

## Short Story

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*A work of fiction, meant for adults. Read something else if you are not an adult, or are offended by stories with sexual content. Then again, if all you're looking for is in-out, in-out, in-out, you should probably read something else. I welcome constructive comments. Enjoy.*

I shook my head trying to clear it as I walked over to Joe's office. I plopped down in his guest chair, dumped my glasses on his desk, and rubbed my face. I shook my head again. Good news -- nothing rattled.

"You figured out their problem?" he asked me.

I was still trying to reset my brain. "*Ja*, sort of. Hell of a deal for a Monday, Joe... That character doesn't speak German, he speaks an *old* dialect of German." I'd just gotten off the phone, about a two hour call with one of our premier suppliers.

"But you can straighten them out?"

I straightened my head up and grabbed my glasses. My vision was fuzzy without them, and was still fuzzy after I put them on, I'd rubbed my face and eyes so much. "It's going to take some doing, but I think I understand what's going on."

"Good. Do it."

I smiled. "Joe, I wouldn't be so quick on that. You might want a *little* more info."

He sat back, his chair creaking. "They're a critical supplier, you know that. Nobody better on the planet, for what I know. We need 'em, and we need that part."

I nodded. We're a small company doing bleeding-edge optical instruments. We get critical parts from a supplier outside of Huntsville, Alabama. Everything we'd gotten from them for years had been top notch, or better. But this last request threw them. Joe tried talking to them on the phone. The guy we usually talk to is just an order taker. Joe finally got to talk to one of the designers, but quickly punted the call to me because as Joe said, the guy had a very thick German accent, and I speak German.

"They want me to visit for a few days," I told Joe.

He smiled and waved bye-bye.

## Short Story - With Dwarves

“And I’m crating up Prototype number one and some other gear from my bench and taking it with me...”

That got him to sit up in his chair.

“Then there’s the beer...” I added. Now I had his attention...

He sighed and rested his head in his hands for a moment. “Okay, tell me a little more -- but just a little. You can start with why Germans in Alabama...”

I chuckled. “Oh, that’s the easy part -- Redstone Arsenal.”

He gave me another puzzled look.

“At the end of World War II, the U.S. Government ‘invited’ a number of German scientists and engineers over to continue their work -- we moved ‘em and their gear from Peenemunde to the Redstone Arsenal near Huntsville -- Von Braun and his colleagues, the V-2. I’d guess we’re dealing with remnants of that.”

“You said something about beer?”

I nodded. “*Ja*. They want me to come out and talk to them. *Und bringen Sie bitte Bier mit* -- please bring beer.”

The look he gave me told me I’d spent his credulity budget for the day.

“Why?” he asked, and I could see it pained him to do it.

“Thirsty, I guess. Oh, the technical part was easy to figure out, after a bit. They’ve been doing optical components for us for quite a while, right?”

He nodded, still puzzled.

I leaned forward. I was going to break his credulity budget for the month at least. “But if you think about it, everything we’ve had them do has been straightforward geometric optics. The diffraction gratings are the most extreme.”

“Yeah, so?”

I smiled. “Joe, everything they do is so damn clean -- I’ve heard you say it I don’t know how many times. This time we want ‘em to do nonlinear optics -- we want those nasty nonlinear properties they’re so good at eliminating!”

He sat back in his chair again, even more puzzled.

## Short Story - With Dwarves

“Joe, they don’t know nonlinear optics! When I was first talking to that guy, you’d have thought I was asking him to ship us parts packed with rusty bolts and goat pee or something -- what we wanted is anathema to them. We talked for a while longer, and Joe, these guys are wizards at geometric optics, and they produce the cleanest gratings around, but I’m convinced there’s an awful lot they don’t know.” I wasn’t going to tell poor Joe now just how much I thought they didn’t know, that would be hard on his heart.

“Okay, when are you leaving?”

“I need Tim to check out air freight options, get Phil building a transportation crate, and I need to go to the Tied House. Probably leave tomorrow late.”

“Tied House?” he asked.

“For the beer, Joe, the beer -- they want me to bring beer.”

He leaned back covering his eyes and shook his head. Then he waved bye-bye again.

I didn’t leave until Wednesday morning. Our custom wooden crate, the bottom layer containing a four by four array of carefully insulated five gallon kegs of Weissbier, Mai Bock, and Oktoberfest, the top layer containing a fortune in bleeding-edge electro-optical gear, had been picked up by the freight company Tuesday afternoon. I’d meet it Wednesday afternoon at the Huntsville airport. I had a rental van at the airport. The optics house was providing me with lodging. We were probably breaking all sorts of laws shipping beer like that, but Joe and I didn’t care, as long as we got our parts.

The flight from San Jose to Dallas was easy. The flight from Dallas to Huntsville was a little shakier. I had plenty of time to reflect on my predicament.

I mentioned we’re an optical house. We’re small, doing precision instruments. Our big deal is taking another company’s optical spectrum analyzer and rebuilding it, replacing most of the optical elements with stuff we get from our friends outside Huntsville. We raise the performance of the instrument by a factor of eight, and the price by a factor of three. After we delivered the first few, the manufacturer cut us a deal -- we’re now an option on their price sheet. We make a little less on each instrument, the customer pays a little less, but we don’t have the hassles of financing, taking orders, and all that crap. It’s a good deal all around.

We were designing our own instrument -- a radical departure, and one which would outperform everything else on the market by a factor of a thousand. If we could get one little part to work better. If we could get our friends in Huntsville to make one little part. As it was, we had a design with a 80 times improvement, but we knew we could do oh so much better. It all depended on an optical component about the size of the tip of your thumb.

Which had me driving a rented van from the freight office at the airport, out past the tech area with companies like Raytheon, Toko, and TDK to the hills *way* outside town, wincing at every bump, worried about my optics, and the beer. But what the hell, what could I do that the

freight company and the air carrier couldn't? My shock sensors on the outside of the crate had been intact.

I'd worried about arriving late -- it would be at least five, possibly six in the evening before I got to the site. Not a problem, I was told, they worked late. Fine by me.

Our business contact was a character named Jürgen, but we called him Jay. When I drove up to the business, a smallish place on the side of a hill, he had me back the van up to a roll-up door. I was leery of leaving the van unlocked, but he told me it would be perfectly safe. I guess so -- the crate did weigh a few hundred pounds, and we were in the middle of nowhere.

We went into his office to talk for a bit. I was a little surprised -- Jay must have been in his fifties. He seemed to be an okay business guy, but it became very clear that he knew very little about optics. His office had a fax machine, some file cabinets, and an old Dell computer. From the business they were in, you'd expect at least some prototype or typical optical assemblies to be on display. Nope.

