.

(C6.243) When an orbital velocity does not translate to forces that balance out the VERT FORCE value, your orbit is eccentric. Over the course of a full orbit (longer than most games take), a ship will accumulate velocities in + or -, which will translate into forces in A or D, which will eventually accumulate velocities into A or D, which will, in turn, translate into forces in + or -, causing the cycle to repeat.

SCIENCE BEHIND THE RULES: ECCENTRIC ORBITS: When you're thrusting directly away from the surface of the tennis ball can, you're making your circular orbit more directly elliptical – you get farther away from can at the “top” of the orbit, and you get closer to the can at the bottom of the orbit. Kepler's Third Law determines that as you get farther away from the center of mass, your orbital velocity relative to that mass decreases; as you get closer, it increases.

(C6.25) TRANSLATING LATERAL OFFSETS INTO FORCES:

The lateral offset distance is the distance (in hexes) that a ship must be from the row of hexes containing the reference frame marker, before a force will apply. As the hex row of the reference frame marker is always A-D, this offset is always tracked in B/C-E/F axis. If using a planetary reference frame system, if direction A is east (090°), E/F is 000° (north) and B/C is 180° (south).

(C6.251) The offset needed to generate a force is lower at lower altitudes, and increases at higher altitudes, as is shown on the chart

(C6.252) When the ship's separation from the reference frame hex row equals or exceeds the LAT OFFSET value, the ship will experience a force of magnitude 0.5 in the opposite direction. This force will be tracked (like all forces) during the Resolve Thrust phase of the Sequence of Play. A bias direction (C2.233) must be chosen when the force begins.

SCIENCE BEHIND THE RULES: LATERAL OFFSET: Thrust in the B/C and E/F directions will change the inclination (or “axial tilt”) of the orbit. To visualize this, imagine that the circle for the orbit is drawn at an angle on the surface of that tennis ball can, with half of it below the equator, and half of it above the equator. If you unwrapped the tennis ball can and laid it out flat, it would look like a sine wave plot centered on the equator. Combining an inclined (tilted) orbit with a large element of thrust in +++, you can recreate a “Mjollnir” type orbit (named after the class of Soviet spy satellites).

EXAMPLE: *Our ship orbiting Schwarzvaal has made a number of combat maneuvers, avoiding coilgun shells, and built up vectors of 10 in E and 7 in F, while diving down to altitude -21. It has, in a lull in the battle, acquired a distance of 61 hexes away from the reference frame hex row in direction E/F. It now experiences a force of 0.5 in direction B/C, with the bias in C. 0.5 is written into the LAT box and the ship undergoes a thrust of 0.5 in direction B/C. Hitting the fast forward button, after one turn, the ship will have drifted 10 hexes in direction E, 7 in F (increasing the separation by 14 hexes), accumulated one acceleration dot in C, and accumulated a half displacement in C. The end result is a velocity of 9 in E, 7 in F, and LAT DIST increases to 75. One turn later, the ship drifts 9 in E, 7 in F (increasing LAT DIST by 14, to a total of 89), and accumulates a half displacement and one acceleration dot in F. The final velocities are 9 in E, 6 in F. A turn after that, the LAT DIST will increase by 12 to 101 hexes, the velocity will be changed to 8 in E, 6 in F, and a displacement will accrue in direction C (reducing the LAT DIST by 1, to 100 total). A turn after that, the ship will have increased LAT DIST to 112 hexes, have reduced velocities to 8 E, 5 in F, and displaced one hex in F, to 111 hexes. Continuing on to the next turn, the LAT DIST will increase by 10 hexes, to 121, a half displacement in C will occur, and the velocity will be reduced to 7 in E, 5 in F. Early in the next turn, the LAT DIST will increase to 122 – which is 2x the LAT OFFSET value for this altitude. This increases the force in B/C to 1.0; the ship will reduce its E/F velocity by 1 hex in each direction, and displace one hex in F. Continued on long enough, the ship will accumulate a substantial velocity in B and C, and drift back (and over) the reference frame marker hex row, until it drifts far enough in that direction to result in a force in E/F. Left to itself, the ship will move in a sine wave pattern over the reference frame hex row, just like NASA satellite tracks do when superimposed over a map of the Earth.*

(C6.26) COMPLETING A FULL ORBIT: Because the reference frame marker is fixed on a cylindrical surface, there is a finite distance away from the marker you can get; the opposite side of the cylinder. This is known as the “half orbit distance” – when you’ve gotten this far away from the reference marker, you’ve gotten halfway around the orbit around the planet.

(C6.261) The reference frame marker does not have to represent an orbit along the planet’s equator, but handling installations on the surface is easiest if it does. An object on the surface of the planet will, in the frame of reference of an orbital map, move in direction D at a very high rate of speed, which will be shown on the planetary data tables. (As of this writing, the person who did the heavy math for these rules hasn’t responded with that data. When we have it, it will be posted to the web site.)

(C6.3) INTERACTIONS WITH OTHER RULES:

(C6.31) SEEKING WEAPONS: When launch seeking weapons from planetary orbit at another target in planetary orbit, orbital mechanics theoretically interacts in two ways – calculating the CV and calculating the MV. We suspect (from limited in house testing of this rule before publishing in Nexus Journal) that the final result of this rule will be that the forces acting on seeking weapons in an orbital frame of reference are so small as to be ignorable, but for testing, here’s the mathematically correct set of interactions.

(C6.311) When deriving the CV, include any acceleration dots from forces acting on the firing and target ship, just as you’d use the acceleration dots of thrust from both ships.

(C6.312) When launching shells in directions A, +, D or -, derive forces for the launch mechanism’s MV, and treat them as thrusts in the appropriate direction for the purposes of the target’s evasion on the shellstar. If launching shells in any window adjacent to those four, halve the MV before deriving forces.

DESIGNER’S NOTE: INCOMPLETE RULE!

This rules set does not cover (and based on the assumptions underlying it, may not be able to cover) the case of a ship in a polar orbit intersecting an equatorial orbit with another ship in it. This results in two interpenetrated rotating reference frames, rotating at 90° to each other, and we’re not quite sure how to make that playable.

This rule set does not cover the math needed to enter an orbit from “free space” (where orbital mechanics no longer alters movement in game-turn time frames) or to effectively leave orbit to free space on a heading of the player’s choice. We use the “enter the Van Allen Belts” as a convenient ceiling for orbital mechanics, but it is not actually a physical limit on the ships in combat time scales.

ALPHA MENSAE II

Translation Velocity = 7.5

Orbital Velocity = 41

Escape Velocity = 17

Planetary Rotational Velocity = 4

Altitude	Vertical Force	Lateral Offset	Wrap
172 or above	disengaged		
116 to 148	2.0(+)	177	1473
77 to 115	1.5(+)	137	1351
44 to 76	1.0(+)	107	1245
14 to 43	0.5(+)	85	1153
-11 to 13	0.0	76	1112
-33 to -12	0.5(-)	69	1073
-52 to -34	1.0(-)	56	1004
-69 to -53	1.5(-)	47	944
-70 or below	destroyed		

DAMSO

Translation Velocity = 8

Orbital Velocity = 50

Escape Velocity = 21

Planetary Rotational Velocity = 9

Altitude	Vertical Force	Lateral Offset	Wrap
152 or above	disengaged		
141 to 151	2.0(+)	208	1914
95 to 140	1.5(+)	164	1768
53 to 94	1.0(+)	130	1638
17 to 52	0.5(+)	105	1525
-14 to 16	0.0	95	1474
-42 to -15	0.5(-)	86	1426
-66 to -43	1.0(-)	71	1339
-87 to -67	1.5(-)	60	1263
-90 to -88	2.0(-)	51	1196
-91 or below	destroyed		

ALTIPLANO

Translation Velocity = 7

Orbital Velocity = 38

Escape Velocity = 16

Planetary Rotational Velocity = 2

Altitude	Vertical Force	Lateral Offset	Wrap
57 or above	disengaged		
45 to 56	1.0(+)	113	1181
15 to 44	0.5(+)	88	1086
-11 to 14	0.0	78	1043
-34 to -12	0.5(-)	69	1004
-52 to -35	1.0(-)	56	934
-53 or below	destroyed		

MEDINA

Translation Velocity = 7.5

Orbital Velocity = 41

Escape Velocity = 17

Planetary Rotational Velocity = 3

Altitude	Vertical Force	Lateral Offset	Wrap
172 or above	disengaged		
130 to 171	2.0(+)	207	1581
87 to 129	1.5(+)	157	1443
49 to 86	1.0(+)	121	1324
16 to 48	0.5(+)	95	1221
-13 to 15	0.0	85	1174
-37 to -14	0.5(-)	76	1132
-58 to -38	1.0(-)	61	1055
-69 to -59	1.5(-)	51	989
-70 or below	destroyed		

CONCORD

Translation Velocity = 7

Orbital Velocity = 52

Escape Velocity = 21

Planetary Rotational Velocity = 4

Altitude	Vertical Force	Lateral Offset	Wrap
119 or above	disengaged		
107 to 119	2.0(+)	143	1711
73 to 106	1.5(+)	118	1602
42 to 72	1.0(+)	97	1504
14 to 41	0.5(+)	81	1416
-11 to 13	0.0	75	1376
-33 to -12	0.5(-)	69	1338
-53 to -34	1.0(-)	58	1268
-57 to -54	1.5(-)	50	1206
-58 or below	destroyed		

OLYMPIA

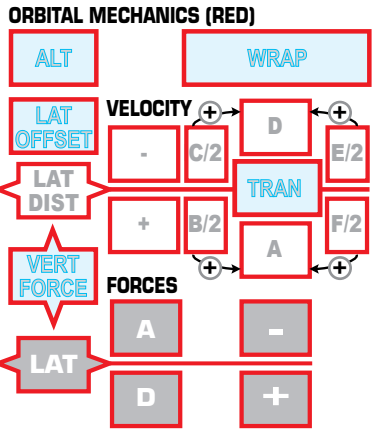
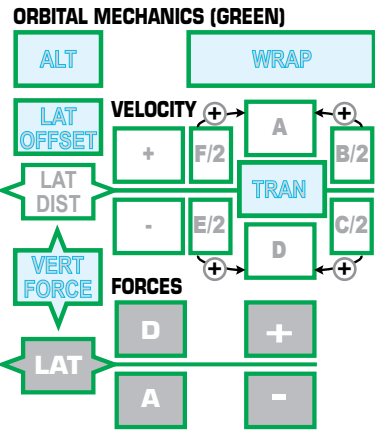
Translation Velocity = 6.5

Orbital Velocity = 44

Escape Velocity = 18

Planetary Rotational Velocity = 2

Altitude	Vertical Force	Lateral Offset	Wrap
67 or above	disengaged		
63 to 66	1.5(+)	104	1307
36 to 62	1.0(+)	85	1222
12 to 35	0.5(+)	70	1146
-9 to 11	0.0	64	1111
-28 to -10	0.5(-)	59	1078
-41 to -29	1.0(-)	49	1019
-42 or below	destroyed		



REFUGE

Translation Velocity = 7
Orbital Velocity = 52
Escape Velocity = 21
Planetary Rotational Velocity = 3

Altitude	Vertical Force	Lateral Offset	Wrap
116 or above	disengaged		
104 to 115	2.0(+)	136	1690
70 to 103	1.5(+)	112	1585
40 to 69	1.0(+)	94	1491
13 to 39	0.5(+)	79	1406
-11 to 12	0.0	72	1368
-32 to -12	0.5(-)	67	1331
-52 to -33	1.0(-)	57	1263
-60 to -53	1.5(-)	49	1202
-61 or below	destroyed		

SCHWARZVAAL

Translation Velocity = 6.5
Orbital Velocity = 41
Escape Velocity = 17
Planetary Rotational Velocity = 2

Altitude	Vertical Force	Lateral Offset	Wrap
67 or above	disengaged		
38 to 66	1.0(+)	93	1154
13 to 37	0.5(+)	75	1073
-10 to 12	0.0	67	1037
-29 to -11	0.5(-)	61	1003
-38 to -30	1.0(-)	50	941
-39 or below	destroyed		

PACIFICA

Translation Velocity = 6.5
Orbital Velocity = 57
Escape Velocity = 23
Planetary Rotational Velocity = 1

Altitude	Vertical Force	Lateral Offset	Wrap
94 or above	disengaged		
90 to 93	2.0(+)	109	1706
61 to 89	1.5(+)	93	1617
35 to 60	1.0(+)	80	1536
12 to 34	0.5(+)	69	1463
-9 to 11	0.0	64	1428
-29 to -10	0.5(-)	60	1395
-47 to -30	1.0(-)	52	1334
-59 to -48	1.5(-)	46	1278
-60 or below	destroyed		

XING CHENG

Translation Velocity = 6.5
Orbital Velocity = 47
Escape Velocity = 20
Planetary Rotational Velocity = 3

Altitude	Vertical Force	Lateral Offset	Wrap
126 or above	disengaged		
122 to 125	2.0(+)	175	1720
82 to 121	1.5(+)	139	1594
47 to 81	1.0(+)	112	1482
15 to 46	0.5(+)	91	1384
-12 to 14	0.0	83	1339
-37 to -13	0.5(-)	75	1298
-58 to -38	1.0(-)	63	1222
-72 to -59	1.5(-)	53	1155
-73 or below	destroyed		

Attack Vector: Tactical 1.5

Why We Did It:

Ad Astra Games prints books in house; this means that incorporating typo fixes is easy; we update the files and print a new batch of rulebooks. We'd intended, once the change log got long enough, to offer upgraded rulebooks for sale to registered customers.

What we got was an amazing response. A wide audience of people who bought the game gave us minor science and math fixes, and a wealth of expanded explanations to put in the rulebook. We also got suggestions for new systems, such as water heat sinks and flash coolers, and the math needed to do a number of other things (like increasing thrust as fuel was spent.)

This forced us to re-evaluate the ship design process, which incorporated those science fixes and got more automated, with other changes "under the hood", cleaning up special cases in ship construction. There are more overt changes, like new hull forms and fuel rules.

The ship design spreadsheet now exports an XML file, which is then parsed into a PDF template to put all the numbers in the right boxes and fill out the tables.

What's Changed:

The separate mast and engine hit location tables have been combined; the engine damage track was, in all essence, another way to get the same effect as the Structural Integrity Track, and so was eliminated.

We no longer track individual crewmen. The old rules were never used.

We made reactors take more damage to destroy; this also impacted how reactors are defined for ship creation. There are several varieties of reactor now.

We added water heat sinks, and flash coolers for weapons. Water heat sinks can store 1 point of heat, or be flash vented overboard to reduce the heat total of a ship by 6 points, without extending radiators. We added solar/beamed power collection arrays, and chemical batteries.

The Thrust Track became the Thrust Matrix. As you burn deeper into your fuel, the fuel units change shape. When you mark off the last unit of a given shape, you move down one row on the Thrust Matrix, and your thrust increases. This

process was extended for cargo, ammunition expenditures, and venting water heat sinks.

The missile construction system was regularized; year of introduction rates for ammunition types were added, and historical introduction dates for missiles were also added.

A new missile ammunition type was added – EMP warheads. These can blind an enemy ship without damaging it, or be used to defend against a massive swarm of inbound missiles. Kinetic-on-kinetic defense was implemented, after Ethan McKinney had a brainstorm for how to fix it. A pervasive math error on escort zone defense was corrected.

The entire seeking weapon section (F0.0) was extensively rewritten. While the basic procedure never changed, extensive explanations of what's going on, and why, were added, and a more thorough tutorial for seeking weapons was put into place.

In developing Saganami Island Tactical Simulator, we worked out a better algorithm for distributing Structural Integrity hits, and a better way to do damage control parties. We ported those back to Attack Vector: Tactical because they add to the game.

The new 1.5 rulebooks have the Range-Angle Lookup Table printed on the back cover.

Over 100 typos were fixed throughout the rulebook.

New Science Behind the Rules notes were added for Rockets, Heat Sinks (adding notes on how the water heat sinks behave) Thermodynamics, the Shot Geometry Table, and Reference Frame Shifts in Seeking Weapon Launch and more.

The index was extensively revised and updated.

How To Get AV:T 1.5:

If your store bought AV:T from their distributor after March of 2006, in all likelihood, they have 1.5 on the shelf. If you registered your game, you can go to services.adastragames.com and buy an upgraded set of rulebooks for \$12. Also available are PDFs of the SSDs in Shipbook 1, as a \$5 purchase item. In the future, 90 days after release of a new Attack Vector product, we'll be selling PDFs of the SSDs to registered customers for ease of play.

Using Miniatures with Attack Vector: Tactical

or, “Miniatures with Attitudes”

Part 1

First off, let us review what we already know. Ad Astra's Attack Vector: Tactical is a great game as is. Let me even say it is unique in its solution for a table top space combat simulation. That is, it is the only game I know of that uses Newtonian physics and genuine three dimensional game play, set into a researched science background.

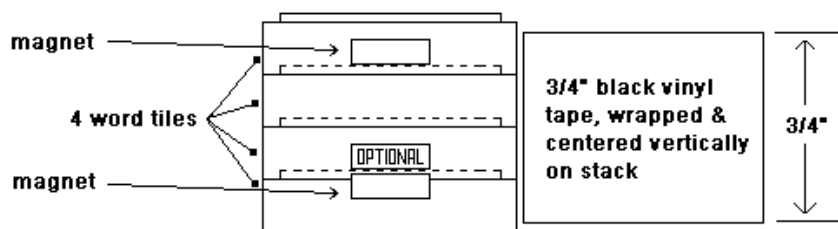
This article is for those that desire a variation of play that employs the use of ship miniatures other than the practical box minis included in the game. With an estimated cost for this project of about \$100, you will understand why Ad Astra Games didn't include this inside the box. With that said, the first subject I want to focus on isn't the ships. Indeed, it is what the ships will be “perched” upon. I believe that the reason the current stacking tiles are the thickness they are is that they would fall over if they were

as they are eight times stronger than ceramic magnets. For my choice, I particularly liked a disk “Nd” magnet that measures $1/8" \times 3/8"$ (.125" x .375"). The cost for one of these can be as high as \$.50, which becomes cost prohibitive for this purpose. The cheaper ceramic magnets can work as well, but I bought a few hundred of the Nd magnets and that brought the cost closer to 20 cents instead of 50 cents. With that done, all that was needed was a “stacking cube” to attach them to. In a case of serendipity, I noticed that the size of the stacking word tiles from a game called “Upwards”[®] was close enough to fit to the existing stacking tiles included with the game (more on this later). The tile word game comes with 100 tiles. If four tiles are stacked together, placing one magnet under the top tile and one super-glued under the lowest tile, it forms a cube that stacks well with other cubes. Of course, care is necessary to pick a magnetic

Also, instead of gluing the tiles together, I wrapped them horizontally with $3/4"$ black electrical vinyl tape. If done just right (centering the wrapped tape), the tape leaves a little of the original tile color at the extreme top and bottom. With this small gap left, it allows for easy counting of stacked tiles in a column (see photo below).



Now that we have a way to show ships “at altitude”, we need a way for the “tree” to have “roots”. In other words, the stacked column will stay together as they all fall over because they have nothing to bond to on the table. To solve this, go to a sheet metal shop and purchase several 24" by 37" pieces of (guess what?): sheet metal. Laying the sheet metal under the paper hex grid gives the columns something to lock onto. To make the bond exceptional, I add an extra disk magnet to the bottom stacking cube in a column (yes, it fits inside the hollow bottom with the other magnet). This is one reason the Nd disks with the previous dimensions work well. In some of the photos that I've taken, I glued one disk magnet to some red and green 1- $3/8"$ “counting disks” used for preschool education. This just makes it easier to add a “foot” to the column of cubes.



STACKING CUBE, used with .9" hex grid map

a proportional height as related to their width (about 24mm). I wanted my ships to have a “feel” of proportional altitude when “working” them on the board. Thus, a “stacking cube” is needed that will remain strongly attached in a vertical column.

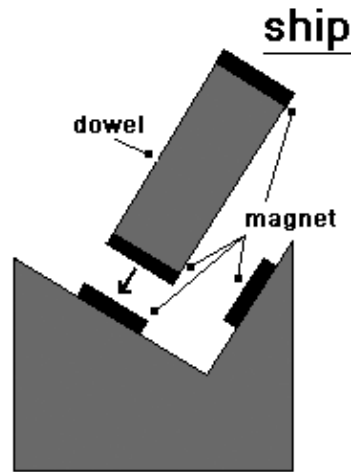
Instead of using various plastic building blocks (which I will cover later), I decided to build proportional cubes that bond using magnets. I chose Neodymium, or specifically NdFeB (Neodymium Iron Boron) magnets,

orientation (N/S or S/N) and to keep to the pattern, or some cubes will just repel others (this is known as a “D’oh”!). I played it safe by using a third magnet between the two bottom tiles, and thus didn't need to glue anything (it held the bottom magnet in place).

by Darell C. “BuShips” Phillips

You will no doubt be pleased that our tilt blocks that we are much endeared to will still fit on the top of the column. One of these tilt blocks should be slightly modified to magnetically hold the miniature in place (you DO remember this was about miniaures, right?). I suggest gluing two ND disk magnets to the “climbing” ramps of the block. Attach one magnet under the hollow part of the block (under the 30-degree surface). Then superglue another magnet on the very top of the 60-degree ramp. In order to center the magnets properly, I suggest gluing a magnet under one of the stacking tiles and placing it on the ramp to see where it should be centered. Just don’t glue THAT magnet down (you can attach the magnet to be glued to that “alignment tile”. Remember that you can purchase extra tilt blocks from Ad Astra Games to make plenty of modded tilt blocks. Combined with the stacking cubes, we the new tilt blocks will create an enhanced “3D battle space” that a ship miniature will fit into. In order that a model will fit properly to the tilt block, use about a one-inch by 3/8” dowel with magnets glued on each end (remember to get the polarity right). This will raise the miniature out of the “valley” of the tilt block. This assumes you will attach a magnet to the ship miniature (bottom). Here is a suggestion for a magnetic tilt block with the suggested magnet positions and showing a dowel that will hold the ship in position. Note that

I suggest using a white game tile with another magnet that will let the tilt block attach to cubes and other tilt blocks. I glued mine to the tilt block permanently. When finished, the tilt blocks will stack on top and in various ways to add to



the angles already offered. Since the box-mini is replaced by the miniature, we would “lose” all six 90-degree facings that interact with the tilt blocks. There are several ways in which these angles can be recovered. One is to use more than two blocks to do pitch and roll. In other words, 30-degrees plus 60-degrees equals 90-degrees (and recreates the missing orientation). Inverted flight is allowable using multiple blocks stacked in a “waterfall” method. See below for

an example. Another method is to visit your local Ace Hardware (or similar store) and look in the bolt section for a “square key” maybe 1/4” by 1-1/4”. It is similar to the dowel, but has flat sides (at 90-degree angles). Like the ship dowel, it attaches to the magnets on the tilt blocks and allows the miniature to flip at right angles. This piece can even be used to do double-duty as the dowel, but I just like using the dowels to support the ship miniature (my dowels are even red and green), with the square keys showing right angles to the ramp walls of the tilt blocks.

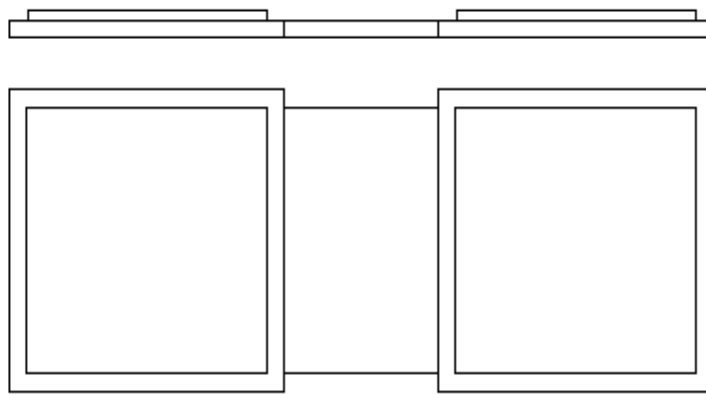
The reason for the dowel is so that the ship clears the tilt block, but remains parallel with the surface angles. One optional method for a pre-made dowel with magnets is to head for the toy department of a local store and look for one of several brands of magnetic building sets that use magnets and have pegs that are about one inch in length. These parts can even be considered for an outright replacement of the “stacking cubes”, but would need additional stronger magnets on the ends for taller columns. Again, the size of the .125” x .375” Nd disk magnets is perfect for adding reinforcement. Remember, the tilt blocks would need to have the hollow underside filled in (you can glue a standard stacking tile to the bottom with a magnet attached inside). A large washer or disk is needed at the base for stability. Children’s plastic “counting disks” work well for this.

I want to stress that these ideas are for those that want some options of using ship miniaures over and above the methods that were formulated for the game as published. There are very good reasons that the stacking tiles, for instance, were “condensed” for the game, as was the decision to produce “box” minis over metal miniaures. My thought was that if I was going to adapt the game to miniaures, then I might as well “go for broke” and attempt to create a proportional 3D battle space. I believe that to do one of them encourages the addition of the other. For example, if one wants to display a ship that is directly above another ship (in the same column), then a “thicker” stacking tile must be



used. It then begs the question, “How do you show a box-ship or miniature that is above/below another ship?” Remember earlier that I mentioned to revisit the ability of the tiles and cubes to attach together. What I suggest is to “recycle” some of the thin stacking tiles by gluing two tiles side-by-side. This creates what I call a “balcony tile”. I prefer to add a one-half inch section of styrene between the tiles for added separation (such as the material offered by Evergreen Scale Models).

The styrene piece separates the tiles so that the tilt blocks of the additional ship can be placed on the “balcony” at the correct height within the column. This separation also allows for the overhang of a box mini (and a miniature if positioned



1/2" x 3/4" plastic styrene "bridge" glued between two tiles.

correctly). There are of course four 90-degree positions for placement options when close to another column. If more than two ships are within a column

at close range (can you say: “wall-of-battle”?), then rotating each balcony tile 90 degrees should give clearance for ships at other levels. Thus, you can stack ships inside a column in a “spiral” method using balcony tiles to represent multiple ships in a vertical formation. The example below shows the need for horizontal separation between stacking tiles that are “joined at the hip”.

Note that my diagrams show stacking cubes that are just as wide as the white stacking tiles included in AV:T. I created my cubes from an old collection of word tiles that were about one-inch wide. Current versions of the word game have smaller tiles (about 3/4" wide), but still work just fine as the raw stock to make stacking cubes (the height is about the same, thus still using four tiles per cube).

Ship miniatures that are even longer than box minis would be limited to flying on the “wing” positions (only two, not four of the balconies), or a less visual numbered “bookmark” can be placed on the balcony. The ship would have to be off to the side of the map with a matching bookmark identifier showing its position within the column. To me though, this defeats part of the reason of having miniatures on the board in the first place. I would try to show ship positions and attitudes as close to where they are as possible.

Thus, there lies the goal: to balance the desired visual benefits against the physical limitations of a multi-dimensional universe.



Part 2

As I mentioned earlier about using various methods of constructing “full height” stacking tiles (stacking cubes) and the use of “Nd” magnets to support them and a system of modified tilt blocks, these comments will focus on a perhaps simpler method of employing common plastic building blocks as an option for larger hex maps. Yes, building blocks.



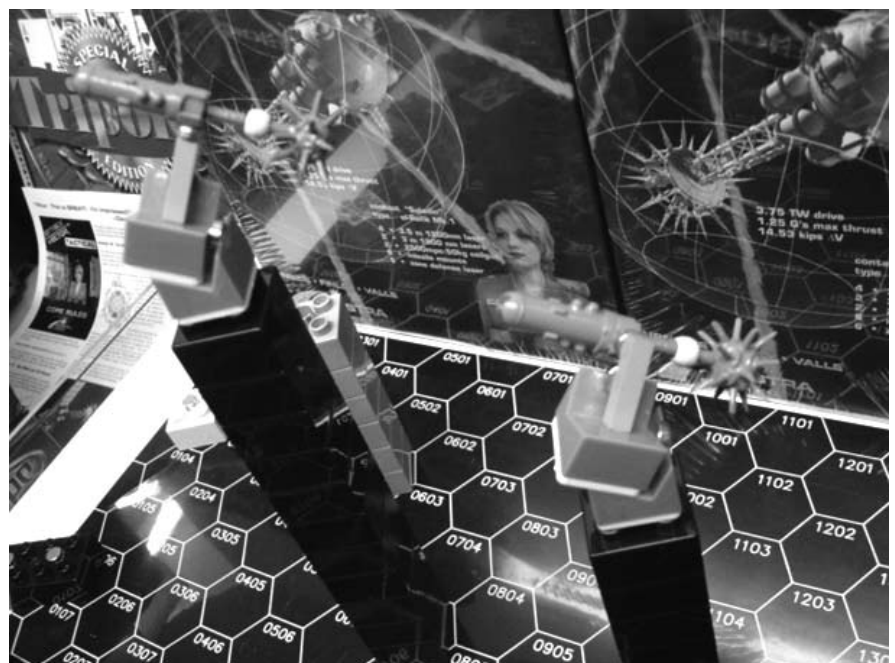
One reason for their choice is the almost endless supply nearly anywhere on this planet. Another is cost. You won't have to wait very long to catch a sale, and I hereby forbid any thought of pirating from innocent children within pilfering range. Seriously though, look at the “bucket” collections and several will supply you with an ample amount of “tiles”. Although the small “standard” bricks will work with the .96” hex map, for added stability I now prefer the use of the “preschool” sized components. There is a “yellow” colored tub that has 57 “2X2” shapes that work well with the 1.33” map sheet (as well as the felt map with a 1.5” hex grid, offered from Ad Astra Games). I used the blocks for the first time at a recent game convention, and the height of the blocks gave the feeling of the battle being in a “holographic tank”. With the addition of a set of custom miniatures (*Wasps* and *Rafiks*) that I had built and used, it was commented that there was a visual improvement to the “stop frame” flow of the battle as the two ships corkscrewed past each other. These are my words, but I'm sure you get the picture. As per the instructions in Part One, I used the same magnets to add strength to the column of 2X2 bricks, but here is where the cost

saving enters the equation. As long as a method is used to “bind” the bottom of the stack, no magnets need be used above the interface of the sheet metal until you reach the top brick. Having one or two magnets on the top brick is all that is necessary to secure the previously modified tilt blocks (I still suggest the same 1/8” x 3/8” Nd disk magnets). The two *Wasp* miniatures below are “perched” upon a column of 2X2 “preschool” blocks, using the previously mentioned magnetic tilt blocks and a steel “square key”. The metal key, which is found in most hardware stores in the bolt section, duplicates the 90 degree angles of the printed box mini. To reduce the use of consecutive tilt blocks for inverted positions (instead of adding multiple blocks to get to 120 degrees), I suggest mounting of the miniature on the side of the metal key. For a fully inverted ship position, remove the tilt blocks and mount the metal key onto the top block, laying the key on its side and overhanging one edge.

Now that we have reduced the main cost of the project by replacing most of the magnets and custom cubes with common plastic building blocks, we need to see if there might be another way to reduce cost. Second only to the magnets is the other metal component to the original project (that could easily exceed

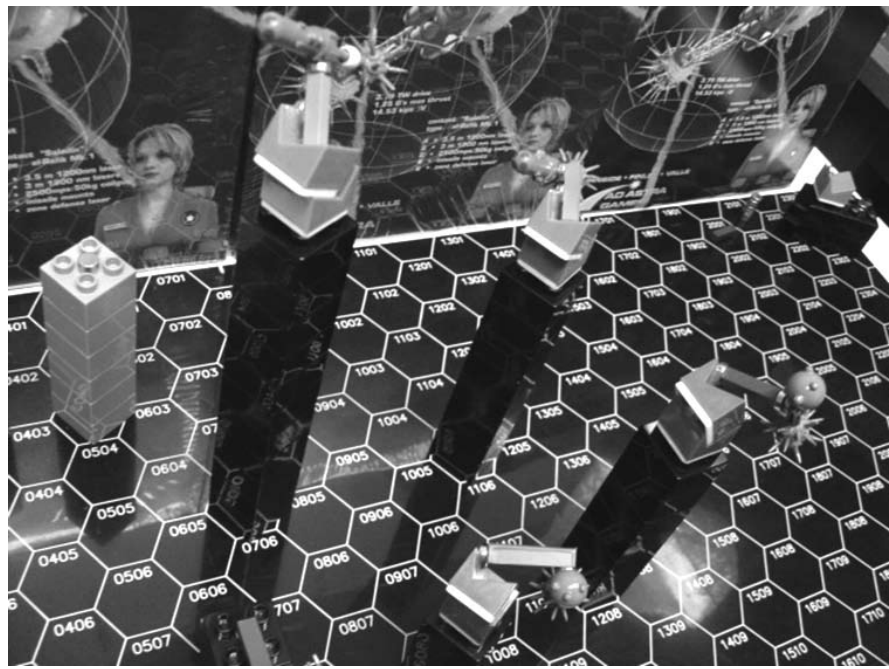


\$100), and that is the galvanized sheet metal. I for one *like* my sheet metal, and will probably keep it. One reason is that I have already bought mine, but perhaps you are waiting for those plastic blocks to go on sale and \$30-\$40 for sheet metal would buy a lot of plastic. One thought might be to acquire small pieces of sheet metal and have them move under the map while attached to the base of the column. Another thought might be to just find a metal table to play on, and you won't need to buy any sheet metal for under the map at all (!). Also, you could skip the sheet metal underlayment entirely (saving that expense) and glue a clear plastic disk (3” or 4” diameter)



under one 2X2 block to give support to the base of the column of blocks (like a thumb tack face down). There are plastics stores that have pre-made clear disks for purchase. By the way, have I said I still liked my sheet metal foundation before? How about the magnets? OK, ok, we'll just name that the "heavy metal, light waller" method...

I suggest several additional uses for blocks that add to the system's usefulness. Use the "2X4" blocks (just look in the yellow bucket) for the same purpose as the "balcony tiles" explained in the first article for interposition of multiple ships in the same column. Although this might be a rare occurrence in Attack Vector: Tactical play, it very well could be a necessity for vertical ship formations (the 'Wall-of-Battle') in Saganami Island Tactical Simulator (based on the best-selling novels by David Weber). Although a ratio of one "2X2" block for each 'altitude' level works fine visually (and for the balcony positions), the block height of $\frac{3}{4}$ " isn't truly proportional to the hex map hex sizes (either the .96" or 1.33"). If you are using the felt map offered on the Ad Astra website and you want full proportional column height, count TWO blocks as one white stacking tile. This gives a height of 1.5", which matches the horizontal map grid spacing.



Of course, if a column includes any blue blocks it is no longer proportional, but still very playable. You get dark blue blocks in the bucket I have already mentioned, and other buckets (i.e. green) have a light blue colored block included. If you haven't figured out what the blue blocks are used for, either you haven't read the rulebook or you can't have had any great period of time elapse since you last played with blocks like these.

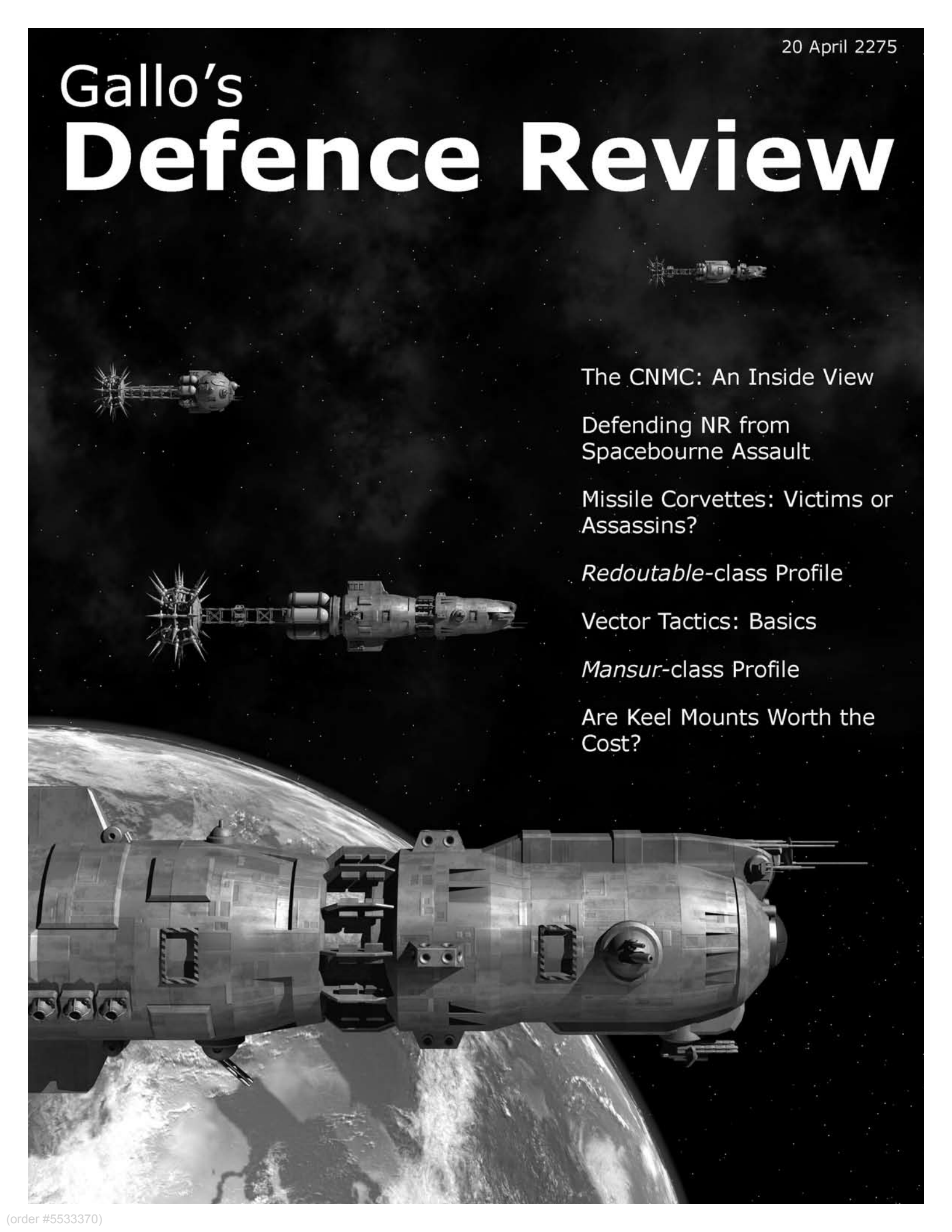
One last thing that I'll mention that will actually increase your project cost (now that you've saved all that money) and that item happens to be black paint for the blocks. I've kept the light and dark blue blocks for high "altitudes" (just like the rules for tiles- hint), and a few yellow ones for "negative" markers. Since I want most of the blocks black, yellow replaces the single black tile used for indicating negative "height". I don't use just any black spray paint on my blocks. I use paint that works well on plastic (called Fusion), and happens to have a trade name that is the same as the type of reaction that drives the starships within the systems of the Ten Worlds setting.

Thus, there lies the goal: to balance the desired visual benefits against the physical limitations of a multi-dimensional universe. Until we can "play" in other higher dimensions, we will have to work with the ones we know about. For other ideas working with miniatures options, look over the Ad Astra Games forums where anyone reading this should already know about (unless you are from another dimension and you are reading this inside-out)...

<http://www.adastragames.com/forums/>



Gallo's Defence Review



The CNMC: An Inside View

Defending NR from
Spacebourne Assault

Missile Corvettes: Victims or
Assassins?

Redoubtable-class Profile

Vector Tactics: Basics

Mansur-class Profile

Are Keel Mounts Worth the
Cost?

Spaceborne Assault Operations

The CNMC View

The Olympian recognition of Xing Cheng at the Pacifica Conference resulted in a sea change in the Republic's political outlook. A direct consequence of the lower perceived threat has been greater openness within Xing Cheng's military about the real capabilities available to the Republic during the Saladin War.

Xing Cheng's secretive soldiers have admitted that the vaunted Marine Drop Brigade was almost launched on Novaya Rossiya (NR), one of the two nations that share the world of Alpha Mensae II (AMII) in 2268. Though the Xing Cheng Celestial Navy (XCCN) squadron defeated the Olympia Defence Force – Space Arm (ODFSA, the Olympian Space Navy) forces in the AMII system, the damage sustained by Xing'er ships forced their commander to call off the assault. The invasion threat was to be a decisive factor in the AMII neutralization agreement. This prevented Olympia from using Alpha Mensae II as a forward base during the rest of the war, the main declared war aim for Xing Cheng.

The CNMC Drop Brigade

Recently published material has shed new light on Xing Cheng's war plans prior to the Saladin Incident. It has emerged that far from being a spur of the moment operation, the orbital assault on Novaya Rossiya had been the cornerstone of Xing Cheng's General Staff (henceforward shortened to XCGS) planning for well over a decade. These plans were also the covert motive behind the broad reorganization of both CNMC (Celestial Navy Marine Corps) and XCDF (Xing Cheng Defence Force, the regular Ground Service) units into armor-heavy formations. The main target for the transformed Marine Corps was secretly defined in late 2255. The General Staff decided that the CNMC's top priority was denying AMII territory and resources to Olympia, to prevent the system becoming a forward base for the ODFSA. The Drop Brigade would thus be primarily aimed at Novaya Rossiya. The Marines were also to maintain the

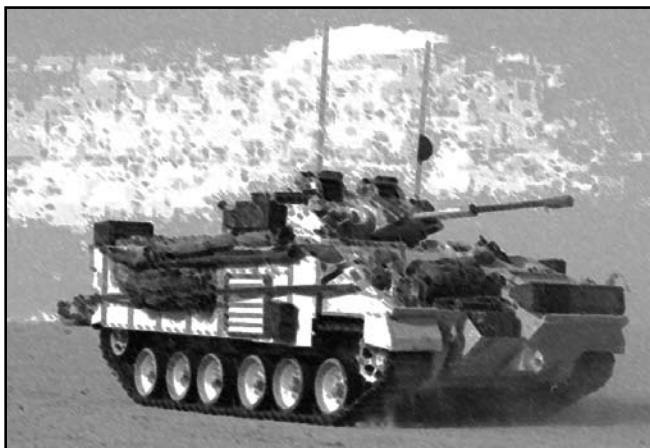
capability to deploy anywhere in the Ten Worlds, however, and funding was to be earmarked to this effect.

Consequences of the Twelve Hour War

The Twelve-hour war in 2258 spurred Xing Cheng's armed services to focus on a repeat encounter. It was accepted that the XCDF's permanently deployed unit on Alpha Mensae II, the Light Brigade, had insufficient strategic mobility to threaten NR directly, as opposed to remote outposts such as Demyansky Island. Neutralizing Novaya Rossiya would require a direct assault on its heartland. This was possible only from orbit.

The Xing Cheng General Staff had also noticed that some Ten Worlds nations had strengthened their orbital defences in response to the threat posed by the Drop Brigade. It was realized that these had made combat drops impossible to undertake close to the intended targets. Landings could thus be undertaken only outside the target's Zone Defence (ZD) umbrella, some 200 or more Km away. Ground fortifications protecting said ZD umbrellas would also be very extensive. The General Staff realized that the Marines were ill-equipped to face both these new developments. In 2258, the Drop Brigade was a Light infantry unit with a very high proportion of hardsuits, similar to the XCDF's Light Brigade today. The Marines had neither the mobility to land outside the Zone Defence umbrellas, or the firepower to take on heavy ground defences.

These considerations merged with the evolving tactics employed by the CNMC and XCDF in operations against Xing Cheng's native life forms. Expanding numbers of agricultural and mining settlements led the General Staff to abandon its former doctrine of passive defence. This relied on guard posts and fortified settlements, manned by moving in airmobile forces when needed. The new tactics are based on highly mobile armored forces, built to seek out and destroy hostile wildlife concentrations before they become a threat. The General Staff thus accepted the Marine Corp's proposal to re-equip the Drop Brigade into an armor-heavy unit, transforming the Marine TO&E. The brigade nearly doubled in size, exchanging its trademark hardsuits for tanks and IFVs. The new Drop Brigade, under the cover of greater effectiveness in its home defence mission, had gained the mobility and firepower needed to defeat any potential target.



by Claudio Bertinetti

This was the starting point of an intense cooperation between the Marines and the Xing Cheng Defence Force, with pride of place going to the Defence Force's Centre for Advanced Tactical Studies (CATS). This had been created nearly two decades earlier to prepare XCDF troops assigned to off-world posts, as well as disseminating operational experience learned there throughout Xing Cheng's armed forces. The Centre came into its own when tasked with preparing the CNMC for an assault on Novaya Rossiya, under the cover of wildlife defence and XCDF training missions. Deploying the CNMC, the only permanent ground force unit on Xing Cheng, in the native life suppression role allows the XCDF to concentrate its reservist call-up times to train against Marines in set piece battles. Most of this training is focussed on counter-invasion tactics, with the CNMC simulating off-world invaders. What was not appreciated until today is the fact that many training scenarios were designed so as to have the Marines face simulated Novaya Rossiyan units. The Defence Force's unique makeup allows this, as it comprises both regular and reservist personnel with varying levels of training. It also features the March Army, which comprises the Theatre Reconnaissance Regiment, a commando unit used to simulate NR's Desant (regular) troops, and the Strategic Cadre Regiment. This was purpose-built to train allied forces and raise home defence battalions on short notice. The SCR's cadre companies are thus ideal, when provided with an influx of raw XCDF recruits, to simulate NR's class B militia. With the training areas temporarily cleared of native wildlife, the CNMC could thus practice assault tactics against some very realistic opposition.

The CNMC Re-Equipment Programme

The Defence Force was also instrumental in the design and testing of Alpha Mensae II-specific equipment. Under the cover offered by the Light Brigade deployed in Novo Brasil, the other nation on AMII and a Xing Cheng ally, all items of gear in XCDF (and CNMC) inventory were thoroughly tested under AMII conditions. The CNMC has never disclosed what vehicle modifications are available to its forces. To operate on any given planet, a specific modification package must be applied to every vehicle, and indeed most items shipped there. To reduce launch costs, the CNMC possesses two full brigade sets of equipment, one of which is stored on its main staging base on XCLuna. The other is used on Xing Cheng itself, and would not be involved in any out-system operations. Only Marine personnel would be sent off-world, and mated with equipment stored on XCLuna.

The most obvious consequence of the re-equipment programme is that XCDF and CNMC now share much of their equipment, structures and tactics. The CNMC has adopted the XCDF's armored vehicles and doctrine. The XCDF has transformed its brigade support elements, introducing the Marine concept of dedicated regiments. Just as with the Drop Brigade, the backbone of both services are the 43-ton type-245 MBT and the 26-ton Type-247 IFV. Though based on different hulls, there is some component sharing to sim-

plify logistics. Both vehicles are modern adaptations of pre-Loss SSA designs, built with current technology.

Deep-Space Transport Issues

The main consequence of the Marine Corp's reorganization has been an huge increase in dedicated space transport. The Drop Brigade in 2268 includes a grand total of 9,200 men, nearly twice as many as its 2255 incarnation. Besides larger and more numerous line units, the Brigade also features extensive support elements, equivalent to a 21st Century division. The greatest impact on transport requirements, however, derives from the two thousand four hundred-odd heavy trucks and armored vehicles of all types in the new TO&E. As noted earlier, equipment earmarked for use off Xing Cheng is stored in the CNMC's main staging depot on XCLuna, where a special unit prepares it with the unique modifications required by each and every target world. Each vehicle is loaded in an individual capsule, and then onto its carrying transport ship, a mobilized civilian freighter. The Marines drop with their trucks and AFVs, and travel on the same ships in adapted passenger pods. Six 100-ton or ten 60-ton capsules fit onto a standard cargo pod dock. The capsules themselves are automated, allowing the vehicle commander to operate them by simple commands. The Drop capsules are designed to be quickly adapted for re-entry in all of the Ten World's atmospheres. An orbital assault is accepted by the Xing Cheng General Staff to be a one-off, extremely expensive affair. The entire brigade, including enough supplies to sustain combat for about two months, would require a minimum of 300 to 350 cargo pod docks, a sizeable portion of XC's civilian cargo fleet.

The greatest expense by far was to provide sufficient capsules for every vehicle. The CNMC was lucky to have proven 60- and 100-ton designs available for mass production in 2258, but even with old stocks available almost ten years were necessary to manufacture enough capsules to provide re-entry capability for the whole unit. An attack involving the full Brigade would not have been possible before 2267 at the earliest.

Preparing the Drop Brigade's vehicles for a assault landing, and loading them in their capsules and then onto the transports is a very lengthy proposition. As mentioned above, it is now clear that the vehicles stored on XCLuna were already modified for use on Alpha Mensae II. All necessary combat supplies were also pre-loaded in their capsules. This explains the incredible speed with which the CNMC mobilized the Drop Brigade and sent it on its way to AMII. The CNMC's boast that the Brigade could depart for its destination as soon as the Marines could be lifted off Xing Cheng was thus proven to be true - so long as the target was Novaya Rossiya.

A Combat Drop is also just that - a Drop. For the Marines, regaining orbit requires capturing the means to get there,

a spaceport. The drop is thus very much a one way, success-only ticket.

General Considerations

The Xing Cheng Celestial Navy and Celestial Navy Marine Corps estimate that no combat drop is possible without complete control of the target world's orbital space. This entails neutralizing local Naval units, and silencing ground-based orbital defences. This is by far the toughest problem. Ground-based lasers are much larger and more powerful than their space ship-mounted counterparts. They can also fire more often, as a planet offers ample heat management facilities that are lacking on a starship. The XCCN, however, possesses the only warships in the Ten Worlds whose mission is orbital defence suppression. These Frigates were built on Earth before the Loss, and were kept in mothballs for many years. We will not examine this subject in any detail, as it would require a full article by itself. We will point out that though the XCCN defeated the ODFSA in the Alpha Mensae II system in 2268, the attempted invasion of Novaya Rossiya was aborted due to the heavy damage sustained by its ships, which made victorious control of AMII's orbit a risky proposition. There was thus no true orbital combat in 2268.