Well, almost none. He said he needed to check on the unloading of the van, and stepped out of the office. I took a look at a framed letter on one wall. It was typewritten, and signed by none other than Doc Flash, Harold E. Edgerton, dated October of 1951, thanking them for the superb optics. Didn't he take pictures of Ivy Mike? These folks had been in business longer than I thought!

When I sat down again, I noticed a little multifaceted crystal suspended from a silver thread or chain. It was hanging from a little holder, a curved metal rod in a block of wood. The crystal facets caught the last of the setting sun as the crystal swayed back and forth, creating an interesting display of colors. I guess I brain-farted for a while, watching the thing move.

"Herr Doktor Miller," a voice said from someplace far away.

I blinked and slowly turned to see Jay standing in the doorway to the hall. Wow, I had faded out -- it was dark out. "Please call me Paul," I told him.

He nodded formally. "Klaus will see you now. This way, please."

I stood up, a little wobbly. Wow, I was more wiped out from the flights than I thought. I followed Jay down a hallway to a flight of steps going down.

He stepped to the side. "Down the stairs to the first door on your right, Herr Doctor," he said, bowing a little and indicating the way formally with an open hand.

I gave him a curt nod and headed down the stairs.

The passageway was dimly lit, but there was the door. A little on the short side. I'd expected a damp, cellar-like smell, but the air was crisp, clean, and not too dry. I opened the door.

I entered in spite of what my eyes told me. Klaus was sitting in an old wooden chair, sitting behind an old wooden table, with another old chair in front of it for me. The table had an assortment of optical gadgets on it. The room was smallish, ten by fifteen or so, and the lighting was dim, cool, but crisp.

The only problem was Klaus. Klaus is a dwarf. No, not a growth-challenged-person, but a D-W-A-R-F. Think “Lord of the Rings.” Think “Gringott’s Bank.” Pointy ears with tufts of hair, wiry eyebrows, long pointed nose, long very dexterous very thin fingers, large intense eyes. He wore a standard white lab coat. He also wore a lopsided grin that covered half of his face. Somehow I knew Jim Henson’s people were nowhere to be found.

I guess he was wondering whether I was going to shit, sit, or scream. So was I.

I amazed myself. I held out my hand. “*Guten Abend, Herr Klaus,*” I said.

He stood, the chair making some noise as it moved across the wood floor. He was about four and a half feet tall. He extended a hand and shook mine. His grip was firm, cool, and leathery. “Herr Doktor Miller, we thank you for this distance traveling. *Bitte.*” He sat, and so did I.

I recognized his voice; I’d spent a few hours on the phone with him on Monday. Funny, the face didn’t fit the voice...

I was still wondering why I hadn’t run screaming out of the room when we started talking random pleasantries. He asked about my flight, or more accurately how my flying had been. Something told me he didn’t get out very often.

When I told him it had been as the best flights are, boring, he laughed out loud. His teeth were numerous, small, and on the yellow side. His tongue was long and pointed. When he laughed, his mouth opened *very* wide, and his eyes seemed to glow.

Our conversation moved to more business matters. He talked about the relationship between our companies. They had done business with us for a short while, about a decade, and we had been a good customer. We both understood the nature of privacy, which was very important to them. I nodded; I certainly understood their reasons for privacy and anonymity better now. Our latest request had puzzled them; they knew there had been many advances in the field, and had been looking for the right partner to work with them and advance their understanding.

With that short speech he turned things over to me. Very weird. My hands and legs weren’t shaking. Why? I’d had more stressful meetings at trade shows. I thanked him for his confidence in us, letting him know that the components they provided us had always been of the highest quality. As we had discussed on the phone, I would try my best to help them.

## Short Story - With Dwarves

He nodded, his smile extending to both sides of his face -- thin lips and a *very* broad smile. He asked if I would like to see more of the company and speak with his colleagues. Yes, if that would be convenient.

He stood, and I followed. His white lab coat came to about six inches from the floor. He was wearing Nike's.

I looked around, expecting to see a looking glass behind me, but we went out the same door and a little further down the hall. With another wry smile, he opened the door and bid me to enter.

It was a large space, clearly underground. The light came from somewhere, I'm not sure where or how. It was that same cool, crisp light, on the dim side. As we went down a set of wooden stairs I looked around the room. My crate was in one corner, still closed. Intricate looking machines abounded, separated from each other by partitions. I looked at a group of machines, and looked again, trying not to gawk.

Klaus chuckled and led me closer to the ones I'd first spotted. Four machines were working away, each covered by a glass dome, the four covered by another dome. Each machine, intricately fashioned parts of glistening metal, was mounted on a large piece of granite about a meter on a side, its dome sitting in a groove in the granite.

I looked through the twin bubbles at one of the machines. It was a ruling engine, and a masterpiece, producing a diffraction grating, ruling lines microns apart on a substrate. Every part of the machine was engraved or decorated, yet still looked so functional, with no wasted effort or space.

The four blocks of granite holding the ruling engines were floating in the air inside the larger bubble. I couldn't tell what was powering the machines.

We looked at machines and workstations. I guess you can't really say the workstations were "manned;" they were being operated by dwarves wearing blue coats. Glancing around I saw some yellow coats.

The equipment they had was so amazing! I couldn't tell what the metal was, but everything had such a high degree of finish on it, managing to look delicate yet quite functional at the same time.

It clicked as we walked to an optical bench set up on a slab of granite five or so feet on a side and a foot thick, floating about two feet off the ground. I was seeing the height of nineteenth century craftsmanship! And everything was consistent with my earlier diagnosis -- none of the equipment you'd see in a modern optical shop or lab. Oh, some things haven't changed -- the mounts you use on an optical bench for holding components, micrometers and similar measuring tools. But no lasers -- no electro-optical components or instruments.

## Short Story - With Dwarves

With the exception of the ruling engines, the shop layout funneled work from blue-coated workers (dwarves, and already I could tell differences between them -- shapes of noses and ears, frizziness of eyebrows and hair) to the stations of the yellow-coated dwarves. Quality control? There wasn't a speck of dust to be seen in the place. How do you do that, run some of these benches next to grinding and polishing stations?

But as we went to another station, part of me was still wondering -- I'll bet they don't do customer tours every day... As we headed to a door on the other side of the hall from where we entered, I didn't imagine I'd see the usual OSHA posters and minimum-wage signs posted. I had a better idea why they weren't located in the Jetplex Industrial Park by the airport.

He asked me if I was ready to meet with the others. Yes, I was, if it wasn't too late for them. He gave me another one of those lopsided grins and told me they had just started working before I arrived.