To examine the operational plan's details, we will assume, for the purposes of this article, that the XCCN took full control of AMII orbital space in 2268. Another major assumption is that Novo Brasil would declare itself neutral. Far from being a handicap, this last event is the very scenario for which the CNMC has been training for the past decade. No Novo Brazilian support means that the Marines would fight alone, with very little backup even from the XCDF forces on-planet. Reinforcements are quite theoretical, however, as Novo Brasil does not possess sufficient seagoing transports to carry sizeable assistance to the invading Marines. These would also be very vulnerable to Novaya Rossiya's air force and coastal defences. Sheer distance and the oceans have ever been Novaya Rossiya's main defence against Novo Brasil, and vice-versa. This has allowed Novaya Rossiya to under-invest in its ground defences. Taken together, these reasons ensure that any successful invasion of Novaya Rossiya would need to be an orbital combat drop. It also means that Novaya Rossiya is very vulnerable to just this form of attack.

The Orbital Assault – Preliminaries

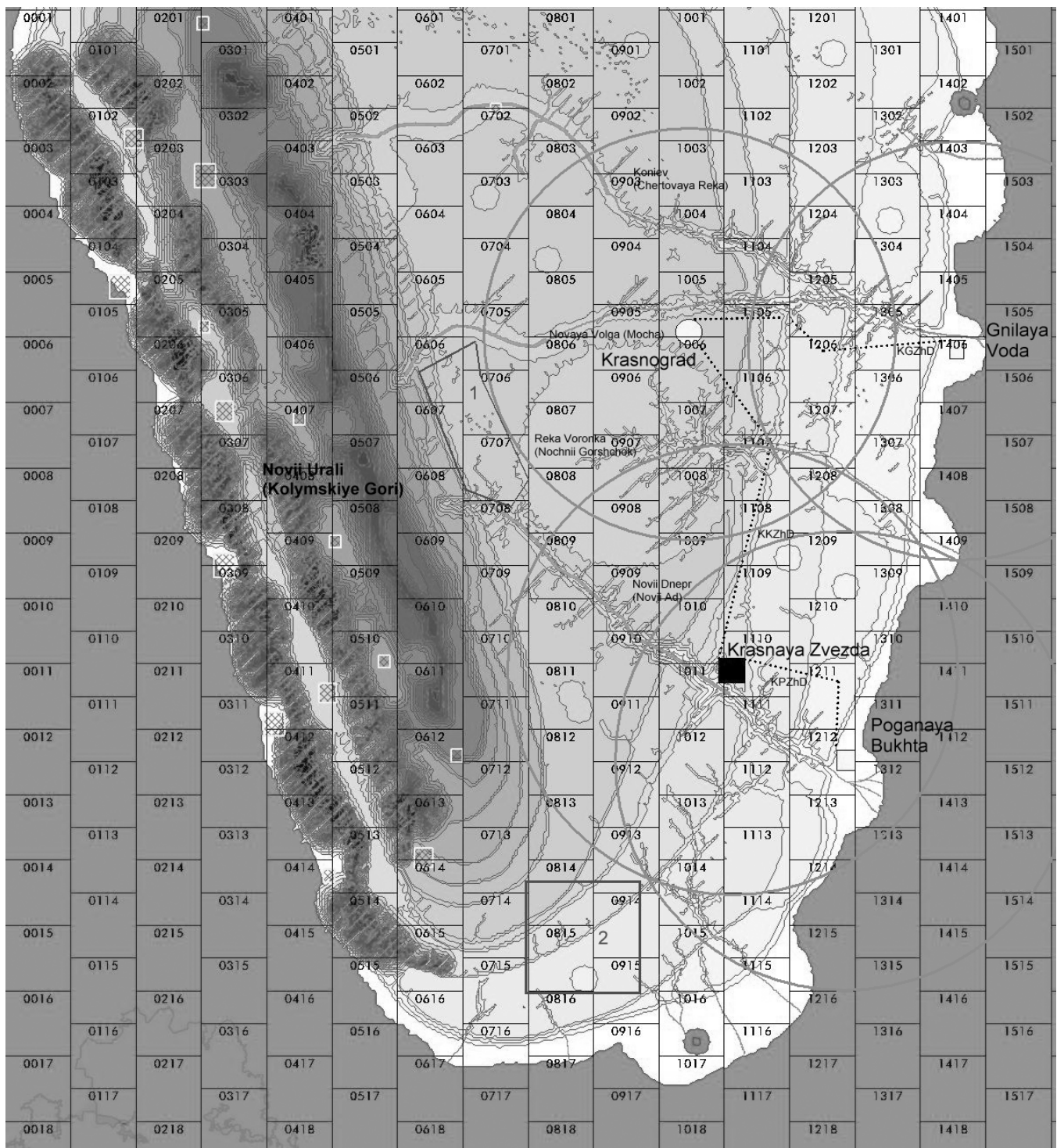
A combat drop on Novaya Rossiya needs to address a few major constraints. The main obstacle would be the arrival of Olympian Naval reinforcements from their base at Epsilon Indi, in roughly 8 weeks. This enforces a strict time limit on the entire operation, as the XCCN would be hard pressed to contain the arriving Olympian squadron. It is worth noting that the Drop Brigade has plenty of mobile orbital zone defence artillery, and can thus defend itself from space-based attacks. Being cut off from its Fleet-based source of re-supply would severely limit the tempo of its operations,

however. Any ground combat must thus be successfully resolved before the XCCN loses control of AMII orbit.

Selection of the Drop Zones would start as soon as the Fleet secures Alpha Mensae II orbit, once orbital defences have been reduced. From this phase on to the very end, the main constraint on operations will be the Heavy ZD and orbital defences around the Novaya Rossiyan capital city of Krasnograd, and Krasnaya Zvezda spaceport itself. NR is special among the Ten Worlds in the fact that it possesses extensive orbital defences. These are required to protect the planetary surface from the intense bombardment emanating from the planetary rings. As the Spaceport is the main target, yet another constraint appears: care must be taken not to damage the main launching laser, as this facility will be required to regain orbit after the invasion.

As mentioned earlier, recent CNMC doctrine states that a combat drop is far too risky to undertake close to the primary target area. Heavy ZD fire would ensure that most of the assault force would never even reach the round. The main priority for the invasion force would thus be to determine the range of the local ZD umbrella, to ensure the landings take place outside of it. This is made easier in NR's case by the frequent firings of AMII's orbital defences against meteoric bombardment. This allows direct observation of the ground-based defence's range and capabilities. Most of the intelligence would however be gathered from the moment the Fleet reaches orbit.

Little is publicly known about the range and combat capabilities of the ZD umbrellas around Krasnograd and Krasnaya Zvezda. It is generally assumed, however, that modern ZD installations have an effective range of 120km or so, and can turn any direct attack into a harmless light show. We will thus posit that the no-go zones are a 200 to 240 Km diameter circle around either location. This, and Novaya Rossiya's geography, effectively forces the landing to take place in or around Hexes 0606, 0607, 0706, 0707, and 0814, 0815, 0914, 0915 of the map included with this article, all about 200 Km away from the targets. The CNMC's top priority would be to conduct extensive reconnaissance of the potential Drop Zones (DZs hereafter) in the week prior to the invasion. Given the fact that the heavy weapons within the ZD umbrellas pose a serious threat to ships in low orbit, all but the specialized orbital bombardment frigates will need to keep out of range, to reduce exposure to the defences. The first phase would therefore see extensive drops of long-range, automated recon drones well away from the ZD umbrellas. It is also certain, though the XCCN has so far refused to confirm this, that the reconnaissance drones would be complemented by robotic attack drones, tasked with engaging and destroying any target of opportunity discovered in the drop zones as they unmask to fire on the combat drops. The primary targets would be NR reconnaissance assets, observation posts and ZD installations: the defenders are bound to place masked defences in the areas prior to the landing. Even so, their scale would force NR to



spread out its defences, further minimizing CNMC losses during the drop.

The Combat Drop – Reconnaissance and Logistics Area Setup

The drones would complement the primary reconnaissance elements, the Brigade's Pathfinders. These belong to the Reconnaissance group, and would deploy in numerous 4-to-8-man teams with light vehicles soon after achieving orbital superiority and about one week prior to the main

Drop. Given the near-suicidal futility of engaging heavily fortified main planetary defences from orbit, it is also understood that the orbital bombardment frigates would concentrate their efforts on supporting the Pathfinders and isolating the Drop Zones. Two separate drop zones would be selected within the same map square, within easy reach of one another, both on open and firm ground, and with access to a large body of water such as a river or lake.

D-Day would most probably occur one to one and a half weeks after achieving control of AMII orbital space, and after the DZs have been selected and declared clear of hostile forces. The troop transports would assume orbits that would allow them to launch their complements of Drop capsules within reach of the DZs while keeping out of range of the ZD umbrellas. The Combat drop would occur over a number of separate DZs, and would involve all the combat units of the Brigade. A mass assault is considered to be safer than numerous smaller ones, as it prevents any one spearhead unit being overwhelmed by the defenders. The CNMC also feels that the benefits of safety in numbers from ZD fire outweigh the risks of total chaos in the DZs.

The two main DZs would become the primary Brigade logistics areas. We will point out that the whole invasion plan hinges on the Brigade being able to produce its own fuel on the ground. It is implausible to expect that the fuel requirements of 1,100-plus AFVs be met by dropping supplies from orbit. The Brigade is thus equipped with two pebblebed nuclear fission reactors and Skolnick Filters, which would be set up by the engineers near a large water source within the first few days of the landing. These would start producing octane fuel as soon as possible; it is expected that a sizeable portion of the Brigade's ZD would be detailed to defend the reactors, as well as the supply depots that would be organized around them. Each Logistics base would be complemented by a small airstrip for UAV operations, and feature a drop capsule recovery team to manage the supply drops. One of the Brigade's two MP companies would be based at each logistics area, to provide area security and contribute to the supply convoy escort mission.

The mission is strictly one way, as there is no way to return to orbit until the spaceport is captured. This has important consequences for casualty treatment. The CNMC includes a frontline hospital in its TOE, and this would be set up in yet another location, some distance away from either logistics area. CNMC policy is that the hospital would be open to any and all casualties, Xing'er or defenders; it would furthermore be openly marked, and lightly defended. Access to it would mainly be by road convoy or helicopter, for urgent medevac cases. The Brigade possesses a small number of helicopters, earmarked as air ambulances and command taxis.

The Advance: Onwards, but to which Target?

CNMC doctrine states that the Drop Brigade would break out of the DZs within two weeks of taking control of the target world's orbital space. The Brigade's line units would have consolidated the area around the DZs prior to the advance, but would not have embarked on major offensive operations due to the fact that until the Logistics bases are fully set up to receive supply drops from the orbiting Fleet, the AFVs would rely only on the fuel, battery capacity and ammunition load they carried with them during the drop. These are considerable, and estimated by the Xing Cheng General Staff to be sufficient to engage the small defend-



ing units present on the ground prior to the landing and what reinforcements NR could manage to send to the area after the drop.

The main uncertainty of any orbital assault is the Brigade's primary target. On Novaya Rossiya, this is reduced to a choice between taking the Spaceport, the logical target, and besieging Krasnograd itself. Xing Cheng's General Staff was very vague on this matter, and refused to be drawn out. Attacking the Capital would entail facing all of Novaya Rossiya's Militia and some brutal urban combat, but CNMC and XCDF commanders insist it is a feasible option. Success in the Capital could bring a swift resolution to the conflict, but it remains to be seen whether NR would contemplate surrender at all. Taking the spaceport, however, would both allow the Drop Brigade to be reinforced indefinitely and isolate NR from off-world reinforcements. This would strengthen Xing Cheng's hand at the negotiating table. It is thus probable, but by no means certain, that the CNMC would target the spaceport, and use its proximity to the Capital to confuse Novaya Rossiya's defenders, forcing them to divide their forces between both locations until the very end. We shall henceforward assume that the Spaceport is the Drop Brigade's main target, and that the landings would occur in square 0707.

The Advance Continued: Time is of the Essence

Given the assumed objective, jumping off point, and existing roads used by mining convoys, the advance to the target should be relatively straightforward. The CNMC has been quite open on the fact that it expects growing resistance as it nears its target. This would in the main consist of raids by small units of Novaya Rossiyan regulars and Category A reservists. The XCGS assumes that the relative scarcity of these units will force the defenders to use them with great care, as they would be needed to stiffen the far larger Category B militia. The Xing Cheng General Staff believes that these poor quality troops are useless, unless their units are built around a solid core of experienced troops. It will be seen that the main weakness in NR's defences is the fact that this core is largely absent, due to the very small numbers of Novaya Rossiyan regulars.

It must be noted that a century of combat against Xing Cheng's wildlife has turned Xing'er ground forces into the

Ten Worlds' foremost experts on mobile armored combat. Xing Cheng units are built to go into combat as semi-independent combined arms companies, often operating (on their homeworld) at very long range from their parent battalions and brigades. This has also evolved dedicated staff skills within the parent units HQs, to ensure the timely provision of any and all required support. Xing'er commanders are taught to seize the initiative and never relinquish it.

The advance would be led by the Brigade armored reconnaissance company, a holdover of the old reconnaissance by fire concept. Discovering masked defences and shielding the brigade's advance from enemy reconnaissance assets are the missions of the Reconnaissance group, which owns the pathfinders and the armored reconnaissance company. With attachments from the line battalions, the Recon group becomes the Brigade's fifth combat battalion. This also ensures that the Line battalions remain concentrated at the Brigade commander's disposal. In ideal circumstances, the Brigade's reconnaissance element would prevent defenders from pinning down the rest of the brigade, or indeed locating it at all. All units would proceed under round the clock air cover provided by the brigade's aviation regiment, a large, UAV-equipped unit that operates all the Brigade's long-range reconnaissance, strike, ZD suppression, CAP, and CAS air assets. Each line battalion is supported by a dedicated UAV-R (rotorcraft) company, which provides combat UAV-R detachments to the line companies. UAVs, in both small jet and combat helicopter form, provide a crucial addition to the Brigade's firepower. These aircraft are quite distinct from the smaller, dedicated reconnaissance and datalink UAVs deployed at battalion and company level or lower in the line and support units. Even these have a secondary attack capability, however.

The advance would be supported by two of the Brigade's crucial combat support units. The first is the Combat Engineering regiment, whom we've already met setting up the logistics areas and pebblebed reactors. The Regiment features two battalions of three companies each. Four of these six companies are designed to split up in halves, each of which would support movement by one of the line battalions, the artillery regiment, the aviation regiment and the reconnaissance group. The fifth and sixth companies feature dual equipment sets, and can replace their standard earthmoving and breaching vehicles with a dozen mobile bridges each. These are in turn dedicated to support the two Logistics companies, each with twelve supply trains. Each train possesses heavy trucks and their armored support vehicles. It should be noted that the trucks are robotic, and unmanned: they're supervised from each train's two command and control wheeled APCs, which also control the UAVs attached to the convoy. This concept has been extensively and very successfully tested in Xing Cheng's outback, to support the far-flung independent companies deployed on Native Wildlife suppression. The trains would ply the route between the line battalions, the Brigade's forward staging area, and the rear logistics areas. It is expected

ed they would also be prime targets for the defenders, and would travel with both their own organic hardsuits and MP escorts. The unmanned trucks have provided a major saving in trained manpower, always the scarcest resource for all the Ten Worlds.

The Reconnaissance group, Engineers and trains combined are the crucial assets required to ensure that the advance maintains its momentum. The XCGS estimates on the time required to cover the 200 km separating the DZs from the objective vary greatly. While some optimists insist that the distance could be crossed in as little as three or four days, others insist that three weeks are more probable. The fact that the Brigade could start moving on its target at best a few days after landing grants additional time to the defenders. We must point out that strategic surprise as such is not possible in a planetary invasion. NR's defenders have had at least 5 to 6 weeks to prepare for the landing from the moment the XCCN invasion fleet entered the Alpha Mensae II system. Local defences would thus be at their highest state of readiness. The defenders would be unable to cover all routes to both their Capital and the Spaceport, however. Bypassing fixed defences is thus at a premium, as is sustaining the advance with on-time logistics. Momentum is crucial to catch the defenders off balance, and prevent them from blocking the Marines far from the target. It is also essential to beat the clock, as Olympian reinforcements are bound to reach orbit within 8 weeks of the start of the operation.

Delaying operations by Novaya Rossiya's defenders would rely on their lone battalion of regular infantry and the mobile artillery. This reporter has been made to understand by his sources that the Xing Cheng General Staff is hoping for these meeting engagements, for which the Drop Brigade has extensively trained. Any loss in momentum would be balanced by the defenders losing some of their best troops. Deploying the artillery away from the fixed defences around the targets would also make them much more vulnerable to counter-battery fire and air attack. The XCGS is willing to brave some strikes from masked NR artillery batteries, if this allows the Brigade's aviation battalion the chance to hit them as they redeploy. Estimated losses to artillery would be relatively low if the advance can be kept up, but the risks become far higher once the target's fixed defences have been reached. It must also be said that each and every AFV is equipped with a vehicular ZD system, ensuring very effective AA protection as well as good counter artillery fire. Also, having the regular infantry attack the advancing Brigade would reduce the risk of raids on its logistics areas to the rear, another major concern.

The Main Assault: The Search for Achilles' Heel

It will now be assumed that the Brigade will reach the target area without suffering major losses, and with the defenders having proved unable to both cut the supply lines to the logistics bases, or attack the bases themselves. The next step is investing Krasnaya Zvezda spaceport's defences.

The XCGS estimates that between 70,000 and 100,000 men could be mobilized to defend the spaceport. The defences would be arrayed in concentric rings; the Category B militia reservists would be stiffened by all available Category A troops. Though this may seem formidable, the General Staff considers this to be its most favorable scenario. It must be remembered that the Category B militia would have had two months of refresher training at most, on top of a very low basic level of military experience. The Category A militia are much better, but also far too few in number to provide sufficient cadres for all the men NR could mobilize to defend the spaceport. We will now guess at the tactics the CNMC would use to crack Kraznaya Zvezda's defences. These are derived from the few after action training reports made public over the past few years, most often as a result of formal Voice of the Houses inquiries, and off the record interviews with XCDF and CNMC commanders.

The advantage possessed by the defenders is the fact that they are fighting from prepared defences. The Xing'er attackers would need to approach them from ground already marked for artillery strikes. The main disadvantages are the defender's low standards of training, and the fact that their uncertain behavior under fire forces the NR commanders to place them in bunkers, thus eliminating most options for manoeuvre. The defenders will be immobile, and indeed wholly dependent on their bunkers for protection. Their large numbers would strain NR's logistics, were it not for the time constraints under which the Brigade is operating. A decade of armored assaults on simulated NR defences on Xing Cheng, with XCDF troops replicating Category B militia with Category A or regular cadres, has proved that relying on bunkers is a serious weakness for the defenders.

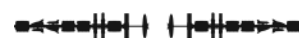
We can suppose that the main plan is the safest but slowest option. It would be a standard bid to isolate a sector of the defences, and roll it up with an assault by dismounted mechanized infantry with heavy armor and artillery support. The main model for this operation would be the Goose Green operation in the Falklands War of 1982, long a staple of CNMC training. The Kraznaya Zvezda operation indeed resembles Goose Green, writ large. The far greater number of defenders is offset by their even lower standards of training when compared to their 20th Century Argentine counterparts, and the professionalism and heavy armor of the CNMC. Individual bunkers, once discovered, could even be targeted with penetrating munitions fired by UAVs or CNMC artillery.

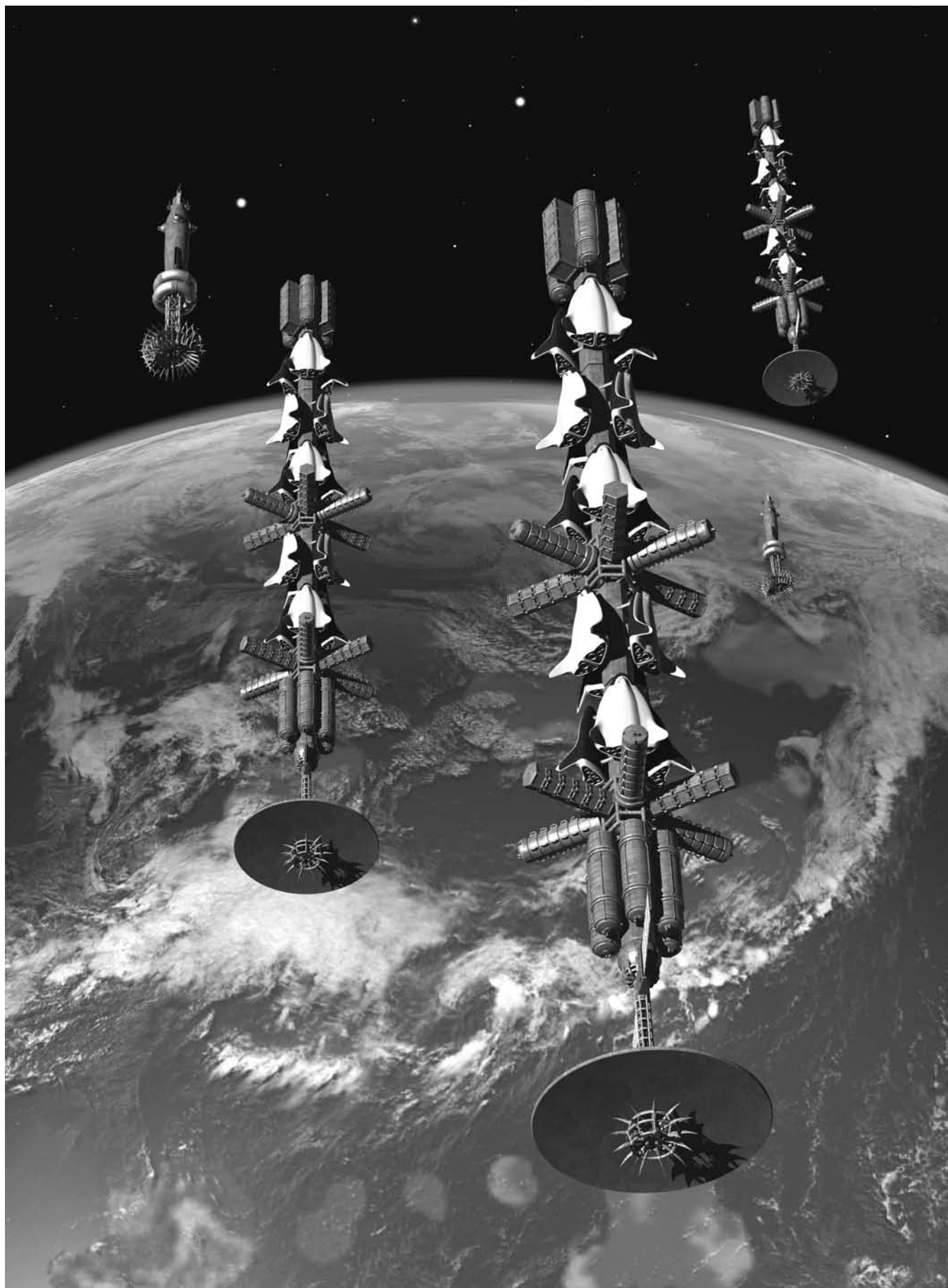
There is also a plan B, however. Again, no confirmation has been forthcoming from the XCGS, but details have been gleaned from the minutes of interrogations in the House of Voices, Xing Cheng's Parliament. This plan seems to be inspired by the Desert Storm I operation in early 1991, and was devised to use the Category B militia's weaknesses to the hilt. It is a little known fact that the heaviest vehicle in the XCDF and CNMC inventories is a 52-ton armored bulldozer. This has been extensively used with great success in Xing Cheng's outback to build and maintain roads, as well

as prepare fixed defences for outlying settlements. With additional armor, the combat bulldozer's protection can easily exceed the type 245 MBT's. Some three dozen are included in the Engineering regiment's TO&E. The plan would be very straightforward: open a breach in the defences via pinpoint artillery bombardment or, failing that, a direct armored assault supported by the massed Brigade Artillery regiment. The sides of the resulting wedge would be pinned down by one or more Line companies. The remaining side would then be invited to retreat, or prepare to be buried alive, while the bulldozers advance under cover of direct fire from an armored battalion and artillery. Artillery fires around the target would leave only one way to safety for the defenders: in, towards the inner defensive rings. The Category B militia are expected to break, and smother the inner ring defences by sheer force of numbers, ensuring panic among all of the spaceport's defenders. The armored battalions would keep up the momentum. A safe way out would be left open to let the demoralized defenders run back towards their Capital. It is telling that all Xing'er commanders that we've spoken to insist that the Spaceport would be invested from its south or southwest quarters, away from the Capital.

While this plan may seem far fetched, it has been tested in smaller scale numerous times over the past decade. In every occasion, selected XCDF recruits were taken over by small units of the March Army's Strategic Cadre Regiment. Once placed in simulated bunkers, they were subjected to a mock attack, led by one or more armored bulldozers. Whenever the cadres were too few in number, the recruits panicked. In at least two cases casualties occurred, as recruits did not get out of the bunkers in time. It remains to be seen if these results can safely be applied to troops aware that they are fighting for their nation's very survival.

Much is still unknown about the entire operation, and how close the CNMC got to its second combat drop. The Xing Cheng General Staff, however, is convinced that the CNMC would have captured the spaceport. It is also certain that the Drop Brigade has lived up to its role of a strategic force-in-being, pushing Novaya Rossiya to agree to a full neutralization of AMII during the Saladin war. This was the second-best option pursued by Xing Cheng. The enormous investment made since 2258 to update to CNMC into a force to be reckoned with has paid off. It must also not be forgotten that the Drop Brigade's secondary role is also Home Defence against Xing Cheng's native wildlife, and in this the reorganization's success has been outstanding, with far fewer combat casualties thanks to the heavier armor available to the defenders. Another crucial positive effect is the impressive cooperation between the XCDF and CNMC, which had been lacking up to 2258. In short, the Drop Brigade's reorganization has been fully validated by operational experience both at home and off-world. The CNMC has the means to live up to its motto: "Ready to fight Anywhere, Anytime".





"Ready to Fight Anywhere, Anytime"

The Xing Cheng Celestial Navy Marine Corps

Introduction

Xing Cheng's (Zeta Tucanae III) Celestial Navy Marine Corps (CNMC) is the only military force in the Ten Worlds dedicated to interface assault. Its unique capabilities provide the Republic of Xing Cheng with a powerful strategic deterrent. Before the Loss, the Drop Brigade served to signal the Sovereign States of Asia's readiness to take the fight to enemy territory in the event of a war. The CNMC fulfills the very same mission today. As the sole full-time ground military unit permanently based on XC, the Marines also bear the brunt of the defense of their Homeworld's settled areas against hostile native wildlife. The need to remain credible in an evolving threat environment has led the CNMC to evolve into the premier armor combat force in the Ten Worlds.

The CNMC boasts 13,000 Marines, over two thirds of whom belong to the Drop Brigade. The Brigade's total manpower of 9,200 troops includes 8,800 Marines and 400 drop-qualified XCDF artillerymen. The remaining 4,200 Marines are assigned to other units, the largest of which is the Marine Training Regiment. About 17% of the CNMC consists of reservists, who would be called up en masse when the Drop Brigade is mobilized. The members of the Marine First Reserve man every fourth Company or Battery in the line, artillery, aviation and logistics battalions, and every third company in the engineering regiment, serving a month or more every year. The CNMC's prestige means that only in booming economic times does it have problems finding the highly motivated recruits to replace the regular troops that pass into the reserves. Like all of Xing Cheng's military services, the CNMC is intensely proud of its Chinese People's Liberation Army ancestry. While the standard term of service in the military is three years, the CNMC requires a two-term com-

mitment, mirroring the special forces terms of service in the old PLA. Marines tend to serve much longer, raising the overall levels of expertise in the CNMC. After leaving active service, Marines remain in the First Reserve for two to three more years before passing into the Senior Reserve, usually for another five years.

The CNMC is part of the Xing Cheng Celestial Navy, and thus uses naval ranks and adheres to PLA-Navy traditions. Because the Marines were issued distinctive uniforms when the XCCN was founded in 2215, there is some off-world confusion about whether or not they're an independent service.

Increasing integration among XC's forces has resulted in the Marines using the XCDF's military instruction system. The CNMC has a large exchange program with the XCDF, through which selected Marine officers and NCOs gain operational experience off-world, and their veteran XCDF counterparts serve in the Drop Brigade. Integration has its limits, however, as both the XCCN/CNMC and the XCDF have kept their separate military academies, NCO training schools, and senior officer education colleges.

Missions

The Brigade's primary mission is Xing Cheng's strategic deterrent, via an orbital assault capability. Its secondary mission is protecting the human enclaves on its home world against attacks from the planet's numerous and very aggressive hostile indigenous life forms. This has led to the Brigade being evenly split between XC's spaceports at Xingjing and Wuhan, to shorten reaction times against wildlife incursions. This deployment also allows faster launch to orbit upon mobilization. Taken together, these missions have determined the shape and timing of the CNMC's recent re-

equipment program, started in 2255 and completed in 2267.

As noted earlier, the Brigade numbers 9,120 troops. This complement is almost twice that of its closest 21st Century equivalents. This growth in size is necessary to make the Drop Brigade a self-contained, self-sustaining and self-supporting combat unit. A conventionally deployed Brigade from other forces would number 4,000 to 6,000 men, but could rely on extensive support from divisions and corps operating within the same theatre. The CNMC's Drop Brigade, by contrast, will find itself alone on an enemy planet. There is no "rear echelon" to which a broken tank could be sent for repairs.

The Drop Brigade consists of four combat maneuver battalions, a reconnaissance battalion, a full regiment of artillery (three battalions), a Zone Defense (aerospace defense) battalion, an aviation regiment (two battalions and two independent squadrons), a regiment of engineers (two battalions), a military police battalion, a logistics regiment (two battalions) and a headquarters. The combat maneuver units (each with four line companies, a headquarters-weapons company and a support company) include two armor and two mechanised infantry battalions. The large artillery regiment is intended to increase the Brigade's firepower to division level without transporting or risking a full division's worth of troops. The Marine aviation and zone defense assets are generous when compared to those assets deployed to a contemporary division, but are the minimum level required to protect the Brigade's operating area and provide reconnaissance capabilities. The large

by Claudio Bertinetta

complement of marine engineers is necessary to provide the Brigade with mobility support when moving overland 200-400 km from its Drop Zone to the objective, counter-mobility (to keep enemy forces away from the Brigade), defensive construction (to allow the Brigade to dig in on its objective and survive all attempts to expel it), and to build the infrastructure required for a long occupation. The engineers can also provide additional defensive infantry when required. The military police manage traffic flow, guard the two supply bases, assist the supply convoy escorts, and handle prisoners. The logistics regiment has considerable assets, in keeping with the Brigade's mission. These support assets are also beneficial when doing the secondary mission of wildlife repulsion and emergency support of settlements.

Two further CNMC missions are protecting XCCN bases in the Zeta Tucanae system and elsewhere, and ensuring that the extensive stocks of ready-deployment AFVs, weapons and supplies stored at Chen Suo base on Xing Cheng's moon are kept in working order. A number of dedicated units fulfill these missions. These are not part of the Drop Brigade.

The Line Battalions

The two armor and two mechanised infantry Marine line battalions at the core of the Drop Brigade are all built on the same template. Both types of battalion can support all models of AFV and their Headquarters and Logistics companies are nearly identical. This is a holdover from the old CNMC organization, when the Line battalions all shared the current XCDF's infantry/hardsuit TO&E. The CNMC abandoned this when it transitioned to the current armor model. To ease peacetime logistics and training, the CNMC has elected to keep separate tank and mechanised infantry battalions. These units are based in matched pairs, ensuring close cooperation between infantry and tanks, via synchronized training and deployment schedules.

The Drop Brigade's organization is built for flexibility, and the assumption of cross attachments of platoons and companies between the line battalions. The line battalions can also be tailored for a specific objective with reinforcements from the artillery, engineering and logistics regiments. Though "pure" in their standard TO&Es, the battalions always deploy as combined arms units. While a standard operation would see each battalion deploying as a balanced unit with two armor and two mechanised infantry companies, offensive operations would be carried out by three tank companies who would swap one tank platoon for an mechanised infantry platoon, with a "secure the objective" mechanised infantry company replacing the fourth tank company. Defensive operations would be carried out by a mirror image organization. Whole companies can also be attached to the Recon Group to turn it into the Brigade's fifth maneuver battalion, thus freeing the line battalions from screening duties.

In keeping with its PLA and SSA heritage, the Drop Brigade's four Line battalion organization and copious artillery support indicates a preference for heavy firepower to secure its objectives. The Drop Brigade's high degrees of training and organizational flexibility allow it to cross attach to work as a set of maneuver oriented battalions. This flexibility puts a premium on mid-level officers with initiative and extensive training; one of the peacetime weaknesses of the CNMC is that line officers that successfully pass the training requirements get lured into the civilian sector with great regularity.

The HQ company operates all battalion weapons, while logistics are concentrated in a separate company. Battalion combat support includes a four-tube 120mm mortar platoon, with HE, smoke, WP, and guided rounds for precision strikes. There is also an MRL platoon with two firing sections of four 30-tube 130mm multiple rocket launchers; these can be split up and assigned to the maneu-

ver companies. The Recon Platoon is mounted on six Type-187s. Every battalion has a hardsuit platoon with eight hardsuits. With each hardsuit comes a pilot, an electrical technician, a mechanic, and a Type-187. Including a small HQ team, the platoon TO&E is 28 Marines, eight hardsuits and nine Type-187s. Specialized units are rounded out by signals, sniper and forward observer sections, as well as a signal UAV platoon. These units can attach part of their Marines and vehicles to the Line companies and firing sections, though the snipers and the Recon and hardsuit platoons remain at the battalion commander's immediate disposal.

The Logistics company concentrates all of the battalion's medical, NBC, repair, recovery and supply platoons. This last function is undertaken by the Support platoon, which is a robotic supply train directly attached to the Line battalion. The ambulance and repair and recovery platoons attach part of their vehicles to the Line companies.

The armor line company HQ consists of two tanks and two IFVs shared among the CO (Commanding officer), XO (Executive Officer), 1SG (First Sergeant), and the Operations Officer. The Operations Officer coordinates communications and reconnaissance assets, and generally takes a load off the CO. He (or she) is a veteran platoon leader, and is slated to become an executive officer. As mentioned earlier, the HQ Company's specialized vehicles are in part parcelled among the companies. The mechanised infantry company HQ are based on two HQ IFVs and have no tanks, but are otherwise identical. CNMC units are built to deploy independently in XC's outback, far from any support. This has led to a relative abundance of support vehicles such as UAV control tracks, armor ambulances and repair and recovery vehicles.

Limited manpower and the requirements of its primary strategic mission have led the CNMC to put a premium on heavy mobile firepower. This ex-

plains the large and flexible CNMC armor company, with its four platoons of four MBTs. Mechanised infantry companies, by contrast, have three platoons of four vehicles, each carrying three crew and eight infantrymen. The Marine dismounted infantry platoon is thus based on a nine-man command team, which includes the attachments from the Medical and Communications platoons, three nine-man squads, and eight vehicle crew (drivers and gunners). Every squad is organized in two fireteams, each with a team leader, a grenadier, a light machine gunner, and a sharpshooter; the squad leader doubles as IFV commander. All fireteam members are armed with either a version of the basic 6.5mm caseless Type-216 assault rifle or the Type-221 LMG, and carry extensive lightweight body armor, individual short-range radios, IFF gear and night vision equipment. Helmet-mounted HUDs display all relevant information. Most Marine infantrymen will also carry a small disposable anti-armor/bunker-buster rocket. Fireteam and squad leaders carry a laser designator to guide aircraft-carried weapons and ground-launched kinetic-kill missiles. Snipers, reconnaissance personnel, pathfinders, forward observers, platoon sergeants, platoon commanders and higher ranking officers and NCOs carry more advanced communications and battle management systems, enabling them to link into the tiered command networks, depending on clearance. While dedicated combat pioneer platoons are desired by the CNMC, the reality is that the second and third companies are cross trained for this mission, due to manpower constraints.

The XCCN was once known as the most enthusiastic users of hardsuits in the Ten Worlds. It is surprising to see how few remain in the Drop Brigade today. These are now retained for only two missions: urban combat and logistics train support. City fighting is where hardsuits come into their own as nimble "indoor tanks". Their high burst speed over short distances and heavy weapons turn them into

essential force multipliers in urban terrain. Within the logistics regiment's supply trains, hardsuits are vital elements for convoy defense. They are also very useful once the convoy's destination has been reached, as once stripped of their weapons packs, pairs of hardsuits can greatly speed up loading and unloading the trucks. In all forms of mobile combat, however, they come a distant second to combined arms formations based on AFVs. Hardsuit-heavy units are also quite expensive to maintain, as they require a large dedicated support organization. Due to the numerous delicate components that make up a hardsuit, this provides the equivalent of a major overhaul after every mission. MBTs, by comparison, are cared for by their crews, and require higher-level service only rarely. Hardsuit operators are also the product of a long and arduous training process, close to that given to helicopter pilots in its intensity and selectiveness. MBT crews, by comparison, are far easier and cheaper to mass produce. Another crucial consideration is the full life-cycle cost of individual hardsuits, when compared to MBTs. Though tanks are more expensive per unit, hardsuits lose out once you factor in the full training and maintenance costs. MBTs end up costing as much as a two or three hardsuits, and are much more effective in most combat situations. AFVs are also far more survivable, and mobile.

Recent CNMC combat experience on Xing Cheng has highlighted a drawback in the shift to a fully mechanised, combined arms model. The lack of organic airmobile troops makes relief operations difficult. Airlifting a light infantry/hardsuit company to man an outlying settlement's bunkers ahead of a wildlife incursion was a staple of past Marine home defense operations. This has led to the creation of the Immediate Reaction Force. This re-roles one dismounted Marine platoon in each of the CNMC's spaceport bases. These are drawn in turn from each mechanised infantry battalion, and mated with specialized assault

shuttles operated by XCCN personnel. In an emergency, the Immediate Reaction Force can reach any part of Xing Cheng within ninety minutes or less from lift-off. It can however deploy only as light infantry with very limited heavy weapons, which has often put the force at considerable risk. Though its missions are indeed very dangerous given the lack of backup, the Immediate Reaction Force is the darling of XC's public, and earns the CNMC much political goodwill.

The CNMC has recently requested the funds to raise two new light infantry/hardsuit battalions, to expand the Immediate Reaction Force. This would raise the total strength of the Marine Corps in each of its Xing Cheng spaceport bases to a full Brigade, and that of the full CNMC to a small division. This proposal has been met with much hostility and concern by the Xing Cheng Defense Force's Home Defense units, who've taken up the airmobile relief function, and refuse to give up their share of public recognition that derives from this. The main opposition to further growth of the Marine Corps has not come from its Ground-based rival, the XCDF, but from within the Celestial Navy leadership itself. Naval commanders, worried about the CNMC diverting further scarce resources away from the Fleet, have started to reverse the past decade's trend of explosive growth for the Marine Corps. It has not been lost on XCCN Commanders that the Marines are now as numerous as their Naval Spacer counterparts. Where the Marine Corps was once a large but subordinate part of the Celestial Navy, it can now claim equal pride of place, as well as a greater share of the Naval budget. Any further expansion of the CNMC would come at the expense of the XCCN.

Recon Group

The Recon Group provides the Brigade with a dedicated ground reconnaissance capability. This unit is organized as an embryonic battalion; it can be expanded by cross attaching companies from the Line battalions,

so as to become the Brigade's fifth maneuver unit. Though it can be used in an offensive or defensive capability, the Recon Group's ideal missions are scouting ahead of the Brigade's line of advance, and providing flank security. Its presence allows the remainder of the Brigade's Line units to remain concentrated, and thus achieve their missions.

The Recon Group constituent units are a headquarters company, an armor reconnaissance company, a pathfinder platoon and a frogman platoon. The headquarters company is a stripped down version of the line battalion headquarters company, as it lacks the integral fire support. This, and the lack of a dedicated support company, are corrected by direct access to the Brigade's heavier artillery and logistics assets. The company is otherwise identical in function to its Line battalion equivalent.

The CNMC prefers to collect data with lighter ground units, avoiding contact with the enemy to preserve the element of surprise. In some situations, fighting for information will be inevitable. This has led to the creation of the armor reconnaissance company, a specialist heavy reconnaissance unit. This is based on the armor company template, but replaces two tank platoons with two mechanised infantry platoons, and adds an Multiple Rocket Launcher section with four 130mm MRL tracks. This is the only company in the Drop Brigade that owns its own fire support. The company's infantry are all experienced scouts, cross-trained as artillery spotters and forward air controllers. Some are also dedicated snipers. The company can operate far ahead of the Brigade, relying on speed and artillery support to engage the enemy and evade contact.

The pathfinder and frogman platoons provide the Brigade with limited Special Forces capability. According to doctrine, pathfinders are to drop one week before the main body to scout the most probable landing zones. To confuse the enemy, at least three dif-

ferent and well separated areas will be chosen. The pathfinders must locate any prepared defenses in the chosen areas, using UAV drones for cover and immediate fire support. While doctrinally, the pathfinders are capable of calling fire support from orbital assets, this is of most use in taking out prepared positions. After the drop, the pathfinders provide a long range reconnaissance patrol capability to the Brigade commander, as well as a raiding capability.

Though the Marines of the Frogman platoon can be employed as pathfinders, they come into their own after the drop. Their main task is to lead the Brigade in any river crossing, by clearing any obstacles ahead of the engineers. They also specialize in waterway patrols and amphibious warfare.

Like the MPs, the members of the Recon Group receive extensive language training from the Defense Force's language school. All members must be proficient in at least one non-Chinese language.

Brigade Artillery

The CNMC is a profound believer in the virtues of artillery. The artillery regiment consists of three battalions, each with four batteries with either six self-propelled guns or Multiple Rocket Launchers, or twelve anti-tank kinetic kill launcher tracks. Each battalion is rounded out by a forward observer company mounted in dedicated AFVs and a headquarters/support company. While individual batteries could be parcelled out to the line battalions as required, in normal practice the Brigade commander will concentrate them under his control. The heavy batteries will be used en masse to weigh the battle, while the kinetic missile batteries can be used to screen those sectors of the Brigade front for which no troops are available. Each line battalion is well-supplied with integral fire support: they possess a light (130mm) MRL platoon in the Headquarters company along with a platoon of 120mm mortars.

In keeping with the principles of mobile armor combat, the Brigade's integral fire support is made up of one hundred self-propelled weapons, in both tube and Multiple Rocket Launcher varieties. Xing Cheng's gunners, as their SSA predecessors have for centuries, worked from the shoot-and-scoot doctrine. All vehicles feature a three man-crew, precision positioning and aiming electronics and automatic reloading systems. The Brigade's guns and Multiple Rocket Launchers operate under a deep air defense shield to protect them from counter-battery fire and air attack. They can rely on the Brigade's myriad reconnaissance and target acquisition assets, ranging from high altitude UAVs to infantry spotters, to ensure the effectiveness of every fire mission. The heavier, Brigade-level weapons, especially the heavy MRLs, hold a high proportion of their ammunition in precision-guided rounds. Though very expensive, greater precision allows a reduction in ammunition expenditure. This is necessary, as every single shell and rocket must be carried down from orbit: every shot counts.

Dedicated fire support units are available at both Brigade and line battalion Level. At Brigade level, the CNMC fields a 155mm medium artillery battalion. Though their shells are expensive and more vulnerable to Zone Defense fire than MRLs, the 155mm guns have proven hard to replace. On Xing Cheng itself, their long range is essential to assist lightly armed first response units to contain wildlife incursions. Against modern opponents, time on target firing tactics, where the first, high trajectory, long flight time rounds act as decoys to the subsequent low trajectory, low flight time shells, undertaken by pairs of batteries or the full battalion have proven very difficult to stop even by the heaviest ZD concentrations. Where this is absent or has been suppressed by air attacks and counter-battery fires, tube artillery regains its full effectiveness. 155mm guns are indispensable for the sustained sup-

pression mission, when each battery fires a single round at the target every minute or so. Their heavy shells are still the most effective weapon for disrupting armor concentrations. It is worth noting that 155mm was not a PLA- and SSA- standard artillery calibre, but was widely used by other powers. This was adopted exclusively on Xing Cheng as the guns and their ammunition were to be built on the planet from the outset. It was hoped that exports would help reduce the manufacturing plant's high costs, and thus help defray the initial investment.

Though the high trajectories of 120mm heavy mortars make their shells very vulnerable to zone defense fire, the CNMC has retained them in its inventory. Their low cost HE and WP ammunition ensures they remain the main source of the Line battalion's immediate fire support against XC's native wildlife. On a modern battlefield, heavy mortars remain useful when deployed with decoys fired from the 130mm MRLs. Once enemy ZD has been suppressed, mortars can undertake precision strikes with guided munitions, essential in urban combat to reduce collateral damage. They can also deliver reconnaissance warheads. The CNMC also retains 60mm mortars, which can be issued at platoon level when circumstances call for them. These small weapons would only be used against fairly primitive targets, however, as modern battlefield threat detection networks can turn mortars into a greater threat for their users than their intended targets.

MRLs are available in two calibres, 30-tube 130mm launchers in the Line battalions and 12-tube 230mm heavy rockets at Brigade level. 130mm MRLs are deployed in two four-vehicle sections within the Line battalion's HQ company, and are the CO's primary support weapon. Each vehicle is able to launch its full rocket load in 10 to 15 seconds, ensuring target saturation even in presence of heavy ZD. Unitary HE rounds are used the most, but White Phosphorus, submunition

dispensing, reconnaissance and decoy rounds are also available.

The 230mm MRL is the product of a late 21st century rationalization of the large inventories of medium and long-range launchers then available to the SGF. It is the largest size rocket that can be launched by medium-sized AFVs in two 6-unit packs, ensuring target saturation, long range and heavy payload. The normal tactical unit for the 230mm MRLs is the 6-vehicle battery. These have a wide array of warhead types, but the most frequent loads are submunition dispensers, white phosphorus, or Fuel Air Explosives. These weapons have a wide-ranging list of missions, such as reduction of prepared defenses, clearing minefields, strikes against mobile or area targets, and counter-artillery. Their most important function, however, is ZD suppression, to allow freer operation by the Brigade's tube artillery.

The Brigade's artillery regiment also deploys high velocity, ground hugging kinetic kill guided missiles, launched from the specialized armor vehicles of the anti-tank battalion. These are deployed to the rear of the Line battalions, and rely on infantry spotters to laser-paint their targets. Their main targets are armor vehicles, but they can also be deployed against static fortifications and aircraft. Their mission includes screening sectors of the Brigade front for which no troops are available.

In addition to the Brigade's myriad UAV's and the Line battalion spotters, each artillery battalion fields a company of dedicated forward observer IFVs, which can double as forward air controllers for the aviation regiment.

Air and Zone Defense

The Drop Brigade is designed to keep fighting even if the invasion fleet has lost orbital superiority. The artillery regiment includes a dedicated zone defense (ZD) battalion, which deploys three distinct types of lasers, detailed below.

The long-range, fixed zone defense lasers deploy at the logistics bases and can hit aerial or orbital targets out to 400 km. They also have a secondary capacity against nearby ground targets, and are engineering cousins of the smaller naval shipboard lasers, though they are optimised for use within an atmosphere.

The Type-260 heavy mobile air defense system can reach up to low orbit to stop orbital strikes and artillery barrages, as well as high-flying aircraft. It consists of a laser/fire control vehicle and a power supply vehicle; these must be stopped and connected to fire, and need to extend radiator spikes into the ground to get rid of excess heat. The type-260's lack of ability to fire on the move is more than made up by the huge firepower possessed by this system: it can completely protect a battalion from any orbital attack.

The Type-262 light mobile air defense system provides last-ditch defense against orbital attacks, but its main use is against artillery bombardments and low-flying air targets. Mounted in a single vehicle, the type-262 can fire on the move, enabling it to keep up with the brigade's maneuver units. Its efficiency is multiplied when it can stop to extend spike radiators into the ground: this allows the Type-262 air defense system to discharge the excess heat generated by its laser, thus boosting its rate of fire.

The zone defense battalion is organized in a small headquarters, one Orbital Defense Battery of two platoons that set up in each of the two Logistics bases, and four mobile Air Defense Laser Batteries of four platoons each. Two mobile platoons are assigned to each logistics base, to complement their defenses, while the remainder are parcelled out to each Line, Artillery, and Aviation battalions as well as the Brigade HQ the forward Logistics area and the Recon Group.

The Brigade's air defense capability extends down to individual vehicle level: all tracked and wheeled AFVs carry a common self-defense ZD laser sys-

tem. When a company integrates the firing arcs and detection systems all of its vehicles, their zone defense fire can intercept most plausible saturation densities of anti-armor ordnance aimed at them. This light system also has a secondary capability against incoming artillery and aircraft. When all of a battalion's air defense systems are integrated in a seamless, cooperative whole, the theoretical defense against artillery and similar threats is impressive. Actual field experience with comparable Olympian and Medinan systems used on Damso have raised concern in some Xing Cheng procurement circles.

Air Operations

Air power is crucial for the Brigade's mission. In addition to its reconnaissance mission, the aviation regiment attempts to maintain complete air superiority over the brigade. Xing Cheng troops make heavy use of UAVs and UCAVs, both rotorcraft and small jets, to meet all of the Brigade's support requirements. One full squadron of rotorcraft is kept continually on call to provide close air support for each line battalion. The jet UCAVs undertake counter-air, long-range strike, suppression of air defenses, and contribute to air defense. Whole flights can be controlled by a single supervisor for some missions, allowing the aviation regiment to undertake round-the-clock operations for as long as its fuel reserves last. It is worth noting that UAVs are stored until needed: this reduces their maintenance requirements to minimal levels. Precise data is not available, but it is estimated that there are at least two combat UAVs per operator on the Aviation Regiment's TO&E. This can also lead to innovative tactics: if the tactical situation warrants it, the aviation regiment is capable of deploying all its aviation assets in a massive surge, at the price of a much-reduced tempo later on: its real limitation is not the number of pilots, but of dedicated aircraft maintainers and spare parts. Counter-force doctrines are to kill any UAVs or UCAVs seen, preferably as far out on their patrol range as is possible, as the

number of spare parts and spare UAVs is one of the sharpest constraints on the CNMC's deployment.

A policy of spreading the use of UAVs down to the lowest levels explains their large numbers at the company, battalion, and brigade levels. All HQ IFVs can deploy small recce UAVs. All but the smallest platoon- and squad-deployed UAVs have an anti-UAV capability. The only manned aircraft are a dozen medical evacuation helicopters, which are also used for liaison and troop insertion duties. On Xing Cheng itself, the aviation regiment is crucial to keeping the safe zones around the CNMC's spaceport bases clear of hostile wildlife by constant aerial patrols.