Dim light, night work -- made sense. Don't think they get out much during the day. Some part of me knew my weird-meter had been left pegged and smoking on the floor. But so far, it felt like a tour of a Nikon plant -- except for the dwarves, the tools they were using, the dwarves using them, and how the hell did they get those benches to float in the air like that?

I asked if there was a lab area we could use for setting up the equipment I'd brought. I also mention I needed AC power to run things.

That amused Klaus. Yes, my equipment would be moved to a lab shortly, but first I should meet his associates.

Through another door; I had to stoop a bit. A little maze of twisty passages, all alike? Or was it a twisty maze of little passages, all different?

No, a straight corridor heading to a another room, where I heard sounds of people -- no, dwarves -- talking. It sounded like typical shop-talk, ignoring the fact it was in that weird dialect of German. It wasn't the Swiss-German I'd experienced working at CERN in Geneva -- it had an old, Northern feel to it.

Conversation stopped when we entered. They did me quite the honor. Klaus introduced me as "Herr Doktor Miller," and as I was introduced to each of the three white-coated dwarves, they told me their true names. I can't and won't write them. Instead, I'll use their familiar names, Willy, Guenter, and Steffen. I told them in my best (I hoped) German that I was honored to meet them, and I hoped they would understand my difficulty with the language. They all chuckled, and we agreed to proceed on the basis of familiar names and mixed English and German.

I'd guessed Klaus the senior among the group, but Guenter raised an eyebrow at him and asked if I'd been offered refreshment. Klaus looked to the side in response.



Willy muttered something in German that I didn't quite catch, but clearly sounded vulgar. He stepped to a cabinet mounted in the wall and opened it. He picked up a clear glass stein and filled it with a pale brew from a tap in the wall. He turned and handed it to me formally.

I thanked him as I accepted it. The stein was made of gorgeous double-walled optical-quality glass. I waited until all the others had similar steins. Guenter made the toast, we had a sip, and sat down at the old wooden table.

Small talk we made for a bit again. They were quite interested in my flying. How long had it taken, how fast was the flying? Even though all my scientific work is in metric units, I had to think about it. Figure about 500 miles per hour, which is around 805 kilometers per hour. They nodded at that, and laughed when I told them the best flights are the boring ones.

The brew we were drinking was good, but I thought they might be interested in what I'd brought. I mentioned the crate had equipment in the top, and beer in the bottom. Where could we set things up? Guenter asked what I needed, and I told him I needed electrical power to run some of the equipment, a chalkboard or similar for discussions. He nodded and made a dismissive gesture at Klaus, who gave him a nasty look, downed the rest of his beer (about half a liter) in one gulp, wiped his maw on his sleeve, and left the room.

We started talking optics. They were interested in what we did with their components. I was a little surprised they didn't know -- we didn't tell them what the components were for, but our company has a good Web presence. Hmmm -- these guys don't get out much -- a repeating theme here... I asked for *Stift und Papier* -- pen and paper, as my backpack with my laptop must still be in Jay's office. I expected I'm not sure what -- quill and parchment -- but was quickly handed a standard green engineering pad and a mechanical pencil.

I sketched out a simple double-pass monochromator used in modern optical spectrum analyzers. They supplied us with the curved mirrors, lenses, and most important, the diffraction grating we used in our upgrade. Think of it as a tunable bandpass filter -- the angle between the incident beam and the grating determining the frequency of interest. They caught on quick -- spotting issues such as *Intensitätsverluste durch Polarisation* -- polarization dependent loss, and the requirements for uniformity in the grating.

About that time Klaus returned. Someone asked if I needed a refill -- *Ja, bitte!* I changed tactics a bit, suggesting one of them to explain the monochromator to Klaus. Willy did, using slightly different terms, pointing out aspects important to performance, such as rotating the grating very accurately and smoothly. The tone of voice he used also let me know that Klaus was low dwarf on the totem-pole. Wait, dwarves don't have totem poles...

Okay, they got that, so they understand classical optics. How about calculations? I put dimensions on the major components, and asked how they would improve the resolution.

Steffen looked at things, wrinkling his brow, his eyebrows almost touching. Guenter looked at the drawing and played with the tip of his nose. They talked -- couldn't improve the



line spacing on the grating much, so increase the grating size, along with the size of the other optics, increase the resolution of the thing rotating the grating.

I nodded, smiling, and took another sip of beer. The steins were double-walled, small Dewar flasks, and kept the beer cold. *Ja, gut*, I told them -- but what if you want to improve the resolution by a factor of 200?

Willy made a rude noise, his lips fluttering obscenely. Steffen's eyes crossed momentarily. Guenter frowned for a moment, then gave me a half-smile, tore the used page off the tablet, pushed it back to me, and basically told me to show them.

Time for the second part of my probing. I wrote on the top of the pad

$$\cos(a) \cos(b) =$$

and pushed it back to the middle of the table. I got grumbles and looks that told me they were familiar with trigonometry, but didn't use it day to day. Not surprising. As Guenter was about to send Klaus running, I took back the pad and completed it:

$$\cos(a) \cos(b) = 1/2 \cos(a+b) + 1/2 \cos(a-b)$$

They gave me the "so what?" look (and at least one fart). Okay, I'd suspected they didn't know this area. The classical grating-based analyzer would be familiar to Newton, or at least understandable.

I sketched out a heterodyne optical spectrum analyzer, using a tunable light source and a mixer. As I talked about the mixer, the part we were having problems with, I observed much furrowing of brows. If the performance of the mixer is good, I told them, the overall performance is limited by the detector and the tunable light source.

Willy's frown broke into a grin and he muttered, "*Schlechtes Glas*" -- use poor glass! I nodded and raised my stein. Multiple conversations broke out at once; it made sense now -- they needed to make "bad" optics! No, I corrected them, only "bad" in a particular way. I started going more into that, but Guenter shook his head. Conversations stopped. He tapped a long finger with neatly trimmed but yellowed nail on my diagram, on the box I'd labeled the light source. "*Wie funktioniert das hier?*" How does this work? I smiled and raised my stein again -- yup, that's the problem. We're ready for the big leap.

I completed my beer and asked if the equipment was ready -- it was time for show and tell. Guenter gave Klaus a demeaning and nasty side-glance with a raised eyebrow. Klaus looked him defiantly in the eye, farted noisily, swigged down the last of his beer, then stood up. He nodded his head down the hall, and walked out the door, not looking back. Willy laughed, and I almost did as well -- I've treated Joe the same way.