Marine Engineers

Mobility, counter-mobility, and survivability are the main missions of the CNMC Combat Engineering regiment. This unit allows the Drop Brigade to cross any terrain found on likely deployment zones. The engineers are also tasked with breaching any fortifications set up by the defenders. Once the objectives have been achieved, they must build defensive works to ensure that they can be defended, as well as any long-term infrastructure required for subsequent occupation. Last but not least, the engineering regiments has a very limited capability to manufacture simple machined parts and small arms ammunition, provided it has access to raw materials.

The regiment's mobility mission has seen it assemble a wide collection of specialized vehicles, from 52-ton armored bulldozers to mechanical diggers, dump trucks, mine-clearing tracks, armored bridge layers and obstacle clearing tanks, as well as a couple of dedicated bridging units, of the type known as "Sarvata" for historical reasons. These are equipped with a dozer blade, a Mine Clearing Line Charge launcher and armed with a 155mm gun. On Xing Cheng, Marine Engineers routinely brave hostile wildlife, building roads in dangerous outback areas to reach new settlements

and mining camps. Though still classified, the recent attempted assault on NR during the Saladin War would've seen CNMC combat engineers at the forefront of the final assault on the Spaceport Defenses.

Signals Networks

Shoot-Move-Communicate are CNMC bywords. Every single vehicle and Marine is integrated in one of the Brigade's numerous intermeshing secure communication nets. The voice and data messages carried therein serves as the Drop Brigade's most effective force multiplier. The Brigade is best described as a seamless series of encrypted and interconnected data networks, linking every squad, platoon, company, battalion, all the way up to the full Brigade, including nets for the specialist support regiments, pathfinder teams and even individual marines such as snipers and forward observers. Voice traffic, though considerable, is but a tiny fraction of the data traffic. Commanders at all levels make heavy use of coded short text messages, which are far harder to intercept and jam. But even this pales when compared to the huge volume of data exchanged by every Drop Brigade vehicle's automated targeting and information system. Xing Cheng Zone Defense (ZD) doctrine relies on automated cooperative engagement capability to assign fields of fire to every ZD mount and defend against artillery, air and anti-armor missile attack. Near-instant dissemination of data from all reconnaissance units, ranging from snipers to robotic UAVs, to all interested parties, be they an isolated squad or the Brigade Commander himself, is essential to reduce combat losses and maximise every subordinate unit's effectiveness. These two factors alone explain the majority of the Drop Brigade's signals traffic. To ensure that the enemy cannot read the Drop Brigade's intentions, each sub-network has a different encryption algorithm. These are changed daily or even hourly in some instances, and frequency hopping is mandatory.

This reliance on packeted transmission capabilities puts a particular burden on the Aviation and Engineer units. There are two competing issues; the first is emissions control. While in theory, any unit in the brigade could relay through orbital assets, the power requirements are larger than what is needed for a local network, and the broadcast signature qualifies as a solid "here-I-am, come-shoot-me" signal. A significant number of UAVs are tasked with being relay points for the networks that Xinger units relay upon; this represents a point of failure that can be exploited by an enemy – take out the UAV, and you have reduced the networked assets to line of sight communications with each other. To its credit, the CNMC also tasks its engineers with setting up cellular radio towers to provide some back-up communications linkages. While many services are immediately envious of the capabilities of the CNMCs networked toys, none to date have been willing to put quite that level of reliance in it.

The missions of protecting the Brigade's voice and data networks against jamming and interception, disrupting the enemy's own communications capability, gathering real-time signals intelligence, and maintaining the links to the orbiting Fleet are the responsibility of the CNMC Signals company. This is supported by signals sections embedded in each battalion; these are co-located with the company on Xing Cheng in peacetime, to facilitate training. The Signaller's main task is disrupting the enemy's communications and sensors network, and provide communications-derived intelligence and targeting data to the Brigade: a blind and deaf enemy is that much easier to defeat in detail.

The networks themselves are built up by linking every CNMC vehicle, but are managed by the Command Post Tracks deployed by the Brigade and battalion HQs; these are the main nodal points. As has been standard in network operations for centuries, the network is designed to reconfigure

itself to recover from broken nodal points and missed transmissions.

The effect of redundant and intermeshing fully functional data networks cannot be underestimated. In ideal conditions, the enemy's most powerful defenses or artillery concentrations can be bypassed or abated, allowing the CNMC to advance through pre-plotted fire zones and press on its attack. Conversely, accurate real time targeting data gathered by a wide variety of sources, and concurrent downgrading of enemy sensors multiplies the effectiveness of one's own forces. The Brigade features numerous alternate commands: besides Brigade main, alternate one and alternate two, the command cascade involves every subordinate regimental headquarters. With careful management of the command networks, this provides the capability for the Brigade to carry on its mission, even if its main leaders are incapacitated.

NBC Defense

Because the Ban of Pacifica forbids use of nuclear, biological, and chemical weapons, Xing Cheng does not keep stocks of such weaponry. Nonetheless, the Drop Brigade possesses extensive NBC detection and decontamination equipment. Twelve NBC sections cover all the main sub-units.

Military Police

The Brigade includes a full battalion of MP in its TO&E. This oft overlooked unit fulfills a number of crucial functions requiring specialized skills which would cripple the Brigade if left uncovered. Consisting of a headquarters/support company, two MP companies and an interrogation company, the battalion would be based near the Brigade's Logistics bases. It is responsible for traffic control, essential due to the fact that a huge number of CNMC vehicles are going to transit over a few ill-prepared and badly marked roads. It is also responsible for route security, contributing to the defense of the logistic regiment's supply trains, guarding the two supply bases, and handling prisoners, includ-

ing their interrogation. The MPs are also trained in contact with civilians, making the battalion one of the main beneficiaries of Xing Cheng's Defense Force's Language School.

Logistics

The Drop Brigade is designed to land outside the target objective's zone defense system, and operationally, they're supposed to be able to cover up to 200 km of terrain to reach their objective. As orbital suppression of planetary defenses without levelling cities remains the realm of bad movies, supply drops will need to be made outside the hostile zone defense umbrella, until the Marines can shut it down. Timely arrival of supplies is essential to maintain momentum. Once the target is engaged, ammunition and fuel expenditures will skyrocket, putting further strain on resupply efforts.

These multiple missions are undertaken by yet another specialist CNMC unit, the Logistics regiment. It is organized in two battalions, each running a distinct Logistics depot, and managing a separate drop zone. Each battalion runs four Logistics companies, each with three supply trains, made up in turn of robotic supply trucks and command and control or support APCs. Every company is assigned to keep a specific battalion supplied, with one train at the Brigade forward area, one at its parent Logistics Depot, and one shuttling between the two. Each battalion's integral logistics support platoon carries the supplies for the final few kilometers. Convoy escort, both active and passive, is given by the Brigade HQ battalion's MP companies, one of which is based in each depot.

The supply trains are formidable units, bristling with weapons and UAVs to detect ambushes. These characteristics were developed on XC, where long-range outback operations keep hostile native wildlife away from human settlements. They were refined on Schwarzvaal, where supply and relief convoys are an essential component of XCDF operations.

Hospital

The Marines are well aware that any orbital assault is a one-way, success only ticket. No means or returning to orbit is available once the Drop Brigade is landed: going home is possible only when the target world's launching facilities have been seized. Any casualties must therefore be treated locally. The Brigade includes an advanced hospital battalion, which can be split into a main unit located near the Logistics depots and two forward field surgeries. CNMC practice is that the hospital will be a demilitarised area, open to all casualties irrespective of nationality and military status. To ensure their safety, the hospital and surgeries will be protected by the Brigade's MPs. Every battalion in the Brigade has an aid station, whose mission is to stabilize casualties before evacuation to the field surgeries, and integral armored ambulances. Every squad ideally has one or more Marines cross-trained in First Aid techniques. A separate Medical company with armor ambulances complements the battalion's assets.

Marine Vehicles

With rare exceptions, all of the Drop Brigade's vehicles are armored, down to its utility and cargo vehicles, which sport protected cabs. All AFVs are derived either from the 43-ton Type-245 MBT and the 26-ton Type-247 IFV. The conventionally configured MBT has a four-man crew and mounts a 105mm smoothbore high-pressure gun, firing APFSDS and multipurpose HE ammunition. The IFV carries a turreted 40mm Cased Telescoped Ammunition cannon, ATGWs, and an 8-man squad in addition to its 3-man crew. The tracked AFVs are complemented by the Type-256 8-wheeled, 20-ton APC, used for support missions. The basic version can carry a ten-man squad in addition to its two-man crew, and is equipped with a one-man turret carrying a 12,7mm HMG and a 35mm AGL. All three AFVs have served as the basis for extended specialized vehicle families. All Xing Cheng armored vehicles are equipped with modest, but networkable, zone defense capabilities. The armor on the chassis is a

tried-and-true electric armor design, to protect against shaped charge attacks.

The brigade's heaviest vehicle, however, is the combat engineering regiment's 52-ton armored bulldozer. This is built on a third tracked chassis, and has proved irreplaceable for building roads in XC's outback. Other vehicles are the heavy type-179 8-wheeled truck, which is present in both manned and robotic versions. The Marines also deploy the lightly-armored and mine-proofed Type-187 4-wheeled utility vehicle and a few of the smaller 4-wheeled Type-190 jeep-type vehicle. Nearly all Marine vehicles mount a 12.7mm HMG, most often in a remotely-operated turret. All vehicles drop with their crews and load, and are fully operational within 30 minutes of landing, and often ready in less time than that with experienced crews going over the checklists.

Drop Capsules

The Drop Brigade possesses a grand total of 1,215 AFVs of all types, and many more trucks and light vehicles. All but the light vehicles fill the entire capacity of a drop capsule. A full brigade drop requires 290 100-ton capsules for its 43-ton AFVs, 2,415 60-ton capsules for the lighter AFVs, trucks, and other wheeled vehicles, and 36 120-ton capsules for the 52-ton bulldozers. A couple dozen smaller, 10-ton capsules are also used to drop the pathfinders. In turn, the capsules require some 299 gunboat docks, at 600 tons of capsules per dock. Supplies and personnel pods to carry the Marines themselves would consume still more docks. The CNMC's reliance on the mass-produced 100- and 60-ton capsules is now evident, and also explains the low prices available for their civilian models on the Ten Worlds orbital re-entry market. The sheer numbers of 60-ton capsules helps mask the CNMC's precious infantry units, whose IFVs drop in this type of capsule, during the descent.

The CNMC expects to leave some equipment behind in an actual off-world operation.

Equipment list

The Brigade possesses two full sets of the following AFVs and other pieces of equipment, one based on Xing Cheng and the second stored on Xing Cheng's moon. Depending on available transport, some of these vehicles may be left behind.

- 162 MBTs
- 104 IFVs
- 106 HQ IFVs
- 30 FO/ FAC tracks
- 90 Command Post tracks
- 32 Communications / Electronic Warfare tracks
- 71 UAV tracks
- 58 Field ambulance tracks
- 40 ARV
- 44 Repair/ workshop tracks
- 140 Hardsuits
- 36 NBC vehicles (8-wheeled APCs)
- 36 Armored bulldozers
- 24 Mine clearing tracks
- 12 Obstacle breaching tanks
- 12 Bridgelaying tanks
- 6 Sarvata Bridges (6 trucks each)
- 24 ABLE bridges (4 trucks each)
- 16 8-wheeled APCs (MP)
- 4 8-wheeled APC ambulances
- 68 8-wheeled armored Convoy Command and Control APCs
- 66 8-wheeled armored Repair and Recovery vehicles
- 620 robotic trucks (supply trains)
- 520 trucks (manned)
- 472 Type-187
- 16 120mm SP mortars
- 36 light tracked MRLs (130mm)
- 24 Heavy tracked MRLs (230mm)
- 24 tracked SPGs (155mm)
- 88 ammunition resupply tracks
- 48 ATGW tracks
- 4 Orbital ZD Firing sections (fixed, carried disassembled on four trucks each)
- 16 Heavy ZD Laser tracks +16 power generation tracks
- 32 Light ZD Laser tracks
- 12 utility helicopters
- 12 (+12 spares) reconnaissance UAVs
- 48 (+48 spares) UCAV-R (rotorcraft)
- 48 (+48 spares) UCAV-J (jet)

The Celestial Navy Marine Corps Drop Brigade—TO&E

Brigade HQ (284 Marines)

The Brigade Headquarters groups the nerve center units, command, signals, and medical companies.

Command and Staff: 2x tanks (CO, XO), 2x HQ IFV, 12 command tracks and some 6x Type-187 (112 Marines);

Medical Company: 12 armor ambulances, Type-187 and plenty of trucks (80 Marines);

Communications/ Signals Intelligence/ Electronic Warfare Company: 12 signals tracks, some trucks and Type-187 (80 Marines).

NBC section: 3x NBC vehicles (12 Marines)

Line Battalions

The line units deploy after effecting cross attachments, which depend on the expected mission. The battalion support elements are trained

and equipped to support both vehicle types different vehicles during operations. The armor battalion has a strengthened maintenance platoon for this very purpose, as it owns large numbers of both AFV families. Cross-attachments, however, are not permanent, as they interfere with peacetime training and maintenance procedures.

2x Armor Battalion

1xHQ Company

(230 Marines)

Commander, Staff Officers, and Staff: 2x MBT (CO/XO), 2x IFV (1SG/Junior Officer), 6x command tracks, 2x Type-187s, 68 Marines

Scout/Recon Platoon: 6x Type-

187s (3 crew), 18 Marines
Sniper Section (12 Marines)
Mortar Platoon (4 tubes) - four 120mm mortar tracks (3 crew), one HQ IFV (7 crew), one UAV track (5 crew), 24 Marines

MRL (130mm) Platoon: 2x firing Sections each with four 130mm MRLs, two command

Sections each with one HQ IFV and one UAV track, 48 Marines

Hardsuit Platoon: 8x hardsuit, 9x Type-187s (28 Marines)

Signals Section: 2x Signals tracks, 12 Marines

UAV Platoon: 4x UAV tracks (20 Marines)

Forward Observer/ Forward Air Controller Section: these Marines are attached to company and battalion HQ

1x Logistics Company

(110 Marines)



HQ Platoon: 10 Marines, Type-187s

Medical Platoon: 2 ambulance tracks (8 Marines)
NBC Section: 3 specialized NBC vehicles, (12 Marines).

Support Platoon: 10 ammunition resupply tracks with 3 crew each, 2x Convoy Command and Control APC (seven crew each), 2x repair and Recovery APC (three crew each), 20 robotic trucks, 50 Marines

Maintenance Platoon: 2x ARV (3 crew), 4x repair/workshop tracks (3 crew), 4x truck for spares, 2x Type-187s (30 Marines)



The balance of the Medical and Maintenance platoons are attached to the companies.

4x Armor Company

(100 Marines)

HQ Platoon: 2x tank (CO, XO)
2x IFV (1SG, Operations Officer; each IFV with 3-man crew and 4-man HQ team) Truck+2x Type-187s (Supply sergeant and armourer), 1x ARV, 1x repair/workshop track, 1x ambulance track, 36 Marines

4x Tank Platoon: 4x tanks each, (16 Marines per Platoon)

Total 740 Marines in the battalion. Drop capsule requirements per each armor company: 19x 100-ton, 10x 60-ton; each battalion requires about 80x 100-ton capsules, 144x 60-ton, or 28 gunboat docks.

2x Mechanised Infantry Battalion

1x HQ Company

226 Marines

Commander, Staff Officers, and Staff: 2x IFV (CO/XO), 6x command tracks, 4x Type-187 (64 Marines)

Scout/Recon Platoon: 6x Type-187 (3 crew), 18 Marines
Sniper Section (12 Marines)

Mortar Platoon: 4x 120mm mortar tracks (3 crew), one HQ IFV (3+4 crew), one UAV track (5 crew), 24 Marines

MRL (130mm) Platoon: 4x-firing Sections with 2 x MRL (130mm) each, 2 x HQ Sections each with one HQ IFV and one UAV track, 48 Marines

Hardsuit Platoon: 8x hardsuit, 9x Type-187 (28 Marines)

Signals Section: 2x Signals tracks, 12 Marines

UAV Platoon: 4x UAV tracks (20 Marines)

Forward Observer/Forward Air Controller Section: these Marines are attached to company and battalion HQ

1x Logistics Company

(100 Marines)

HQ Platoon: 10 Marines, four Type-187

Medical Platoon: 2 ambulance tracks (8 Marines)
NBC Section: 3 specialized NBC vehicles, (12 Marines).

Support Platoon: 10 ammunition resupply tracks with 3 crew each, 2x Convoy Command and Control APC (seven crew each), 2x repair and Recovery APC (three crew each), 20 robotic trucks, 50 Marines

Maintenance Platoon: 2x ARV (3 crew), 2x repair/workshop tracks (3 crew), 2x truck for spares, 12x Type-187 (20 Marines)

The balance of the Medical and Maintenance platoons are attached to the companies.

4x Mechanised Infantry Company

(164 Marines)

HQ Platoon: 2x IFV (CO/XO) each IFV with 3-man crew and a 5-man HQ team) Truck+3x Type-187 (1SG/Supply sergeant and armorer + drivers), 1x ARV, 1x repair/workshop track, 1x ambulance track, 32 Marines

3x Mechanised infantry Platoons: each with 4x IFVs with three crew and 8 Marines; three dismounted squads of 9, HQ element, plus attachments (medic, signaller), 44 Marines per Platoon, 132 total

Total personnel: 982 Marines.

Drop capsule requirement per company: one 100-ton and 18 60-ton capsules. Total battalion requirement: six 100-ton and 130 60-ton capsules on 14 gunboat docks.

Recon Group

The Recon Group is an embryonic battalion, led by a Lieutenant Commander or Commander from a reinforced company command post. The group can receive cross-attached companies from the line battalions, turning it into the Brigade's fifth maneuver unit. When reinforced, the Recon Group can undertake the Flank Guard mission. The Group features extensive reconnaissance UAV assets, which have a secondary attack capability, mainly against enemy UAVs but also ground targets. There are four Pathfinder sections, to scout the same number of separate landing zones before the final drop. Once recovered, the Pathfinders become the Brigade Long Range Reconnaissance Patrol Unit. River crossings and amphibious warfare are the preserve of the Frogman platoon, who also double as Pathfinders. The Group's armor reconnaissance company is its largest subordinate unit, and is expected to fight for information. It's a modified armor company, with two tank and two mechanised infantry platoons, plus attachments and HQ. 352 men total for the Recon Group.

Recon Group HQ: 2xtanks, 2x HQ IFV, 2xcommand track, 2x Type-187 (40 marines)

Recovery Element: 2xARV, 2xrepair track, (16 Marines)

Signals Platoon: 2xSignals track, (12 Marines)

UAV Platoon: 4xUAV Track, (20 marines)

Ambulance Platoon: 4x ambulance tracks (16 marines)

Pathfinder Platoon: HQ Section, 8 Marines with 2x Type-187s, 4x pathfinder Sections, each with 16 Marines and 4 x Type-187s (72 Marines)

Frogman Platoon: HQ Section, 4 Marines and 1x Type-187s, 2x frogman Sections, each with 12 Marines and 3 x Type-187 (28 Marines)

Armor Recon Company

(142 Marines)

HQ Platoon: 2xtank, 2x HQ IFV (22 marines total)

2x Armor Platoon: 4xtank (4x crew per tank)

2x Mech Inf Platoon: 4xIFV (three crew+ 6 Marines per IFV)

1x Fire Support Section: 4xMRL (130mm) tracks (3 crew each), 1x HQ IFV (3+4 crew), 1x UAV track (5 crew)

Total drop capsules. 14x100-ton, 32x 60-ton, 27+ 10-ton capsules for single type-187s on 8 gunboat docks. Total personnel: 352 Marines

Marine Artillery Regiment

This unit manages three battalions: one self propelled gun battalion, one heavy multiple rocket launcher (MRL) battalion, one anti-tank (kinetic missile) battalion. The MRL battalion is the only Drop Brigade unit manned by Xing Cheng Defense Force personnel.

HQ Company

(92 Marines)

Commander, Staff Officers, and

Staff: 6x command tracks, 4x Type-187s, 48 Marines

UCAV (spotters) Platoon: 4 UAV tracks, 20 Marines

Signals Platoon: 4 Signals tracks, 24 Marines (works in conjunction with FDC company)

Total drop capsules for the HQ company: 18x 60-ton. 2 gunboat docks.

1x Self Propelled Tube Artillery Battalion

HQ Battery

Commander, Staff Officers, and

Staff: 6x command tracks, 4x Type-187, 50 Marines

UCAV (spotters) Platoon: 4x UAV tracks, 20 Marines

Medical Platoon: Attached to Batteries

NBC Section: 3 NBC vehicles, 12 Marines

Support Platoon: 2x Convoy Command and Control APC (seven crew each), 2x Repair and Recovery APC (three crew each), 20x robotic trucks, 4x hardsuit, 2x Type-187, 28 Marines

Maintenance Platoon: 4x ARV, 4x repair/workshop tracks, 24 Marines

4x Medium Artillery Batteries: 6x155mm SPG, 6x ammo carrier tracks, 2x battery HQ tracks (can operate small UAVs), 1x ambulance track, 54 Marines

1x FDC battery: 10 FO tracks, 50 Marines.

Total drop capsules for the tube artillery battalion: 106x 60-ton, on 10 gunboat docks.

1x Heavy MRL Artillery Battalion

This unit formally belongs to the Xing Cheng Defense Force, but are otherwise indistinguishable from the Marines (400 Gunners)

HQ Battery

Commander, Staff Officers, and

Staff: 6x command tracks, 4x Type-187, 50 Gunners

UCAV (spotters) Platoon: 4x UAV tracks, 20 Gunners

Medical Platoon: vehicles and personnel is attached to Batteries

NBC Section: 3 NBC vehicles, 12 Gunners

Support Platoon: 2x Convoy Command and Control APC (seven crew each), 2x Repair and Recovery APC (three crew each), 20x trucks, 4x hardsuit, 2x Type-187, 28 Gunners

Maintenance Platoon: 4x ARV, 4x repair/workshop tracks, 24 Gunners

4x MRLS Battery: 6x Heavy MRL (230mm) tracks, 6x ammo carrier tracks, 2x battery HQ IFVs (can operate small UAVs), 1x ambulance track, and 54 Gunners

1x FDC battery: 10 FO tracks (IFVs), 50 Gunners.

Total drop capsules for the MRL Bn: 106x 60-ton.

1x Anti-Tank (Kinetic Missile) Battalion

HQ Battery.

Commander, Staff Officers, and Staff: 6x command tracks, 4x Type-187, 50 Marines

UCAV (spotters) Platoon: 4x UAV tracks, 20 Marines

Medical Platoon: Four Ambulance tracks, 16 Marines

NBC Section: 3 NBC vehicles, 12 Marines

Support Platoon: 2x Convoy Command and Control APC (seven crew each), 2x Repair and Recovery APC (three crew each), 20x robotic trucks, 4x hardsuit, 2x Type-187, 28 Marines

Maintenance Platoon: 4x ARV, 4x repair/workshop tracks, 24 Marines

4x Anti-Tank (Kinetic Missiles) Batteries

(50 Marines each)

HQ Section: 2x HQ IFV, 14 Marines

3x Anti-Tank (Kinetic Missile)

Platoons: 4x ATGM tracks, 12 Marines each.

1x FDC Battery: 10 FO tracks, 50 Marines

Total of 1204 Marines and 400 XCDF Gunners in the artillery regiment; drop capsule requirements are 114x 60 ton capsules on 11 gunboat docks.

Zone Defence Battalion

HQ Platoon: 4x HQ tracks, 4x Type-187, 40 marines

1x Orbital Defense Battery: Two Platoons, each of two firing Sections: 3 trucks, one HQ/Signals truck, and one type-187 per firing Section. 12 marines per Section, 48 Marines in total for the company

4x mobile Air Defense laser Batteries: Each with four Platoons; each Platoon has 1x Type-260 heavy ZD system (one gun track and one power generation track), 2x Type-262 light ZD systems, 1x HQ IFV, 76 Marines per company

392 Marines in the zone defense battalion. It requires about 64 100-ton and 74x 60-ton capsules, approximately 15x GB docks, excluding re-supply drop requirements.

Marine Aviation Regiment

HQ Company

Commander, Staff Officers, and Staff: 6x command tracks, 4x type-187, 50 Marines

Medical Platoon: 6x ambulance Tracks, 24 marines.

Signals Platoon: 4x Signals tracks, 24 Marines.

NBC Section: 3x NBC vehicles, 12 Marines

Maintenance Platoon: 2x ARV, 2x repair/workshop tracks, 2x trucks, 2x Type-187, 20 Marines

1x UCAV-R (rotorcraft) Battalion

HQ Platoon: Trucks and Type-187, 24 Marines.

4x UCAV-R Companies: each with 12 UCARs plus spares, for CAS and Recce; 24 trucks, ten type-187, 58 Marines.

1x UCAV-J (jet-powered) Battalion

HQ Platoon: Trucks and Type-187, 24 Marines.

4x UCAV Companies: each with 12 UCAVs plus spares, for strike and CAP; 24 trucks, ten Type-187, 58 Marines.

1x Recon UAV Company: 12 long-range reconnaissance UAVs and 12 spares, 24 trucks, ten type-187, 58 Marines.

1x Utility Helicopter Company: 12 utility helicopters for Medical evacuation/liaison/C2. these aircraft have a limited self defense capability. 30 trucks, ten type-187, 100 Marines.

All the UAVs are in addition to the integral UAVs in each battalion. The line and arty battalion UAV systems are largely reconnaissance-oriented, but also have a secondary attack capability against enemy UAVs, aircraft and ground vehicles. The general principle is to keep a secondary aerial reconnaissance capability in house, just in case the primary is unavailable for any reason. Some battalion-level UAVs also have a small integral warhead, to assist in their secondary attack mission.

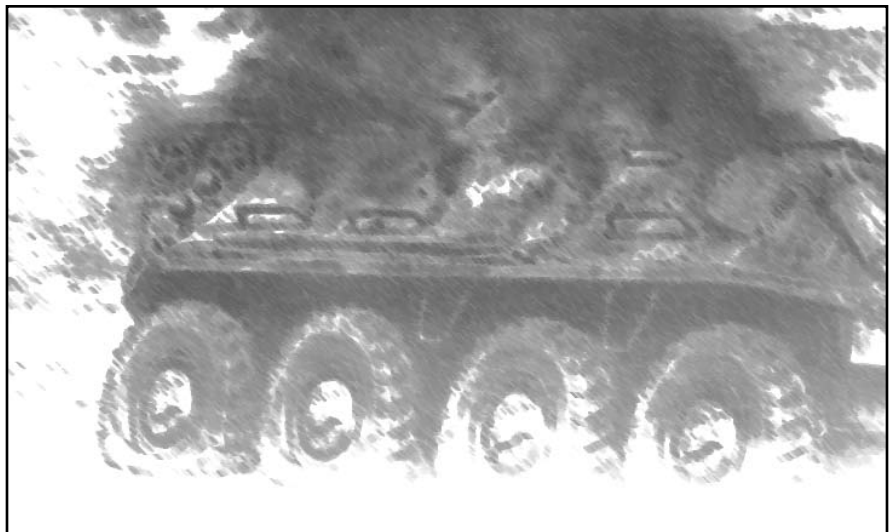
Total drop capsules required for the aviation regiment: 2x 100 ton, 310x60-ton, 800 Marines.

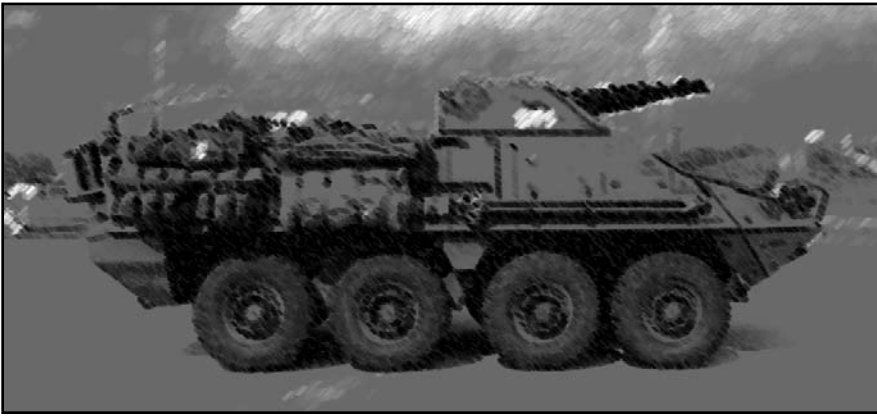
Marine Engineering Regiment

Regimental HQ

HQ Platoon: Commander, Staff Officers, and Staff: 6x command tracks, 4x Type-187, 52 Marines

Signals Section: 2x Signals tracks, 8 Marines





2x Combat Engineer Battalions

HQ Platoon: Commander, Staff Officers, and Staff, 6x command tracks, 4x Type-187, 50 Marines.

Tactical is Intel (S2) and Planning (S3). The latter is where most liaisons will operate.

Operational is Personnel (S1) and Logistical (S4).

Chaplain/Morale specialist, public affairs, and so forth

2x general service engineer companies

2x engineering Platoons: Each with: 3x combat Bulldozers, 1x Sarvata bridge, 1x obstacle breaching tank (with 155mm gun-howitzer), 1x bridgelay tank, 1x large digger, 2x small digger, 4x dump trucks, 2x mine clearing tracks, transporters for most of the above, Type-187. (120 Marines)

1x Bridging company

12x ABLE bridges: 48 trucks, 12 Type-187, 120 Marines plus any specific vehicles required to prepare the ground.

1x Power Generation and Logistic Base Support Platoon: 60 marines.

Specialized Sections with personnel for pebble bed reactor set-up and operation, and well as for rectenna power grid assembly

NBC Section: 3 NBC vehicles, 12 Marines

1000 Marines total for the Engineering Regiment, with 470 Marines per battalion. The regiment requires 24 100-ton, 36 120-ton, and about 300 60-ton capsules to drop with all its equipment, for 40 gunboat docks.

1x Military Police Battalion

HQ Co.

Commander, Staff Officers, and Staff: 6x command and Control APCs, 4x Type-187, 50 Marines

Medical Platoon: 4x ambulance APCs, 16 Marines

NBC Section: 3 NBC vehicles, 12 Marines

Maintenance Platoon: 4x Repair and Recovery APCs, 4x type-187, 24 Marines

1x MI (analysis and interrogation) Company: Type-187, some trucks, (94 Marines)

2x MP Company: Each with 8x 8-wheeled APCs and 10x Type-187 (120 Marines per company);

Total capsules 60x60-ton, 436 Marines, for 6 gunboat docks.

Marine Logistics Regiment

The Marine Logistics regiment ensures that the Brigade's sub-units are constantly supplied, and can keep up the momentum necessary for successful operations. It is divided in two battalions, one for each of the two main Drop Zone Logistics Bases. Each battalion is also responsible for the bases operation once the Engineering regiment has set it up.

HQ Platoon: this is normally co-located with one of the Logistics battalions

2x Logistics Battalions (approx 500 men each)

HQ Company: Communications, capsule recovery and stores organization sections; forklifts, tractors, trucks and Hummers

4x Supply Train Company

3x supply trains, each with 36 Marines:

2x 8-wheeled Convoy Command and Control APC: two-man crew + 5-man C4 detachment in the back. They supervise the trucks and control one or more recce UAVs; they also liaise with the escort and other friendly units. .

2x 8-wheeled repair and recovery vehicles: With ZD, and a small workshop to recover and repair the train vehicles. Winch, crane, small dozer blade, 3-man crew.

4x Type-187: carrying one hard-suit, the operator, driver, and two maintenance engineers who also man the remote turret MG (12,7mm)

20x robotic trucks: 8-wheeled, 12-ton payload, armed with an automated 12.7mm in a remote turret.

The Logistics Regiment's unofficial motto is "We brake for nobody".

Total 1,000 Marines

Brigade Hospital

1x medical hospital battalion. This is a non-combatant group, which deploys separately from the DZ bases. It drops with its own power-handling team that runs a pebble bed reactor and/or rectennas.

This unit divides into a main hospital and two separate field surgeries for transport, to ensure redundancy and survivability. Once landed, the hospital is located near the Logistics depots, and the two field surgeries deploy closer to the front. Total 200+ marines, mostly Type-187 and trucks.



Non-Drop Brigade CNMC Units

CNMC Instruction Regiment

The inevitable subject of many movies, the Instruction Regiment undertakes basic and advanced training for all CNMC recruits. A separate sub-unit trains potential officers in a one-year program. Future officers mostly come out of the XCCN Academy, but also from the Xing Cheng university volunteer cadet training programs. This unit receives more about 2600 recruits per year, but only half are eventually accepted and complete training. There are 400 instructors.

CNMC School of Infantry and Armor

Formerly known as the CNMC School of Infantry, this was expanded to do armor training in 2258. Over the past decade, the school has become XC's premier armor combat instruction center, to the point that it also trains XCDF personnel. In exchange, the Defense Force trains CNMC artillerymen, aviators, signallers, technicians and combat engineers. There are 300 instructors and a varying number of trainees.

CNMC Hardsuit Operations School

Though today's CNMC requires far fewer hardsuit operators than in the past, this school remained in operation, as it was XC's first joint training establishment. It harks back to the SSA, and teaches the same procedures perfected before the Loss. It is still the sole training center for hardsuit operators on XC, regardless of service. There are about 100 instructors and a varying number of trainees, mostly from the XCDF.

CNMC Hostile Environments School

The zero-gee and airless/hostile environment combat training center is based on Xing Cheng's moon. The school trains all XCCN and CNMC personnel assigned to the moon base, and the Marines belonging to the Fleet Security Group in specialist com-

bat, deep space damage control, and maintenance techniques. Another important part of the school curriculum are specialized zero-gee unarmed and melee weapons combat techniques, arguably second only to the Medinan Star Force Ship Security School in the extent and depth of their training. The school is also part of the CNMC's permanent cadre on Xing Cheng's moon. There are 100 instructors assigned to the School.

Lunar Support Battalion

This specialist unit provides the bulk of the permanent cadre on Xing Cheng's moon, and has final responsibility for the care and maintenance of the extensive equipment stocks stored there. There are 500 Marines in the battalion, all technical specialists, drawn in turn from all CNMC units.

CNMC Fleet Security Group

This battalion-sized unit provides the XCCN with ship's troops and specialist zero-gee defense platoons for the XCCN naval bases in the Zeta Tucanae system and elsewhere.CCCC. The group is made up of one headquarters/support company and four security companies, all staffed by regular personnel. The security companies each have three base defense platoons of 32 Marines, and an 8-man command squad. Two companies are broken up, with two platoons deployed outside the ZT system at Concord's Highport Station and The XCCN base at Pi (3) Orionis, two in transit, and two more based at the Zeta Tucanae Rabbit Hole Naval Logistics Station and at the Xing Cheng Orbital Naval Base. The Headquarters support company and the two remaining defense companies are stationed on Xing Cheng's moon, with one company undergoing training at the Hostile Environments School, and the other providing four-Marine ship's troops detachments for the Fleet. Marines assigned to the Security Group are drawn from all the CNMC's units and serve for two or three years. There is

no shortage of volunteers to serve in the Fleet Security Group, as this is one of the few conduits that allow Marines to serve off world. There are 500 Marines in the Fleet Security Group.

Immediate Reaction Force

The CNMC maintains an Immediate Reaction platoon in each of its Xing Cheng Spaceport bases, drawn in turn from the mechanised infantry battalions. The platoons can deploy to any part of Xing Cheng within ninety minutes by a sub-orbital launch, via small dedicated XCCN shuttles. The Immediate Reaction Force is the first unit to respond to an attack on isolated settlements, but can deploy only as light dismounted infantry with limited heavy weapons. Though its missions are very risky given the lack of backup, the Immediate Reaction Force has no lack of volunteers and is the darling of Xing Cheng's public. This earns the CNMC much political goodwill. When the Brigade is mobilized and shipped off world, the Immediate Reaction Force is drawn from mobilized reservists.

Cadre Companies

The two 100-Marine reserve cadre companies are intended to guard and maintain CNMC installations at Xingjing and Wuhan Spaceports when the Drop Brigade is mobilized and moved off-world. Each cadre can operate UAVs and has reservist helicopter and UAV aircrew and maintainers assigned to it. The cadres would also serve as the backbone of four mobilization battalions, manned with recruits just out of training and recalled Marines of the Senior Reserve. The battalions would serve as replacement pools for the Drop Brigade, as well as for Home Defense. There are 200 Marine reservists.

Guard Battalion

The most visible unit in the CNMC, the Guard Battalion provides each of Xing Cheng's embassies with a 32-Marine ceremonial guard and secu-

city platoon. The XCCN complements this with the same number of technicians and communications specialists. There are currently ten Embassies and Missions, and thus ten deployed platoons. At any time, another five or six are in transit to relieve a post and four or five more are undergoing training on Xing Cheng. The platoons on the Home World also form the Marine component of the Joint Service XCCN/CNMC/XCDF Honour Guard for special ceremonies. The Honor Guard is assigned to the First Voice's Office and also guards the Xing Cheng General Staff. Besides rigorous ceremonial, security, and bodyguard training, the Marines also learn non-Xing-Cheng languages at the XCDF's Language School. There are 800 Marines in 20 guard platoons, one 100-Marine headquarters company and training unit, and the Special Security Section, a unit trained in anti-terrorist tactics.

XCCN/CNMC Traditions

When Admiral Bao created the XCCN from the SSA's 2nd Fleet, he took the opportunity to mark a break with the SSF (Sovereign Space Force). A profound traditionalist, he also elected to renew the links to the rich heritage of the former Chinese PLA (People's Liberation Army). XCCN personnel were thus issued the original uniforms of their service's ultimate ancestor, the PLA-Navy's nuclear submarine service, down to the traditional sailor suits. Admiral Bao also received a special request from Admiral Luo Le Ke, a former commander of the 2PPndPP Fleet who had elected to remain on Xing Cheng on his retirement, and had then been arrested in 2215 for organizing opposition to the Viceroy during the Accession. Until the SSF's Marine Corps and Interface Corps ab-

sorbed his service, Admiral Luo had belonged to the former PLA-AF (Air Force). Luo requested that Marines, themselves the linear descendants of the PLA-AF's 15PPthPP Airborne Corps, wear that service's original uniform colours, green jackets over blue trousers, and Bao approved the uniform.

Luo Le Ke

No discussion of the CNMC would be complete without a mention of Admiral Luo Le Ke, Xing Cheng's own Verner Von Braun-cum-Mikhail Kalashnikov. At 21, Luo was one of the very last of officers commissioned into the PLA-AF in 2155, just prior to its being divided between the SGF (Sovereign Ground Forces) and the SSF. A maverick engineer belonging to a service driven by conformism and engineering excellence, his sheer genius would soon propel him into prominence and to the highest ranks. On Earth, Luo was the key to the innovations that turned the SSF Marines from a curiosity into one of the SSA's most powerful strategic weapons. He was the driving force behind drop-capable pebble bed reactors and easily-assembled field rectenna power grids. Luo also personally designed the 60-, 100- and 120-tonne drop capsules still in use today, winning a slew of engineering prizes along the way. Not content with championing his beloved Marines, he was also instrumental in rationalizing missile development for the SSF's gunboats.

The SSF granted Rear Admiral Luo his wish of commanding the Xing Cheng-based 2PPndPP Fleet, and he took up command in 2184. This was supposed to be a stepping stone to better things: he was expected to return to

Beijing, first in the post of Chief of the Naval Staff, and then Chief of the General Staff. He surprised the SSA when he chose to retire as a full Admiral on Xing Cheng in 2194, relinquishing his command to then Rear-Admiral Bao. He had fallen in love with the planet, where he started the very profitable Qui'lin Forges, Qui'lin Arms and Qui'lin Aviation businesses. These are still Xing Cheng's main providers of high-grade metal alloys, small arms and light aircraft, respectively. The last two businesses are famous for the military-grade Settler's Carbine and the Hazardous Life Reaction Force's trademark Ye Ma (Wild Horse) turbo-prop attack aircraft.

After the Bao Restoration, Luo became a leading light of the Bao Faction in Xing Cheng politics. In 2216 he founded the House of Forge Masters, representing XC's steel making concerns, which is still one of the main power centers of the Bao Faction. His death in 2228 occasioned Xing Cheng's first true state funeral. Always unusual in his personal habits, the navy's security services never failed to protect him ... save at the very end. A major mishap in organizing the funeral service ended with six of his former wives disputing the seating arrangements with his widow. The resulting row was forever enshrined as "The Great Xing Cheng Catfight" in innumerable vid shows, movies, and theatre plays throughout the Ten Worlds. Thanks to this unfortunate incident, Xing'ers have acquired a reputation as serial monogamists, their women hell-bent on revenge.



Newtonian Combat: Training, Tactics, and Techniques

Training: Exercises and Manoeuvres

Don't Overthrust. The most common mistake among new players is to thrust too hard trying to close the range to the target, and then wind up sailing off the map. A speed of 8 hexes per turn in any given direction is usually sufficient. Smaller vectors make it easier to change your vectors, and thus keep more maneuver options open. Smaller burns mean your fuel reserves will last longer, too.

"It's all about timing." —Prime Lieutenant Thomas Rhoads

One of the hardest things to grasp is the relationship between where you ship is now, and where it will be a certain number of segments in the future. While you're learning, try the following exercises:

- Take out all the holocube minis and tilt blocks. Assign your ship a vector and facing, then perform a turn's worth of drift and facing changes: but put out a different holocube mini for every segment. Thus you'll have a mini for the ship on segment 1, and another mini for segment 2, and so on; the game includes enough tilt blocks to do 8 segments in this manner. This builds a graphic representation of how the ship will move over the course of a turn. After doing a couple of pivots this way, try thrusting; then try thrust-and-pivots. If you need more than 8 minis, try skipping the hexes where the ship's facing and altitude did not change.
- Using the above technique, set yourself a maneuver problem, and solve it. Try setting up a series of firing passes on a stationary target, then a moving target. Try using thrusts and pivots to circle around a stationary or moving target.
- During a game, make use of the end of turn markers to figure out where you and your opponent will be. Put out markers for an extra turn into the future. You can also use the method outlined above (using extra holocube minis) to plot out future locations of all ships—all current vectors are public information.
- To figure out where a target under thrust will be at the end of the turn, place a second end of turn marker a number of hexes away from the first, in the direction his nose is pointed in. This is generally "good enough" to predict his locale within 2-3 hexes, which is fine for weapons range.
- Do these exercises with a couple different ships—a gunboat, a frigate, and a cruiser—and you'll soon get a feel for how the ships move. Practice makes perfect.

Learn the game in stages. You don't eat dinner all in one gulp; you don't have to learn AV:T that way either. Start by learning to fly the ship, but note that flying in 3D isn't any harder than flying in 2D. Then add beam weapons, power systems, and damage. Take out a pair of *Haifengs* for a battle, because you've learned enough to use all of their major systems. Once you're comfortable with those, add coilguns and zone defence – a duel between a *Kuan Yin* and a *SV Shokoladki* works well for this (ignore the Shok's Katyushas for now). Once you are comfortable with coilguns and zone defence, add missiles.

Combat: Tactics and Techniques

Precision manoeuvre is not necessary for combat. Suppose you're flying a *Rafik* against a *Wasp*. Your best weapons range is 10 or less. The *Wasp's* best range is 6 or less. The most precision you need is to keep your ship closer than 11 hexes for a firing pass, while staying more than 7 hexes away. Don't overcalculate your maneuvers—the enemy won't cooperate with them.

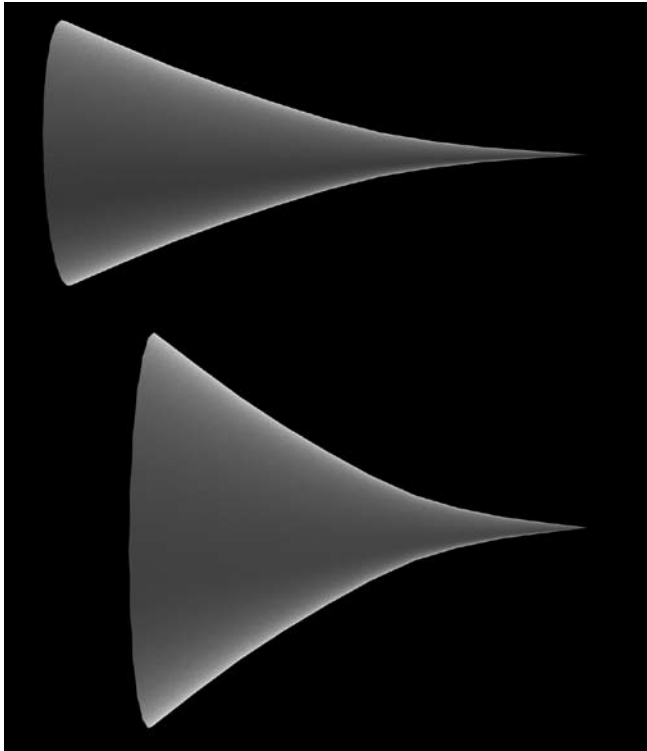
The Trumpet Bell

Try envisioning the potential future positions of each ship as the bell of a horn: the path straight down the center of the horn is the current vector, positions down the length of the horn represent time and distance traveled, and the sides and edges of the horn are the extent to which the ship could potentially change its vector given the constraints of its thrust and pivot rates. As the ship accelerates in a given direction, the horn gets longer and narrower. When the ship has a smaller vector, the horn is shorter and wider. The *Rafik's* superior pivot ability gives it a wider horn. The *Wasp's* superior thrusting gives it a longer horn. Thus the *Wasp's* potential position horn is more like a trombone, while the *Rafik's* potential position horn is more like a tuba's. Remember that these are potential positions: the ship might wind up anywhere within that volume. The *Wasp* wants to make sure that the trombone intersects with the part of the tuba that the *Rafik* actually occupies, while the *Rafik* is trying to ensure that the *Wasp* guesses wrong. If the *Wasp* has a large vector, it loses the ability to correct its guess, but the sheer speed of the crossing may prevent the *Rafik* from dodging into a new area. Both are making pretty solidly educated guesses as to where the other will be, by use

by James Sterrett, Ethan McKinney, James Brown and Ken Burnside

of future position markers, a feel for how quickly the enemy can pivot, and displacements under thrust.

An illustration of a *Wasp's* future position cone and a *Rafik's* is illustrated below:



Tactically, for the *Rafik*, the objective is to fill the volume of space where its cone intersects with the *Wasp's* with seeking weapon death, to dissuade the *Wasp* from closing to its kill range, while the *Rafik* uses its longer ranged and faster cycling weapons to attrit it down.

For those familiar with the Alliance/Union universe of C.J. Cherryh, the probability cone we're discussing is something like what she described with the terminology of "Longscan", and for much the same purpose - it's an estimation tool of where something is a threat.

Porpoising

If your ship pivots faster than the enemy's, use your maneuverability to your advantage. The classic example pits a *Wasp* against a *Rafik*. The *Rafik* begins the engagement at rest, but pivots down (assuming the *Wasp* is slightly higher) and begins to thrust. The *Wasp* must close the range, and therefore noses down and begins thrusting. The *Rafik* stops thrusting, pivots left or right, and begins thrusting again. The *Rafik* is trying to fly along a spiral, using its faster pivot to force the *Wasp* to be "out of phase" during the firing pass, with the *Rafik* not quite coming into the *Wasp's* threat envelope because the *Wasp* cannot keep up with the *Rafik's* oscillations. The *Wasp*, however, should be trying to predict the *Rafik's* future adjustment and aim for it. When using

seeking weapons, both the *Rafik* and the *Wasp* should be using their missiles and coilguns to constrain the others' ability to perform these maneuvers.

Seeking Weapons: Aiming Them

Two elements combine to create the Rate of Closure of a seeking weapon. The first is the Crossing Vector (CV), and the second is the Missile (or Muzzle) Velocity (MV) of the launching mechanism. A thorough examination of the Shot Geometry Table will show that until MVs get fairly large (32 or higher), the CV tends to dominate. This has several implications on maneuvering offensively in a seeking weapon environment.

The first implication is that your fuel (and your rate of thrust) is indirectly a weapon; thrusting towards the enemy increases the CV...which increases the RoC of your shells aimed at him, and his shells aimed at you. Much like in Driver's Ed, Speed Kills..

The second implication is that geometry matters. Firing low MV shells at a target that's moving away from you is wasting power and ammunition. A course offset of 3 usually means it's not worth firing at the target, unless you've got a massive MV capability on the weapon. At course offset of 2, 1 or 0, the CV component is a negative integer, which means you're making the shot entirely off of MV.

Geometry also matters in the Aim Adjustment process; sometimes Aim Adjustment of 1 window can take a target out of arc (or bring it into arc) of a coilgun launcher, but at the cost of 10% of your MV. An Aim Adjustment of 2 windows often times isn't worth the hassle.

Where geometry makes the game easier to play is that once you've got a firing solution worked up, until the geometry changes, most of the effects of your thrust or the target's thrust (unless directly towards or away from one another) tends to come out in the wash of rounding errors.

As MVs increase (32, from either a Burn 4 missile or a 4CG, is the beginning of this threshold), geometry matters less and less to the ship doing the firing; indeed, one of the ways the *Shokoladki* engages the *Kuan Yin* at its advantage is to thrust in directions where its MV advantage is maximized. Very high CVs (in the realm of 44 or higher) start to approach direct fire weapons in some ways - it's almost impossible for Aim Adjustment to happen, and it's worth firing even on Course Offsets of 2 or 1, where the modified CV is a negative integer.

Finally, when firing seeking weapons, don't forget the opportunities presented for time on target attacks, by either downfiring your CGs or under-burning your missiles.

Seeking Weapons: Firing Patterns

According to Jian Zhang (Captain) Er Feng Lai, XCCN, firing patterns come in four basic types: On Target, Maneuver Dissuasion, Maneuver Constraint, and Saturation. Each creates a different set of decisions for the target: how must

it evade to avoid the shells, and how many shells must it shoot down if it does not choose to evade?

On Target shots are centerlined on the shellstar: the target must thrust to evade. This is useful if you don't think the target will want to thrust. It's also useful if you are firing at point-blank range. If you are so close to the target that shells fired now will impact on the next segment, then the target probably doesn't have the time to evade, and will only get one segment of zone defence fire.