We moved down the hall to another room. My crate had been opened and unpacked, and my backpack moved. The beer was gone. Surprise -- a modern whiteboard on one wall, with markers in the usual colours. My "modern" optical bench, a flat metal plate about a half inch thick and a meter on a side with a grid of pre-tapped holes for mounting things, and most of my equipment, was sitting on one of their optical benches -- a piece of granite about two feet thick and about five feet on a side, polished smoother than glass. I looked under it. Nothing. I stood

up and sighed, giving Guenter a cross look -- the damn thing was floating two feet or so off the floor, and I couldn't see for the life of me how they could get it through the hallway or the door. Guenter gave me a half smile and a chuckle.

I gave their "bench" a nudge with my hip. It didn't move. The room had a wooden floor, and this thing was floating in the air! I glanced at Guenter, who gave me another look of polite amusement. I kicked the thing. Nothing. Guenter suggested, "*Treten Sie noch einmal dagegen, fester!*" Okay, I kicked it as hard as I could. Didn't budge. "*Fester! Fester!*" encouraged Willy over the top of his stein, grinning from ear to ear. This time I frowned and shook my head, looking over the tops of my glasses. They chuckled. Okay, my turn for magic...

A standard-looking extension cord was on the floor. I plugged in the outlet strip I'd packed. The extension cord cable snaked out the other door to the room. I didn't want to know what it was hooked to. The idiot light on my outlet strip lit up. So far, so good. I set the optical spectrum analyzer, the tunable laser source, and my laptop on the bench and plugged them in. The analyzer and source needed time to warm up.

Interesting reactions from the gang -- they'd been looking at my optical setup. The analyzer and light source received interest, especially as the analyzer started going through its self-calibration, making whirring noises. But my laptop -- all of them, especially Guenter, frowned. "*Computer sind überall,*" -- computers are everywhere, I told them. That only brought more looks of disgust and the shaking of heads.

They brightened up, though, when I took the optical guts of another monochromator-based analyzer out of its protective bubble wrap. They huddled around as I pointed out different aspects of the construction. They were intrigued with the positioner that moves the output fiber around, and the motor that moves the grating. I explained the use of materials with matching thermal coefficients. A leathery finger pointed at an electrical connector on the side of the assembly. "*Für den Computer,*" I told them. More grumbling.

I shook my head. The analyzer gave another soft *whir* and beeped. I explained to my hosts how the computer built into the analyzer calibrated the instrument when it was turned on, correcting for variations in temperature, humidity, and air pressure, and made it possible to make measurements rapidly and with extreme precision. I reminded them that it had traveled across the country in an airplane and in the back of a van, and was now ready to make precise, repeatable measurements.

That seemed to put a dent in their attitude. As I cabled things together, I showed them the light source and gas cell on the bench. I explained that the source produced a wide spectrum, and the gas in the cell adsorbed specific wavelengths. I hooked it up to the analyzer and we looked at the spectrum.

I guessed from the looks on their faces I was on the edges of their technology -- I deliberately didn't go into the why of the adsorption, let alone what an edge-emitting LED was.

This was a demo I'd given many times. As I talked, I cabled my computer to the interface box on the bench, and connected that to the detector and tunable light source. I reminded them that the analyzer used moving parts, and was dependent on the accuracy of the grating and the accuracy of its positioning for overall performance.

I picked one adsorption pit on the display and went to full resolution. On impulse, I flipped through a setup menu and changed the screen displays to German. "*Computer sind gut!*" I told them. They smiled and chuckled.

I moved the input fiber to my prototype. I started up the control program on my laptop. After a few seconds, it brought up a display quite similar to the one we'd seen.

The looks I got were "so what" again. "*Keine beweglichen Teile,*" I reminded them, pointing to the setup -- no moving parts. Well, ignoring the innards of the tunable source...

I clicked the mouse and jumped it to the same resolution as the other instrument. They looked back and forth. So what? Big deal. "Now, fifty times better resolution," I told them, and clicked again. I brought up the computed ideal waveform for comparison. I told them this resolution would require a grating about 35 meters long. Much nodding now, stroking chins and noses.

"And you can make it even better," I told them.

We spent about an hour going over the prototype. Ignoring the tunable source, it's pretty damn simple -- a coupler, a mixer, a pair of detectors, splitters and some stuff for minimizing polarization dependent loss, and a bunch of software to glue it together and make the pig fly.

Steffen took off, returning with a yellow-coated colleague. He took one of the sample mixer crystals I'd brought back with me, and told the guy (dwarf) what he wanted. The guy listened, incredulous at first, and went off mumbling to himself -- *Scheißglas!*

They wanted to know what an "ideal" mixer crystal would be. I sketched things on the whiteboard and we talked for quite a while, getting more into system operation. I stuck to pre-quantum explanations, also avoiding transfer functions and modern math.

And the more we did, the more furrowed Gunter's brow became, and Steffen's.

I don't know who announced it, but Klaus smiled -- a smile that occupied an enormous amount of his face as he repeated the announcement, "*Abendessen!*"

With a nod from Guenter, we left the lab and went back to the other room -- dinner time! I snuck a glance at my watch -- 22:15, but that was Left Coast time -- it was 1:15 in the morning here! My stomach grumbled; I hadn't had anything to eat since lunch. Was I tired? I was still running on what I called trade-show adrenalin. Walking down the hall, I could smell food. My mouth started watering and my stomach grumbled again.

I stumbled a bit about five feet from the door -- I heard female voices coming from inside the room! Part of me remained surprisingly calm, while other parts wondered about the source of those voices...

Why I didn't fall over in shock I don't know. Inside the room, setting out plates and platters were three very normal looking women -- I mean human, mid to late twenties, nicely built. They weren't thin, but they weren't fat either -- "comfortable" or "saftig" came to mind. They were dressed as you'd expect waitresses to be dressed if you walked into a Bavarian beer hall -- dresses, comfortable shoes, aprons.

And they seemed completely comfortable with my hosts, and with me walking in the door. With nods and smiles we were acknowledged. Guenter led the way, sitting at one end of the table, and offering to his right said, "*Setzen Sie sich bitte hierher, Herr Doktor,*" to me. "*Oh, danke,*" I replied as I sat down.

We sat down to good hearty food -- Sauerbraten, potato pancakes, cabbage, gravy -- and steins of my beer, the Weissbier, which was declared *Lecker!* by my hosts. Funny, Weissbier was new to them. Klaus told me they'd heard of such way off to the South in Bavaria; they were more used to the *Herbes Pils* styles from Czechia. They liked it. Watching how quickly they liked it, I might have to give Joe a call for refills...