Manoeuvre Dissuasion patterns attempt to prevent the target from thrusting in a given direction. If you don't want that Rafik to open the range, fill the relevant direction with shells to make it choose between your laser fire and your shells. The more directions you want to prevent, however, the more shells you have to fire.

Manoeuvre Constraint patterns require more shells than Maneuver Dissuasion, because you're attempting to force the target to choose only one direction to thrust.

Saturation patterns require tremendous numbers of shells. You don't worry about where the target might thrust, because all the possible thrust options are filled with inbound shells. For example, the SV Shokoladki frigates can produce a reasonable degree of saturation with their 6 Katyusha launchers: fire 5 batteries into the 5 center shellstar zones, and fire the sixth in a spread pattern of one per zone. All 5 center zones will have 10 incoming shells, and the outermost zones have one apiece. Unfortunately, Katyusha launchers don't carry many salvos.... Saturation is also useful as a concept in the other patterns: to be effective in forcing maneuver, you need to put more shells into a shellstar zone than the target can reliably shoot down.

Try combining these effects. No firing pattern is effective without sufficient saturation. On Target patterns combine well with all the others, and in some cases is little different from Maneuver Constraint.

Seeking Weapons: Evasion

Evading a pattern isn't always as simple as it sounds. Pivot, thrust, accumulate dots of fuel expended ... and you've destroyed your firing pass, just as your opponent intended. When evading, pay attention to your orientation to the inbound weapons, and to your enemy. If you manoeuvre into a shellstar zone with fewer weapons inbound, but all your ZD weapons are out of arc, your evasion made your situation worse. Likewise, if your evasion puts you into the enemy's primary engagement envelope, and exposes your weaker armor, you're worse off. Sometimes it's better to be hit by a few coilgun shells than to suffer a full-power laser salvo.

You can evade up and down as well as left and right; the absence of this ability makes seeking weapons far more powerful in 2D than in 3D. (The game's seeking weapons are balanced for 3D play.)

The worst time to be fired at by seeking weapons is just after you've begun a multi-segment pivot, or just turned your engines off. Since you're locked into the pivot, or can't turn your engines on immediately, your maneuver options are constrained, and the firer will use this to build higher saturation. Many captains urge that you simply leave your engines on, and accept the risk of engine damage, to maintain continuous thrust and pivoting while dodging.

Core Shots vs. Shallow Shots vs. Propulsion Shots

Given the vital systems in the Core, why would you fire a shallow angle shot? Perhaps the adjacent region isn't as heavily armored, and your fire isn't powerful enough to reach the core anyway. Perhaps the adjacent region has more systems of the type you'd like to destroy. Many ships pack the nose with cargo and quarters, which are valuable in the long run but don't immediately cripple the enemy. The side regions often have batteries and heat sinks that will produce a more immediate effect. A "chin shot" may not hit the core, but if it slices through a bank of powered batteries, the target is going to have a bad day.

Of slightly more interest is targeting the propulsion system; because the mast and engine of the ship are large, open structures, there's a significant (50%) chance that any weapon you fire into them is going to do trivial damage (resulting in Null hits), and their hull depth is very low - making it easy to lose most of the damage of a high damage system (like an SRLS). On the flip side, this is the only way to reduce the thrust of a target, and is one of the best ways to preserve a ship for later capture. While a ship is under thrust, there is a one in ten chance that you'll cause an SI hit - if you don't have enough weapons to aggregate into an armor penetrating attack, playing "Fish for the SI hit" is sometimes worth a long range shot...though it's far from being a sure thing.

This "hamstring attack" is also useful when using seeking weapons (in particular, Frag shot), and the reason why many larger ships have armored masts and engines.

The Heat Clock

Reactors, Batteries, and Heat Sinks produce a subtle but powerful engagement clock. Each ship can only refill its batteries a certain number of times before the heat sinks are filled. A *Wasp* needs 14 segments to completely refill its 28 points of power. It has 2 reactors, and 13 heatsinks, so it can run its reactors for a total of 6 turns, and one of them for one more turn, before suffering from excess heat. It can produce 108 points of power (2 reactors×8 segments per turn×6.5 turns of power production) in addition to the 28 already in its batteries, so it is limited to firing its main laser suite 6 times even with perfect energy management. The *Rafik*, with 3 reactors, 15 heatsinks, and 11 batteries, has up to 142 points of power ((3 reactors×8 segments per turn * [15 heat sinks ÷ 3 reactors = 5 turns of power generation]) + 22 power already in the batteries) to use before suffer-

ing heat damage, and can fire its main laser suite up to 11 times. The heat clock is especially important for ships that rely on coilguns, such as the *Kuan Yin* and the *SV Shokoladki*, because they must fire large numbers of volleys to hit the enemy, producing longer engagements.

With the AV:T 1.5 ruleset, chemical batteries provide a way to “generate” power (actually, storing it from prior generation) without heat tracking. The 1.5 version of the Haifeng and York both use ChemBatts, which have the advantage of being low price and fairly easy to mount into ships - but have the drawback of taking a very long time to recharge.

Most ships with ChemBatts have either solar power arrays or civillian reactors to recharge them with; gunboats can have them recharged by their tender.

Damage-to-Power Ratios

The Wasp’s lasers do more than twice the damage of the Rafik’s, but at half the range. Damage-to-power ratios measure how much damage you get for every point of power you put into a weapon. For example, the average damage from the 2MRLS at a range of 0 to 9 hexes is $[(7 \times 5) + (4 \times 2) + 3] / 10 = 4.6$. It takes 2 points of power to fire the weapon. Therefore, the ratio is 4.6:2, or 2.3:1. For every point of power you put into the 2MRLS, when fired at a target at a range of 0 to 9 hexes, you’ll do about 2.3 points of damage. Let’s examine this for a couple of common weapons over a variety of ranges, with each weapon shown for its first four range bands.

Weapon	Power	Best Range		Second Band		Third Band		Fourth Band	
		Dmg	Ratio	Dmg	Ratio	Dmg	Ratio	Dmg	Ratio
3MRLS	3.0	6.6	2.2	4.1	1.4	2.5	0.8	1.8	0.9
4MRLS	4.0	9.1	2.3	5.0	1.3	3.2	0.8	1.8	0.5
3SRLS	4.5	14.1	3.1	9.0	2.0	3.6	0.8	1.8	0.4
4SRLS	6.0	20.0	3.3	12.5	2.1	5.4	0.9	3.0	0.5

Organizing the chart by range band, instead of by actual range, lets us compare the way that the weapon efficiency curves change. Unsurprisingly, the best damage to power ratios are at the closest range. Less clear without analysis, though, is the rapidity with which the lasers lose efficiency outside their optimal range.

What this chart obscures, however, is the size of the range bands. The MRLS efficiency drops slowly over range, while the SRLS efficiency plummets rapidly. Either way, however, if you have to decide between shooting now and waiting to get into a better range band, it is usually best to wait. The exception? If you expect the enemy to hurt you badly, you may want to either fire everything now, while you still can; or fire some weapons now, to empty a few batteries and avoid a chain-reaction battery explosion.

Unlike lasers, coilguns do not lose efficiency with range, nor does their efficiency change much with size. CG[1]s gain slight advantages in damage over CG[4]s, but CG[4]s present more of a problem for the target’s zone defence to shoot down or dodge. If all the shells hit the target, coilguns would be the most effective weapons in space. Un-

Weapon	Power	Dmg	Ratio
2CG[4]	1	12	12.0
2CG[1]	1	12	12.0
4CG[4]	4	48	12.0
4CG[1]	4	50	12.5
6CG[4]	6	76	12.6
6CG[1]	6	78	13.0

fortunately, most coilguns shells are shot down or dodged. If we assume that only a tenth of the shells fired ever hit a target, then the efficiency of coilguns drops to around 1.2 damage per point of power.

Combat Pivots

Especially in a close pass, don’t pivot to where your target is now: pivot to bring your weapons to bear on where the target will be when the pivot is complete. A beginner’s rule of thumb: pivots take time, so pivot one window further than you think you need to. You can pivot “faster” by pivoting farther: a 360° pivot gets the Rafik’s nose moved 180° in +1, while a 180° pivot moves the Rafik’s nose 180° in +2. This means your nose is going to keep moving beyond the intended window—but if you’re really slick, then that puts your nose into position for your next manoeuvre...

You can always choose to use a worse pivot mode than your ship’s maximum.

Fun with Pivots

A Wasp (or other cylindrical ship) wants to keep its nose pointed directly at an enemy ship. When the bearing is changing one window on one segment and another window on the next, the caterpillars don’t seem to allow you to do what you need to do. Doing a pair of one-window pivots looks like this:

- Segment 1 no change
- Segment 2 one window pivot
- Segment 3 no change
- Segment 4 one window pivot

Which leaves a gap between the two facing changes. If you use the two-window caterpillar, you get:

- Segment 1 no change

Segment 2 two window pivot

Segment 3 no change

This way the change is jumpy—you don't want both your facing changes in the same segment. How do you make a smooth pivot?

Use persistent spins to produce the effect you want (AV:T Core Rules C3.3). Most players think of persistent spins only when they want to rotate a lot, but they're far more useful than that.

Here's the trick:

Segment 1: Mark "Facing Change" and draw a one-window pivot; no facing change occurs in the movement phase

Segment 2: Pivot one window.

Segment 3: Mark "Facing Change" again and announce a persistent spin. You'll use the pivot rate from the pivot window that you're using for this segment's pivot, and you continue to move a number of windows equal to the number of small triangles on the outside of that window. Your ship keeps that pivot rate until you decide to cancel it. For our example, pivot one window.

More Segments: Continue with your persistent pivot until...

Segment 6: Mark "Facing Change" again and announce that you're cancelling the persistent pivot. You start from the wedge you entered when you announced the pivot, and continue it normally to the end.

Better still, the acceleration for any pivot window with an equal number of triangles is identical. That means you can shift up and down the pivot chart, from any window on your ship's pivot table to any other window, as long as both of them have the same number of triangles.

An interesting side effect of this type of persistent spin is when it's combined with thrust. Because the pivot never completes, that Thrust Break Condition never gets used. By noting which segments of thrust generate acceleration dots and correlating it with your rate of spin, you can do a "skating dervish" type of maneuver with a low rate of thrust - accumulating acceleration dots that partially cancel out, leaving you with a vector in the direction you intend to go in, while swinging your weapons around to bear on the target.

These techniques work for all ships; cylindrical ships tend to need it more because of their armor and weapons arrangement. Keep in mind the rule of thumb: if the target passed through your firing arc on the previous segment's motion, you can fire at it in this segment as if it were in arc.

Squadron Tactics

The most obvious squadron tactic is to keep the force close together, ideally in the same hex. Sometimes called the Empire State Building Formation, it is endemic in a lot of space combat games. Its advantages are mutual defensive support, and maximum firepower concentration for ships with same-

family beam weapons in the same range bands. The squadron stack suffers from weaknesses, especially with dissimilar ships. It cedes freedom of motion to its enemies, because it is tied to the worst pivot and thrust modes of the ships in the formation. It cannot cover a volume effectively. Finally, large stacks of ships are vulnerable to nuclear weapons (D4.124).

Breaking up a squadron stack is one of the primary uses of seeking weapons. Launch two Manoeuvre Constraint grade salvos with evasion directions directly apart, and you'll quickly force a squadron stack to separate, or accept a pounding. Further, since the evasion is measured in "how much did my vector change?" bringing the squadron back into formation becomes a tricky task indeed.

More advanced, and somewhat trickier to carry off, is the "wolf pack" formation. The objective is to have your ships close from different vectors at nearly the same time, optimally, by herding the enemy into the kill zone with seeking weapons. Ships operating on separated trajectories can flank their enemies, by forcing them to choose to present heavy armor and weapons towards only one of multiple threats. This works particularly well with seeking weapons. A single massive pattern of seeking weapons from one angle is easier to dodge than two half-size patterns approaching from several windows apart. Dodging one pattern puts you into the teeth of the other, while bringing zone defence to bear on both becomes tricky. Executing this kind of fire requires patience and spatial visualization abilities, and while it should be a strategic objective in planning your manoeuvres, it's best to be aware of the situations that make it possible, and take advantage of them, rather than try to contrive them into being.

Ships with radically different capabilities can complement each other well in another formation, the "wingman" formation. A *SV Shokoladki* and a *Kennet*, provide mutual support. The *Kennet's* long range lasers defend both ships from missiles, while the *Shokoladki's* steady rain of 200kg coilgun shells forces the target to dodge, spend energy on zone defence, or take significant damage. If the target dodges or runs out of battery power running zone defence, the *Kennet* can close for the kill.

These tactics, techniques, and training methods should help you get up to speed more quickly on the complexities of commanding your new ship. These are only guidelines. Every ship has strengths and weaknesses, and combinations of ships will yield synergistic effects when properly handled. A sluggish *Di Gleria* may have a giant seeking weapon target symbol painted on it, and a *York* may be a battery explosion waiting to happen—but combined, they make a significantly more powerful package, the *York's* defensive fires permitting the *Di Gleria* to concentrate on obliterating enemies with its laser suite.

May you be granted a willing foe, and ΔV .

Redoubtable Class Corvette de Dispositif Défensif

Name	No.	Builders	Laid Down	Commissioned
COURAGEOUS	DC 03	Creusot Orbital (Sol III)	13 Jul 2205	15 Jan 2206
LOYAL	DC 05	Creusot Orbital (Sol III)	14 Sep 2205	12 Mar 2206
STAUNCH	DC 06	Creusot Orbital (Sol III)	18 Dec 2205	09 Aug 2206
STALWART	DC 11	Creusot Orbital (Sol III)	03 May 2207	27 Oct 2207
TRUSTWORTHY	DC 12	Creusot Orbital (Sol III)	18 May 2207	02 Nov 2207
FEARLESS	DC 17	Creusot Orbital (Sol III)	18 Nov 2208	02 Jun 2209

Specifications

Mass, Fully Loaded : 2,491 metric tons

Total Length: 84.3 meters

Hull Length: 25.1 meters

Hull Diameter: 24.8 meters

Bell Diameter: 29.5 meters

Crew: 36 [4 officers, 32 ratings]

Propulsion:

ESA-18 Fusion Torch

[2.5g, 4.98 TW]

Tactical ÄV: 15.31 km/sec

Transit ÄV: 122.5 km/sec

Power Systems:

1 Brawley KR07 Gas Core Fission

Reactor [62.5 MW]

5 Voss-Kempff Heatsinks [170 GJ]

6 Zinkel-A2 Batteries [12 GJ]

150 m2 radiators [106.25 MW]

Armament:

2 Kearsar 3.02m Lasers (1600nm)

8 Geneva Triplet Missile

Launchers.

4 Pikewall Zone Defence Laser

Systems

1 Pod Docks

Maximum Armor Thickness:

350mm RHA

Sensors:

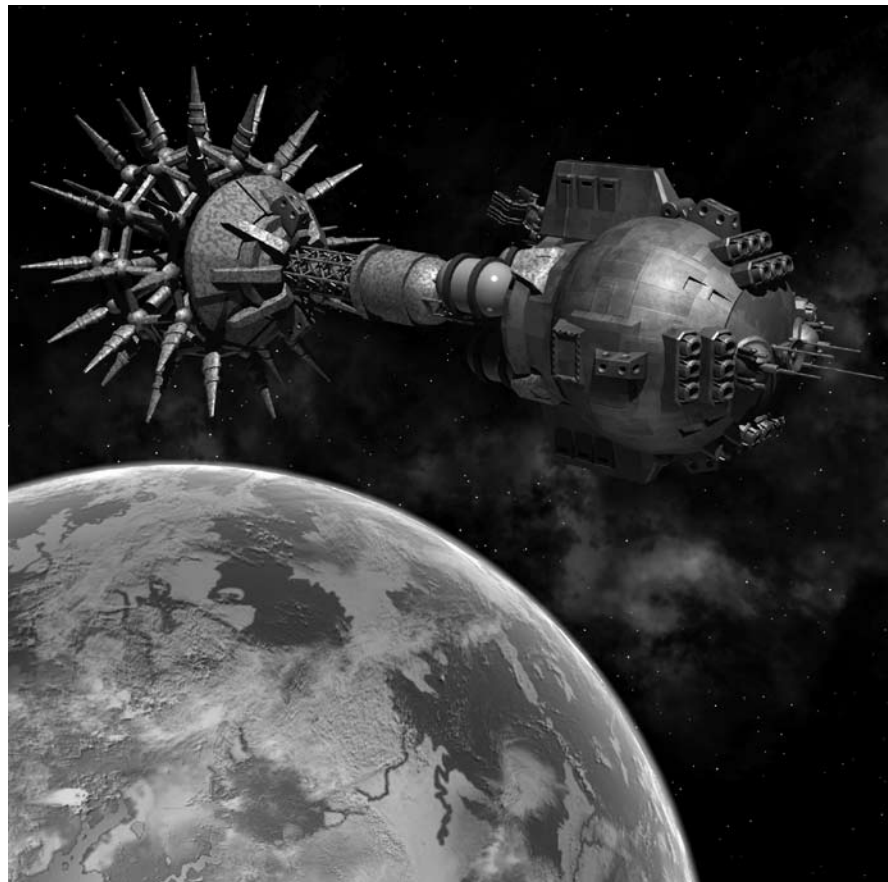
Maypo RLS-17 Radar

LCA-24E Lidar

and missile ships seemed the most efficient way to achieve this.

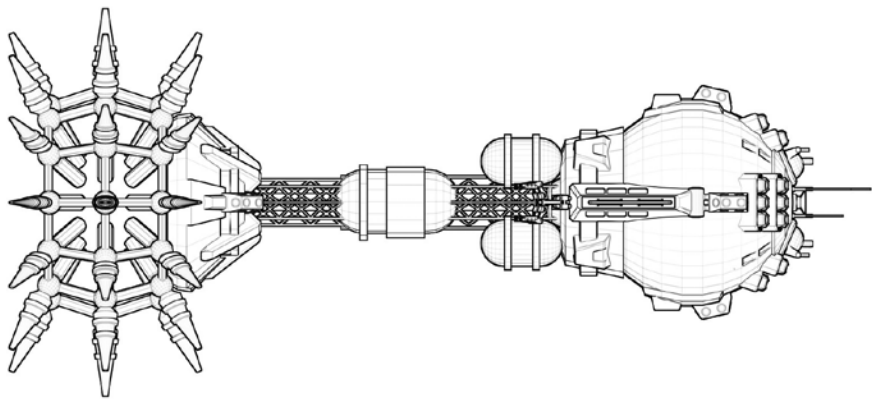
These ships were ordinarily used as support vessels in battle groups and as substitute Planetary Protection Corvettes when no battlefleet was needed. In battlegroups they would be deployed in teams to assassinate selected enemy warships, while in local patrolling actions they could still serve as poorly optimized quarantine ships to inspect and, if needed, destroy merchant ships that might threaten an inhabited world.

While the FN was long held up as an example of an almost limitless budget, the fact remains that priorities must be set. Some risks must be taken to allow greater application of resources where it can do the most good, and this type was a place where corners were cut. Corvettes were selected because the small size implied low costs, and the theoretical knowledge that it had the most usable surface area per size provided a fig leaf to hide behind. The ships were limited to no more than 2,500 tons due to the lack of hyperdrives and the need to be carried by naval auxiliaries when deployed



Development and Class Notes

In 2205 the FN Marine D'Étoile fielded the last of their missile corvettes. The *Redoubtables* were the heirs the earlier Desert class, inspired by the Caliphate's superiority in raw size of laser weapons. While the FN had arguably superior laser technology, the engineering to produce large lasers was something not yet solved. The FN needed a means of competing with increasingly large and powerful Caliphate ships with growing laser sizes,



out-system. While compared to the SSA's Tenders, the lack of naval torches and weaponry mean the comparison is superficial.

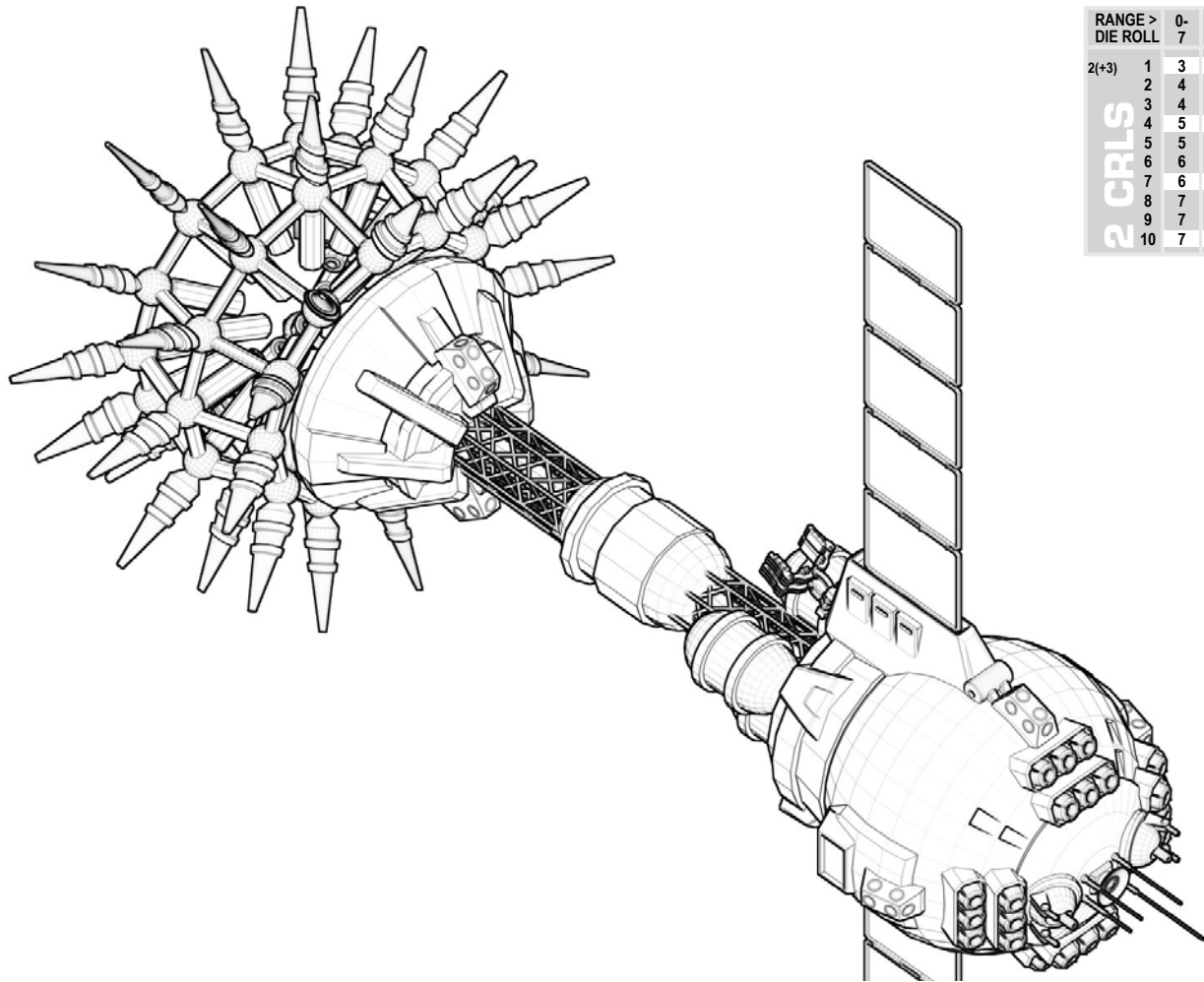
The intent was to use these ships in groups to allow overwhelming missile firepower to smash selected enemy vessels. The ships had adequate zone defense weaponry, but were considered woefully ineffective once the missiles were fired. From that

point on, until the racks were reloaded, they were considered a liability with only very limited uses. The ships were heavily optimized and sacrificed in order to allow maximum quantities of missiles and good command and control facilities to employ them. One such optimization was the sacrifice of endurance. The ships were always deployed with a pod attached, nicknamed the lunchpail, which was used to store expendables, missiles

and some habitability enhancements. With the lack of weaponry, the ships were given heavy frontal armor to provide protection when attacking, and a very powerful torch when it needed to leave the battle to others, or dodge incoming ballistic attacks.

The Rump FN had the *Courageous*, *Loyal*, *Staunch*, *Stalwart*, *Trustworthy* and *Fearless* in service as of the Loss. These ships spent decades in mothballs, probably due to a lack of missile supplies, until the new Olympian owners felt the need for more combat power in light of the rising tensions as the Saladin War approached.

The ships had standard FN design features such as interior space devoted to allow easy access to maintain the ship's vital components, a pair of CRLS lasers for defense against missile buses and advanced torch technology.