We also talked technical as the ladies served. I exchanged glances with the ladies -- the one with the long chestnut-brown hair had a very nice smile. Holy shit -- were they flirting with me? It sure looked like they were flirting with my hosts! A giggle as a dwarf hand stroked a passing thigh -- a mild complaint at a pinch of the blonde's bottom, and then a soft laugh as the raven-haired one pressed Willy's head between her bountiful breasts, smiling as she did so... I exchanged more looks with the long-haired one (confused looks at that -- was she giving me the smoldering eye? Did I see her nostrils flare?) as she passed by. She managed to press into me as she refilled my stein at one point -- comfortable, very comfortable.

But then dinner was over, and we made our way back to the lab. Willy and Guenther wanted the demo repeated. We went through it again, with many pointed questions. A yellow-coated chap (dwarf, sorry) brought in a crystal. Willy and Guenther looked at it, examining it in the strange light filling the room, a silvery light, cool and somewhat dim yet making details so clear. I looked around to see if I could figure out where the hell it was coming from.

But my search was interrupted -- could they mount the new crystal? *Ja, bitte* -- please.

They weren't impressed with my mount, but put the new crystal into it anyway.

I ran a quick sweep with the new crystal. Wow -- far better performance! How much better? I guessed at ten times, then told them I'd do a test run to find out -- that would take about half an hour. With approval, I started it going.

Guenther was most curious about things. During a quiet moment, he leaned over the tunable source, a tufted ear about an inch away. He looked up and gave me a very interesting look. Then he moved over to the wideband light source which fed the gas calibration cell.

In my brief tour of their facility, I'd seen benches with gas discharge tubes, and what looked to be arc sources, so they were familiar with light sources and atomic spectra. My wideband source had been running continuously for about two hours. Guenther placed his right hand about an inch from the top of the wideband source. He frowned and slowly lowered his hand until it touched the case. He evidently expected it to be quite warm, as one of the sources he was familiar with definitely would be. But this thing was cool, just a little over room temperature. His face twisted into the most curious expression.

He seemed a little more at ease when he touched the tunable light source and found it to be fairly warm. But then his brows almost touched, and he exclaimed, "*Es bewegt sich!*" It moved! I nodded, smiling. Yes, that one had moving parts, unfortunately. It was also the most expensive component in the whole setup.

I stepped back and pulled up a stool, sitting on it and leaning against the wall while the dwarves huddled. Fingers pointed back and forth at equipment and questions flew about.

After a bit, Willy smiled and asked me, "*Dürfen wir diese Instrumente untersuchen?*" Could they study these instruments?

I smiled. I thought we were on the same wavelength -- I suspected that "study" meant disassemble-into-component-parts; that's what I did with something I didn't understand.

I stood with a sigh and approached the bench. I told them they could "study" the tunable source and the wideband source, but not my computer, or the completed spectrum analyzer. I told them the monochromator we'd examined before was the same as used in the analyzer; they could do what they wanted with that.

Nodding and thoughtful looks; I expected they'd be able to reassemble things. The tunable source had some tricky aspects; I'd show them how to run it manually once the calibration pass completed.

But something else popped up. Steffen interpreted the look on my face and led me down the hallway to the restroom. He pointed me to the last stall on the end. As I passed by the others, they contained toilets set close to the floor, like you'd see at a little kids school. The last one had a "standard" sized can. I closed the door, dropped my pants, and sat.

As I was finishing up, reviewing what had happened, a small voice inside my head was telling me that this whole thing was more than a little weird. Yet I was getting along better with these guys (dwarves) than I had with the Anritsu people when I visited them in Japan.

The sinks and the mirror on the wall were set lower than I was used to. Not many visitors my size, I guess. But what about the waitresses, the gals who served us dinner?

Steffen was waiting for me in the hall. We walked back to the lab.

The test run had completed. Very nice! I showed them how much better it was doing with the newer crystal, and pointed out where we still had issues. Willy interrupted, insisting that so many things in the system were nonlinear. *Ja, aber der Computer gleicht die Nichtlinearitäten aus*-- the computer compensates for all that, I told them. I looked at the whiteboard, thinking about diving into transform and filter theory. Not tonight, not this morning. I was tired. Oh, I showed them how to run the tunable source in manual mode. They did what you'd expect -- pointing the output fiber at a spot on the wall while having the thing sweep, looking at different colours.

Guenther must have recognized that I was tired. He told me I should go relax and rest. They would "study" my equipment, and we would continue tomorrow.

I shook hands with each of them, thanking them for their hospitality. That brought out chuckles and wry smiles.

Guenther motioned to Steffen, asking him if everything was ready. *Ja, ja*, Steffen replied, then gave me a grin. He motioned for me to follow him.

We walked back through the big shop area; it only had a few dwarves in it. Back up the stairs, down that hallway to the other set of stairs.

"I will leave you here. Up the stairs to the office and you will be taken care of very well," he told me, that leer still on his face.

"*Guten Morgen*," I told him, and trudged up the stairs.

I was met at the top of the stairs by the woman with the long chestnut-brown hair. She held a crystal in front of me, sparkling in the light. She did something, moving it. The sparkles caught me and pulled me in, deeper and deeper. The rest of the world faded -- I was hers, body and soul.

She led me to a small room. I think my suitcase was there. She hung the crystal on its chain around her neck. We undressed and got into bed.

Even without my glasses, I was lost in the crystal, then I was lost in her. I could hear her voice, far away. We made passionate love, ending with her on top of me, the crystal swinging between her delicious breasts. After we made love she held me, rocked me, and sang me to sleep in her arms.

I woke some time during the night. I needed to pee. She was still there, and showed me to the attached bathroom. When I finished, she took her turn. I sat on the edge of the bed waiting for her. But when I started asking her what ... she held up the crystal and I fell into it again, and fell into her arms. I needed her so much, needed to feel her skin against mine, needed

to feel myself thrusting into her, kissing her, squeezing her, smelling her, hearing her moan. And afterwards she held me again. I went back to sleep to the sweet music of her beating heart.

When I woke up, I was alone. I grabbed my glasses from the bedside table. I checked and reset my watch -- it was about four in the afternoon East Coast time. I showered and shaved. I thought about checking in with Joe, but what the hell would I tell him?

I stumbled out of the room and down the hallway. Jay was in his office. He looked up at me and sort of frowned. What was going on? He pointed me to the kitchen at the other end of the hall. It was deserted, but well stocked. I fixed myself two sandwiches and poured a glass of Pepsi. I wolfed the first sandwich down, then took my time with the second one. Have to wait until sundown, I guess. Wonder how my tunable source is doing? Replacing it would cost us about sixty thousand dollars... I finished the second sandwich and my Pepsi. Might as well clean up the place. I dampened a paper towel and started to wipe off one of the counters.

"I'll take care of that..." a feminine voice said.