RANGE > DIE ROLL	0- 7	8- 9	10- 12	13- 15
2(+3)	1	3	D7	D5
	2	4	1	D7
	3	4	2	1
	4	5	2	1
	5	5	2	1
	6	6	3	2
	7	6	3	2
	8	7	3	2
	9	7	4	2
	10	7	4	3

S(HA) Mark 1 Mansur Class Heavy Attack Spacecraft

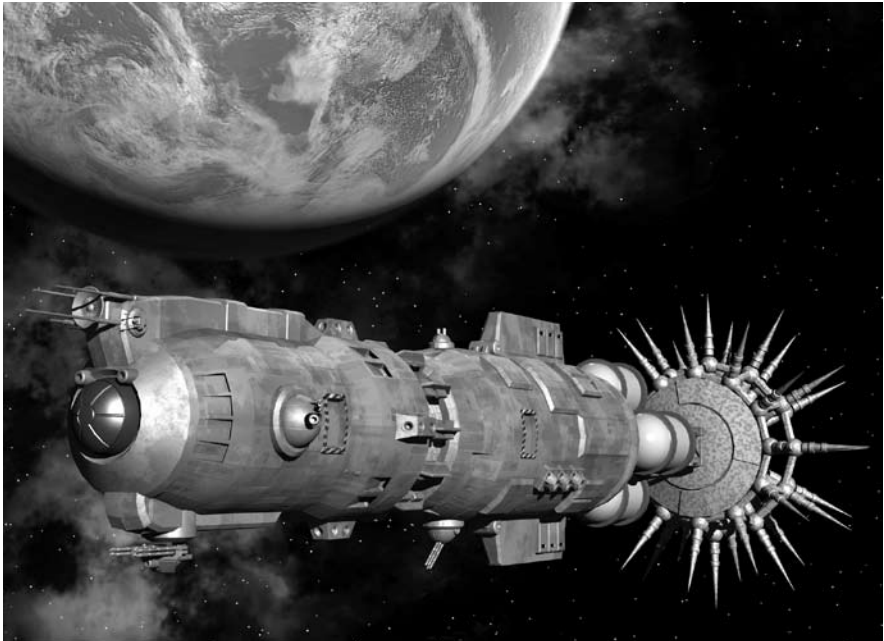
Name	No.	Builders	Laid Down	Commissioned
MANSUR	0001	Sa'ad Waqqas Yards (Sol III)	21 Apr 2190	17 Jan 2192
ALEXANDRIA	0002	Sa'ad Waqqas Yards (Sol III)	1 Oct 2191	12 May 2193

Specifications

Mass, Fully Loaded:
10,062 metric tons
Total Length: 193.4 meters
Hull Length: 42.4 meters
Hull Diameter: 20.3 meters
Bell Diameter: 31.1 meters
Crew: 11 [24 officers, 97 spacecrew]
Propulsion:
Salah-6 Hyperdrive [GDE]
Korun-12 Fusion Torch [1.5g]
Tactical DV: 20.78 km/sec
Transit DV: 166.25 km/sec
Power Systems:
2 Udai Reactors [500 MW]
20 Qalaat Heatsinks [680 GJ]
18 Khalda Batteries [36 GJ]
Armament:
2 Benab-12 6.02 meter Lasers (1200nm)
5 Benab-5 2.99 meter Lasers (800nm)
3 Gemlik-2-4 Coilguns
6 Jabal Raf Zone Defense Lasers
2 Brullus Tri-Missile Launchers
Maximum Armor Thickness:
420mm RHA
Sensors:
Gefara K50-C Radar
Alcantara D44F-2 Lidar

Development and Class Notes

The mobile doctrine reached its zenith with the introduction of the *Mansur* class. During the 2180s, the Caliphate had become concerned with increased FN militarization, especially the new *Bernadotte* heavy cruiser. Benab was approached to design a more powerful laser to penetrate the armor of the *Bernadotte*. Damietta design was selected to be the sole designer of the *Mansur*, in no small part due to the *Baiburs* class fighter. With three primary designers and two governmental bureaus involved in the design, the *Baiburs* suffered from countless revisions through the design period and into construction. Da-



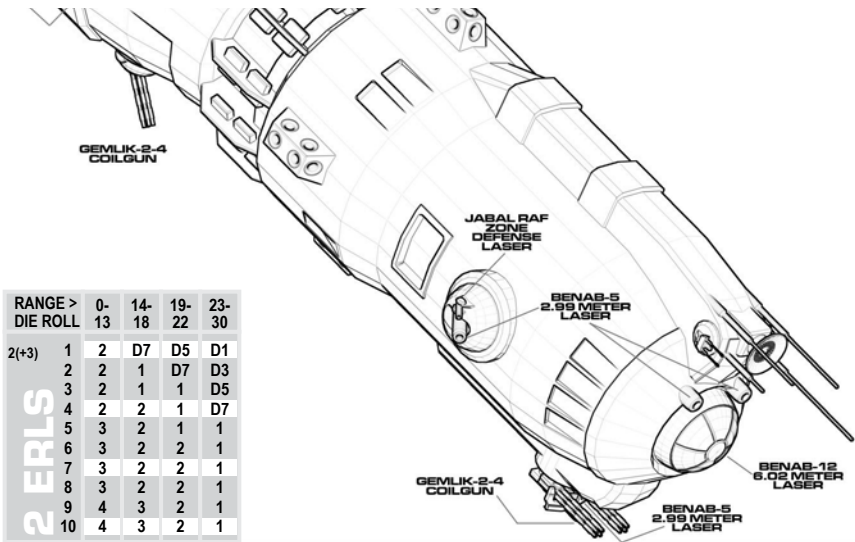
mietta had extensive experience on a number of previous Caliphate designs, and was confident they could produce an effective fighting craft based around the new weapon.

Damietta began working with Benab to create a basic cylindrical design incorporating the new Benab-12, a 1.03GJ 1200nm laser. They decided on a pair of the massive 6.02m lasers, mounted on either side of the keel. Over a period of two years, the basic design was revised twice to accommodate the addition of heat exchangers to reduce cycle time. As secondary armament, the *Mansur* incorporates the venerable Benab-5 800nm laser and the Gemlik 2-4 coilgun, the same coilgun unit employed on the *Baiburs* class. Two tri-missile launchers round out the offensive punch. Damietta heralded the design as a return to the heyday of aerial combat, the primary weapon bolted to the airframe and fixed forward. The final result was impressive.

As designed, the *Mansur* would engage the enemy at the farthest point

of maximum effectiveness while their opponent was still attempting to close the distance. After the initial salvo, the *Mansur* would close offset allowing either the nose or the heavily armored underside to resist return fire while continuing to close for a second shot. After disabling the primary weapons of the opponent, the *Mansur* could then finish them off on a close approach with a combination of ballistic weapons and the 800nm laser mounts. In a capital ship engagement the *Mansur* would attempt to hold open the range while continuing to fire with the primary weapons until the target was disabled.

The *Mansur* is widely criticized for its lack of dedicated zone defense. Six Jabal Raf laser systems provide protection across the port, starboard, and ventral arcs of the *Mansur*. The Benab-5 lasers can provide additional zone defense when operating in reduced power mode, but at the cost of a reduced offensive punch. Coverage of the other arcs is provided by rolling the ship to bring the zone defenses to bear. The *Mansur* is intended to oper-



RANGE > DIE ROLL	0- 13	14- 18	19- 22	23- 30
2(+3)	1	2	D7	D5
	2	2	1	D7
	3	2	1	D5
	4	2	2	1
	5	3	2	1
	6	3	2	2
	7	3	2	2
	8	3	2	2
	9	4	3	2
	10	4	3	2

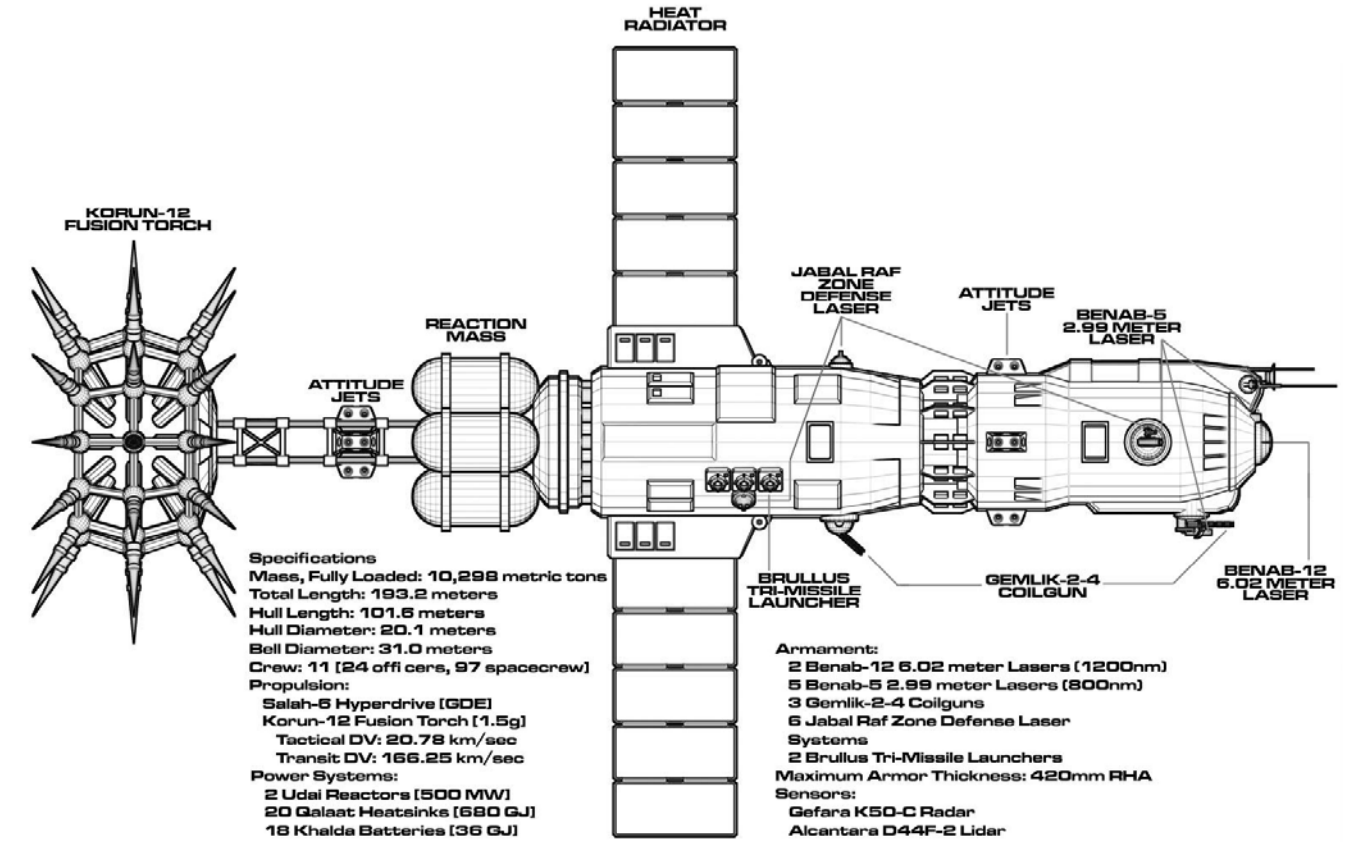
ate with the *Muavenet* class, a dedicated zone defense platform. Standard procedures required 1-2 escorts to cover the *Mansur's* weaker zones. In keeping with the tenets of the mobile doctrine, the *Mansur* carries enough supplies for an extended patrol or transit of nearly seven months.

The 2188 military budget included spending for three units of the *Man-sur* class. The lead unit entered service

in 2192 and entered service with the Home Wing. Initially, the *Mansur* did not meet expectations. Early difficulties with the Rumaylah Industries reactors and a shortage of battery power prevented the lead unit from firing a full salvo of lasers. The mis-sile armament was cut back, and additional batteries installed. Advanced materials were incorporated into a redesigned reactor to eliminate the feed issues, and the *Mansur* entered

service only six weeks behind sched-
ule. Budget cuts in 2195 prevented
the third unit in the class from being
constructed, and held up construc-
tion of the second unit for an addi-
tional year. Both units remained in
service until the Loss, *Mansur* serving
with First Flight, Crescent Wing after
construction of the *Alexandria* was
completed and *Alexandria* replacing
the *Mansur* in the Home Wing. *Alex-
andria* was lost in 2214 along with all
contact from Earth.

Medina has suffered a number of
problems keeping the *Mansur* in ser-
vice. The advanced alloys used in re-
actor construction are no longer avail-
able, and with no sibling ships, the
reactor design is unique. Medina had
three spares in storage at the time of
the loss, and all three had been used
as replacements by 2240. *Mansur* was
refit in 2215, 2232 and 2244. During
the last years of her service life, *Man-
sur* operated on only one reactor with
no spare capability. *Mansur* was de-
commissioned in 2250.



MANSUR Mk 1—Medinan Star Force

Dueling Cost: 3463 Econ Cost: 4128 Boxes: 294

Crew: 25 Officers, 98 Enlisted, 7 Extra

Cruise Duration: 26 Strategic Turns (62 Weeks)

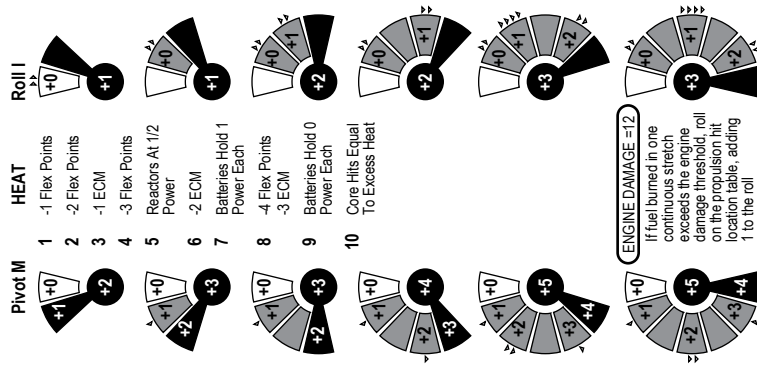
Nose Hull Depth: 74 Surface: 32

Aft Hull Depth: 74 Surface: 32

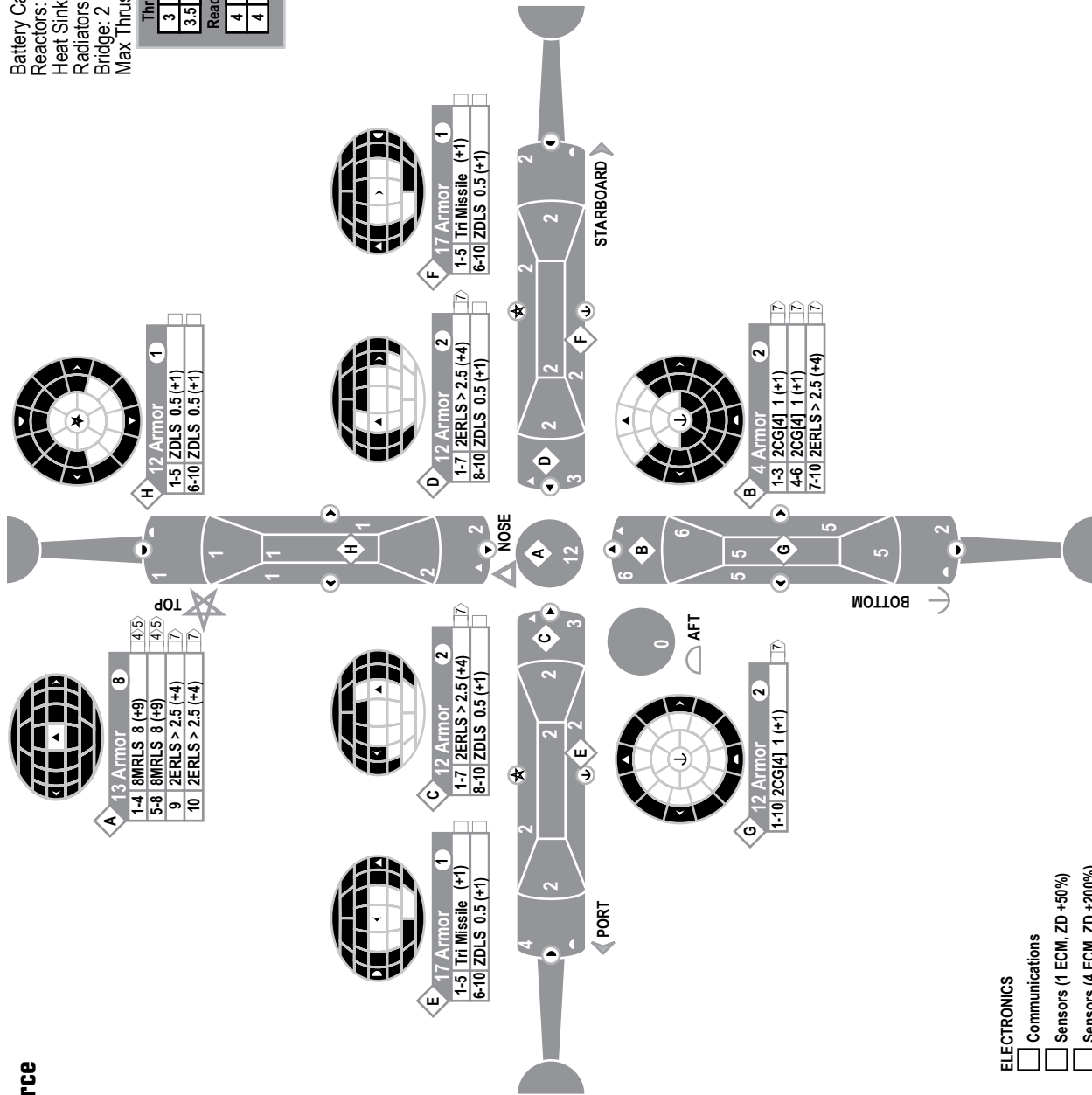
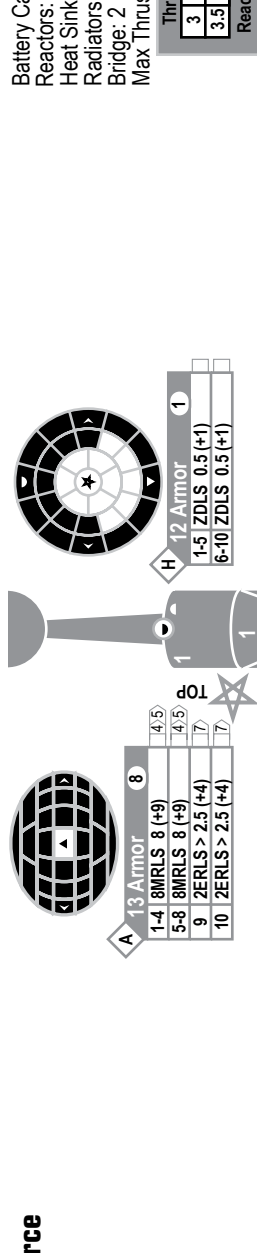
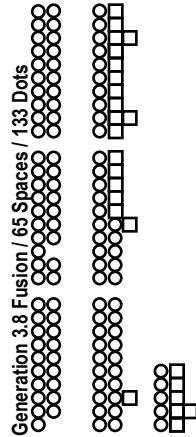
Lateral Hull Depth: 15 Surface: 23

HyperDrive Access Costs:

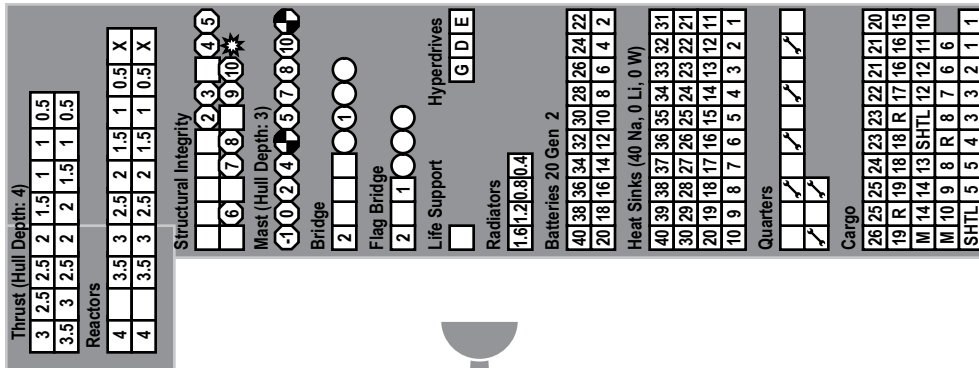
Gamma: 16 Delta: 24.1 Epsilon: 32.1



- ELECTRONICS**
- ☐ Communications
 - ☐ Sensors (1 ECM, ZD +50%)
 - ☐ Sensors (4 ECM, ZD +200%)
 - ☐ Sensors (9 ECM, no ZD)



Battery Capacity: 40
Reactors: +8 Power/Segment
Heat Sink Capacity: 40 Heat Points
Radiators: 1.6 Heat Points Per Turn
Bridge: 2 Flex Points
Max Thrust: 3



Burn fuel from left to right, the gaps between groups are visual spaces every 10 units. Fuel is damaged in columns. When the fuel units change shape, move down one row on the thrust matrix

A Hero's Journey

Historical Background: This is a hypothetical scenario. The engagement in CD-44° 11909 in 2269 involved the *Ataturk*-class Attack Spacecraft *Thabet ibn Qurra*. The Medinan Intelligence Academy hypothesized how the engagement might have progressed had the *Mansur* not been withdrawn from service before the war.

Map alignment: A/D

Red: Medinan Star Force

1 x *Mansur* [*Mansur*]

1 x *Rafik Mk. 1* [*Maharik*]

Deployment: The Medinans deploy within 10 hexes of each other along map edge B/C. The expendables budget is 500 points for munitions and fuel. Nuclear weapons are not allowed in this scenario. The Medinans have been cruising for 5 strategic turns (10 fuel dots) and require 2 turns (4 fuel dots) to return to the nearest supply dump.

Green: Olympian Defense Forces Space Arm

1 x *Wasp* [*Hornet*]

2 x *Olympus* [*Poseidon*, *Achilles*]

Deployment: The Olympians deploy within 10 hexes of each other along map edge E/F. They must begin with identical vectors. Expendables budget is 300 points, but only 50 points may be used to buy fuel. Fuel should be allocated as follows: 20 points to *Hor-*

net, 20 points to *Achilles*, 10 points to *Poseidon*. The Olympians have been cruising for 4 strategic turns (8 fuel dots) and require 1 turn (2 fuel dots) to return home.

Victory Conditions: Score points normally. If the Medinans manage to destroy all the Olympian ships, it is a strategic victory for Medina and they receive double victory points. If the Medinans are forced to withdraw and at least one Olympian ship has Delta hyperdrive, 20 fuel dots and 6 strategic turns of supply, it is a strategic victory for Olympia. If the *Mansur* is destroyed, the Olympians receive double victory points.

Hyperdrive Disengagement: Both forces require Delta to return to a friendly system.

Alternate Setup: To play the historical engagement, keep the *Rafik* and replace the *Mansur* with an *Ataturk* (*Qurra*) and 2 *Musharrif* Interceptors (*Raudhatain* and *Bampur*). Add 100 points to the Medinan expendables budget. In the historical engagement, *Hornet* had suffered a computer failure that rendered her zone defense network inoperative. Treat as a maintenance casualty – *Hornet* may attempt to repair the ZD system normally at the turn break during the damage control step.

Their Finest Hour

Historical Background: During the Saladin War, *Redoubtable* corvettes were used to guard the Olympian installation at Epsilon Indi. Though Xing Cheng entered the system a number of times, they never went up against the *Redoubtables* in-system. It was widely thought that the sheer amount of ballistic firepower that the *Redoubtables* could bring to bear would deter potential adversaries from "casual" attacks.

A favorite scenario of naval wargamers has been to envision the *Redoubtable*'s performance had Xing Cheng engaged them during their battles at Epsilon Indi.

Map Alignment: A/D

Red: Xing Cheng

1x *Daixhing* [*Fuxheng*]

4x *LP-13*

Deployment: The Xing Cheng forces deploy anywhere along map edge B/C. They have an expendables budget of 275 points. The *Fuxheng* has been cruising for 4 strategic turns (8 fuel dots) and requires 1 strategic turn (2 fuel dots) to return to their primary base.

Green: Olympian Defense Forces Space Arm

1x *Redoubtable* [*Courageous*]

1x *Redoubtable* [*Loyal*]

Deployment: Deploy one *Redoubtable* along map edge E/F. Deploy the second unit within 15 hexes of

the first. The Olympian forces have a budget of 500 points.

Victory Conditions: Score points normally. XC's goal is to raid commerce deep in Olympian territory by passing through Epsilon Indi. To accomplish this task, the *Daixhing* must have at least 28 fuel dots left at the end of the engagement. (12 dots for the *Daixhing*, and 16 dots to refuel the *LP-13s* at least twice) If the *Daixhing* has less than this amount remaining, their victory points are halved. If they disengage off map edge E/F with at least 50 fuel dots, then the Xing Cheng player's victory points are doubled. If the Xing Cheng units disengage off any map edge other than E/F, their victory points are halved. The Xing Cheng player loses automatically if the *Daixhing* is destroyed.

Hyperdrive Disengagement: The Xing Cheng forces need Epsilon to return home. The Olympian *Redoubtables* have no hyperdrives, and are already home.

Special Rules: The *Redoubtable* uses Pacifican-manufactured missiles that the ODFSA has stockpiled. Had they seen action in the Saladin War, the *Redoubtables* would have quickly exhausted their munitions without resupply from Pacifica. These stockpiled missiles were mass-produced (1/2 normal cost) but became increasingly unreliable while in storage. In this scenario, the reliability number of the missiles is -6 instead of the usual -8.