I turned to find the source -- the blonde gal from dinner last night. She was smiling. She raised her right hand. I saw the crystal, and fell into it. I fell into her.

"... Later..." she whispered as she led me back to the bedroom.

She spoke to me as I took off my clothes. I couldn't take my eyes off the crystal, or her. I was so hungry for her. I undressed her, feeling her, tasting her, covering her body with my hands and my lips. We rolled on the bed together, reveling in skin against skin. I held her, squeezed her, devouring one of her nipples, breathing in her scent.

As I moved from one nipple to the other the gleam of the crystal caught me once more.

I was on my back; she was riding me, the crystal bouncing between her breasts. She cried out again and I came, filling her. She leaned forward, holding me, filling me with a sweaty nipple.

We showered together and dried each other off. She pushed me back on to the bed again and crawled atop me, the crystal dangling down, swinging, catching the light, catching me. Her voice and her softness enveloped me; her weight on top of me pressed me deeper into the crystal.

She was gone when I woke. I got up, put on my glasses, and got dressed. I headed to the office once again. There were no windows in my little room. Looking out the office window, past Jay sitting at his desk, it was dark once again. I had to smile -- quite a diversion.

Jay turned, a sad look on his face. "I will take you," he said in a flat tone.

He led me to the stairs once more, indicating with a hand.



I went down, down the corridor and through the other door. As I stepped onto the stairs, descending into the large work area, one of the dwarves in a yellow coat approached the bottom of the stairs.

“*Guten Tag, Herr Doktor,*” he said with a crisp bow.

“*Guten Tag,*” I replied. A thought crossed my mind -- was I cutting into Jay’s nookie?

My yellow-coated friend led me to the lab on the other side. The whole white-coat crew was there. One section of the whiteboard had a very nicely drawn mechanical diagram of the important bits of the tunable light source. Another section of the whiteboard had a mechanical diagram of the heart of the wideband source.

Guenter gave me another wry smile. “*Haben Sie gut geschlafen?*” he asked.

“*Ja, danke,*” I replied, matching his wry grin with one of my own. I slept better than I had in a long time, and woke a whole lot better too.

Willy said, “There is much here we do not understand.”

I nodded. “Quantum Mechanics -- the new physics,” I told them.

I started in with the wideband source. Basically, it’s an edge-emitting diode, with a bunch of stuff around it to stabilize temperature and optical output. I ran it with the covers off. I could tell they had a hard time with the idea of Peletier cooling -- pump electrons into a semiconductor stack, one side gets hotter and one side colder. But that’s what it does -- they touched both sides of the transfer plate, one cold, one hot. Similar problems with the light emitting diode. Obviously, you put electrons in and get photons out -- but not through mechanisms they were familiar with.

Ah, now we were at a dicey point -- did they know light was sometimes a wave and sometimes a particle?

“*Häretisch,*” someone muttered.

No, only heresy if it doesn’t work, I told them. Guenter liked that answer -- a practical fellow, ah, dwarf.

But Willy boggled at “*einfarbiges Licht, das zusammen hängt,*” the best I could do for coherent and monochromatic when describing the tunable laser source. He threw up his hands and started shaking his head, muttering. Guenter called a caucus and took his crew out to the hall.

I leaned against the stool again. Do they know Maxwell’s equations? Do I need to do electromagnetic theory before I dive into quantum, or just the part I need for lasers and nonlinear properties of materials? How much math? I shook my head and started muttering as well -- two

years of physics and a few years of math. I'd taught the stuff as a grad student and postdoc, but that had been a while ago. Okay, different approach -- what do they need to do the job?

The crew walked back in, three of them. Steffen wasn't with them.

Willy asked, Would I teach them this new physics?

*"Wir entschädigen Sie dafür,"* Guenter added -- we will repay you.

*"Ja, Ich unterrichte Sie,"* I told them. Why not. Let's go for it.

Big smiles all around. A nod from Guenter, and Klaus took off.

I decided to dive in with the two remaining. I gave them an overview of the quantum nature of light, going from energy levels in atoms to photons. They listened closely.

We were interrupted after a while by Klaus and Steffen returning. Both gave Guenter the all-okay.

At Guenter's request, we went back to the dining room. We sat and beer was served. Dinner would be out shortly, I was told.

They were curious about this new physics. I gave them the historical overview, starting with the photoelectric effect in the early 1900s, then the advance of the perihelion of Mercury, and the bending of starlight by gravity -- physics working at the very small and very large.

I get passionate when talking about the history of physics -- it's exciting to me. As dinner was served, I talked about my days as a student, learning, teaching at the University, then moving on to work at our little company.

The ladies were here again, but they were more subdued tonight. I exchanged smiles with all three of them, but they seemed detached somehow.

Dinner wound down, we kept talking. Then with a nod from Guenter, we got up. We stopped by the restroom, and I took my damn time. I almost laughed, listening to my hosts cuss at each other. I'd never heard such *Kneipendeutsch* before. You can judge the vulgarity of a spoken German phrase by how much it sprays -- and if done well, they spray from the back of the throat. I wonder who cleans the mirrors?

I expected we'd go back to the lab where my equipment was set up, but we went through the large area and back to the little room where I'd first met Klaus -- was that only yesterday? There were some short stools and a high-backed wooden chair in the room, and the table had been moved off to one end a bit; it looked more like a woodworker's bench now, with wood clamps at one end. Sitting on the other end of the table was a weird framework holding flat and curved mirrors and beam-splitters.

## Short Story - With Dwarves

But it was easier for me to see where the light was coming from. Two pipes, each about ten inches in diameter, extended down from the ceiling, ending about five feet off the floor. One illuminated the far end of the bench and the large wooden clamps. The other was a foot or so in front of the chair. Both cast circles of cool, crisp, silvery light. I put my hands into the shaft of light near the chair, almost trying to feel it. From the way it looked, it should feel silvery, silky, and crisp; smooth yet sharp like the feel of a tart lemon pudding.

Another hand moved into the shaft of light, a dwarfish hand. The hand turned, exposing a multifaceted crystal to the silvery light.

The world fell away as I was sucked into the crystal. I barely felt myself being moved to the chair -- my eyes never left the crystal. A wave of dizziness washed over me as the crystal spun. Something pressed against my forehead, pressing me to the back of the chair. That didn't matter; only the intricate flashing of the crystal mattered.

Something else passed between my eyes and the crystal -- my glasses had been removed, and something else appeared in their place. I could still focus on the facets, the light, the colours.

From far away, Guenter's voice said, "Now you will share with us this new Physics."

I saw his eyes, their eyes, all the dwarves, through and reflected in the crystal. Share with them?

The light through the crystal flickered and moved, pulling me in.

I didn't share -- they pulled it out of me. I would have cried out -- I would have screamed, but I couldn't move, I couldn't even blink. They were pulling it out of me, through my eyes, through the front of my head, through my face, through my breath. All the math, the physics, the optics I'd studied, all that and more pulled out of me, pulling me through the memories as they pulled it out of me. The pleasure I felt as a little kid, finding a pattern in the last digit of perfect squares -- 1,4,9,6,5,6,9,4,1, 0... The feeling in the pit of my stomach as I turned in my take-home midterm in Quantum Mechanics, along with the request to drop the class, I felt I'd done so poorly... The elation to find that with a score of 36 out of 100 points, I'd gotten the highest grade in the class... Teaching my first classes... Meeting Kimberly, making love with her, the depression when she left the day before I defended my Ph.D. thesis...

The emotional pain was nothing compared to the physical pain, worse than the worst sinus infection I'd ever had, worse than the worst headache, and things kept going faster and faster, and it hurt more and more. I wanted to scream, but I couldn't; was I even breathing?

It stopped. Something covered the crystal. My eyes closed. My head fell forward on to my chest as I panted. Hands held my shoulders, holding me upright in the chair, or I would have fallen to the floor.

My hands shook as I regained the ability to move. My other senses returned -- I heard wooden stools being moved along the wooden floor, then heard and smelled someone retching.

More motion, more voices, the door opening and closing. Hands helped me stand up.

I managed to open my eyes. Guenter and Willy were on either side of me, smiling slightly.

“Now we will repay you,” Guenter said.

I turned my head a little, recognizing motion to my left. Steffen handed something to Guenter.

He held up another crystal, and before I could scream or look away, I was caught. This one was different -- I felt my muscles melting into the shimmering light. Hands moved me on to the table, sliding me on my back, the crystal always in front of my eyes. Clamps gripped the sides of my head and held my shoulders down. Something went across my forehead, and the shimmering light from the crystal melted me further into the table. I hoped my eyes would close, but they didn't.

The light got brighter, that silvery light now fully illuminating my head and face, making the colours of the crystal even more intense.

The crystal moved to the left side a little. Guenter moved into the right edge of the light. He held a strange lens in one hand, and brought it closer to me, over my right eye.

Pain seared through my right eye and out through the back of my skull. Once again, I couldn't move, blink, or cry out. The lens moved and the pain moved, searing my eye, my brain, getting brighter as it moved.

As quickly as it started it stopped. But after two heartbeats of surprise, the crystal moved to the right, and the lens moved over my left eye. The pain hit me, but somehow it wasn't as bad -- I was past the point of caring, present only as an observer as the silvery light seared through my eye and my brain, increasing in brightness, increasing in pain, but I knew, I prayed, that it would cease.

The light flared in brightness in both my eyes -- must I endure more? But then the light dimmed, the crystal moved out of my vision, I'd made it, I'd lived... Leathery hands turned me on to my stomach; I still couldn't move. My shirt was pulled up and my pants pulled down. Pain seared through my body, along my spine and out through my limbs, burning and searing from the crown of my head to the tip of my coccyx, spreading through every part of me, and I mean *every* part.

Just as my vision started to fade into darkness, it stopped. Leathery hands turned me once more to my back. I could breathe again.

## Short Story - With Dwarves

I blinked and moved. My eyes hurt. My head hurt. I opened my eyes to see Guenter above me, smiling, looking very tired. He held a piece of cloth between his hands, lowering it over my eyes.

Just before the cloth blocked my eyes, as I looked at him, he did something, and so did I. I knew that he was *pushing*, pushing his German into me. As he did, I looked at him, into him, and *pulled*. I caught my breath as something hit me -- but it wasn't a physical impact. Something cool now covered my eyes. I felt hands tie the cloth behind my head.

Leathery, wiry hands helped me to sitting on the table.

"Drink," Willy said.

Something pressed against my lips. I sipped a liquid, sweet and thin, like an after-dinner drink. I hadn't realized how dry my throat was.

Other hands touched me. Human hands, soft hands. I almost broke into tears.

Those soft hands led me up the stairs and down the hall. They helped me undress.

I was feeling dizzy as those soft hands leaned me back into the bed. I was joined by a warm, soft body. I clutched her, and she held me. She rocked me and held me. That helped.

Did I sleep? Were they dreams? Were they more than dreams? Just as they'd pulled things out of me, I'd pulled things out of Guenter. It had only been a flash, so brief, but it expanded in my mind, in my dreams. He had to be six, seven hundred years old, maybe older. I grew up with him. Shared his fear as he and his kind were chased through forests. The joy of craftsmanship, working metal -- the hands I saw were my hands, dwarf hands, but they were unwrinkled, so young. The danger and excitement of working with humans, being paid in metals -- and in other ways.

One dream, I was cold -- a cold draft on my back, cold wind and rain. I relived memories of being hurried into large wooden crates, we were going on a trip, and would be safe when we arrived. Who was that putting us in? It looked like a young Jay -- and a middle-aged, human Klaus? They put us into crates, sealing us in darkness, jostling us along. Then more noise, and falling? No, flying! Then it go so cold, oh so cold! Fingers and toes so stiff, huddling together to stay warm, getting hard to breathe...

I woke up thrashing on the bed, the top half of my body exposed to cool air, my eyes still covered.

Someone held me, comforted me. I held her, letting her cover us as I snuggled in.

That must have been the flight from Germany. Somehow, I knew four of us died on that trip.

I needed to go to the bathroom. She helped me, then helped me back to bed. As we snuggled together again, my mind was still racing. She held me, but after a short while her hands started to wander over my body. She inflamed me, and I responded. As my body responded, the images filled my mind -- images of holding a certain crystal, images of my dwarf body filling a human female, hearing her cry out in a mixture of fear and pleasure. Images, recent images, of my long dwarf-tongue bringing cries of ecstasy from a willing human partner.

She pulled me on top. A part of me realized how different my weight must feel on top of her. We kissed as we made love. Her hands on my lower back urged me on past the point of no return. Afterwards she tried to move away, but I held her to me, holding her head to my chest.

When I woke, I pulled her to me again. After a bit I could hear a soft whimper, almost a cry. I held her closer, rocking her gently in my arms. I must have dozed off again, as I awoke to her hands working their magic on my body once again. I pulled her on top of me and sucked joyously on her as she rode us to bliss.

“Can I take this off?” I asked her some time later.

She pulled me to a nipple as her reply.

But later I felt her hand, which had been holding the back of my head, maintaining that delicious contact, slipping the bandage and the cloth eye-cover off my head.

I was on my back. I could tell she was at my right side, propped up on an elbow. I reached to the nightstand at my left, fumbling for my glasses even before I opened my eyes. Did she giggle? I didn't find them! I was lost without my glasses -- I couldn't even count my toes without them!

Somewhat panicked, I opened my eyes. The room was brighter than I'd remembered it from yesterday.

And everything was perfectly clear.

I caught my breath -- maybe I made a noise, as I felt her holding me from behind.

“Are you okay?” she asked.

I looked around the room. I could see, without glasses! My head and eyes started to hurt, but I could see, even in the dim night from the nightlight in the bathroom!

I turned to her, and saw beautiful blonde hair, blue eyes, and a smile. I grabbed her and kissed her, pulling her on top of me again. I held her and squeezed her as my heart raced, my eyes closed once more. I'd worn glasses since I was six -- and now I could see!

Her weight on top of me reminded me that I needed to go to the bathroom. We managed to get up. I went into the bathroom and turned on the light.

“Oh shit!” I said, and immediately flipped it off -- it was too damn bright!

Wait a minute -- it hadn't been bright yesterday....

Oho -- more things fell into place. That cool, crisp, dim light? Somehow I knew it was moonlight, stored moonlight. They'd done something to my eyes -- my eyes were a lot more sensitive now...

We showered together, then made love one more time. Everything I did, everything I looked at had fringes of memories, dwarf memories attached. I wonder what they're going through with mine? Or were they more selective?

She remained in bed as I got up and dressed. I smirked -- the performance of more than my eyes had been improved, it would seem... My pants looked weird as I put them on -- the thread holding them together was a strange color, contrasting sharply with the fabric.

Wait a minute -- it hadn't been yesterday; it had been pretty much the same color. What was going on? I needed answers. I glanced at my watch as I put it on -- almost six in the evening, and everything was so clear! I leaned over and kissed my paramour. She smiled and snuggled into the bedding

I winced a little as I stepped into the brighter lighting of the hallway, but was surprised that I seemed to adapt, at least some. Jay's office was empty. I headed downstairs.

Observing the large work area, I understood better. I guessed that not only was my vision sharper, my eyes also responded to a wider bandwidth of optical radiation. A minute or so with the tunable source would confirm that.

The other part was more troubling. I looked at the benches, floating in the air, and suddenly I understood them -- something I'd pulled from Guenter. I knew how to make them do that -- it was so easy -- and I shuddered, realizing that if the magic - spell - force field - I didn't have a term for it, failed, a block wouldn't fall to the ground, it would fly off into space. I'd have to double-check, but if I remembered that aspect of physics correctly, combining it with what I'd pulled from Guenter, any block more than about seventy kilos would exceed escape velocity if cut loose.

Even more troubling -- I pulled that from Guenter by accident. He'd looked quite tired -- what he'd done had taken a lot out of him. Did he know? Did they know?

Only one way to find out. I waved to a yellow-coat as I crossed the floor.

The crew was in the lab room, huddling over my optical bench. They must have replaced the crystal -- the fringes of the local oscillator and the mixer response were sharper.



I looked at Klaus. I remembered/dreamed seeing him as an old man, an old human -- sixty perhaps, and that would have been around 1945. But here was a dwarf. I should have looked at the crew on the floor better. There were slight differences in skin tones, some other small differences between Klaus and the rest of the gang. Which were age related?

Guenter walked to me and extended a hand. I shook his hand. We both smiled. I thanked him for his gift. He nodded, grinning that implausible grin which seemed to cover most of his face. He thanked me for my gift as well.

He motioned to my optical bench. They'd made a new mixing crystal, and from what they understood, they were at the performance limit of the materials. A new one was just about ready, and they'd try that.

I pulled up a stool and looked closer. All the "warranty void if seal broken" stickers were missing from my equipment. Yet everything seemed to be working. I woke my laptop, taking control of the tunable source. I disconnected the fiber from the mixer assembly, letting it point at the whiteboard. I set up a slow sweep, watching the spot of light.

Holy shit! I could see colors I couldn't name -- almost an octave more on each end of the normal "visible" spectrum! I muttered under my breath. Guenter cackled with amusement, as did the others.

I reconnected the mixer. On a hunch, I tapped the touchpad on the computer. I told it to print the screen, bringing up an option I didn't use very often, and sending the data to the computer's IRDA port, an infra-red optical port.

Damn that was bright! I covered the port with my hand quickly as the dwarves cursed. I muttered apologies. Not only increased bandwidth, but increased sensitivity, it seemed.

A yellow-coat came in, telling Guenter a new crystal was ready for him. Guenter gave me a cross look. Klaus laughed. Yellow-coat led the way, the rest of us following, back to the large work area.

Looking closer at the workers, I thought I saw more differences, trying to arrange them into ranges which might correlate with age -- interesting problem.

We closed around one bench. Guenter picked up a crystal in its holder fresh from faceting and polishing. He reached up, pulling a large tube closer, turning something on the side of it.

His hands and the crystal were illuminated in that clear, crisp, cool light -- moonlight! I watched intently, realizing what he was doing. I saw, I felt him reaching *into* the crystal, reshaping it. The others were watching as well. I understood -- they were watching and learning as a master craftsman worked. He'd done the same thing last night. And suddenly I knew -- I could do this, for I knew what Guenter knew. And I had the benefit of understanding crystal lattices, and the physics involved.

But what I didn't know was whether or not he'd be happy with that state of affairs.

Guenter pronounced the crystal "*Gut!*" and led the procession back to the lab. He handed it off to be placed in my mount. No, it wasn't my mount any more -- it was one of theirs.

He invited me to run a sweep. I did a partial one, and it almost brought me to tears. We were close to the point where the ghost of Heisenberg would appear and tell us we couldn't see any more. I'd need to do a calibration run, but the plots on the screen were beautiful, looking like they'd come from a simulation, not an instrument.

Shaking of hands, congratulatory hugs -- they'd done it. We'd done it. I turned to the whiteboard and started probing. What were the limits of detection, in terms of the physics involved, I asked? What were the limits imposed by the materials?

I led them through the process, feeling their uncertainty in working with these new ideas - - yet it was clear that they had a grasp of quantum mechanics, nonlinear optics, the math involved. They'd pulled it out of me, but now needed to integrate it, work with it and make it their own.

Just as I needed to work with the <magic> to tweak optics, to tether optical benches -- *to form the crystals which would control human minds* -- I saw that as well, realizing what had been done to me in Jay's office -- that crystal, the ones the ladies used.

I faded back into the conversation. They understood. We talked about suppliers for glasses with different dopants. Yes, I could order those for them, and I would. I gave them a quick overview of zone diffusion furnaces and crystal pulling. As I did, I saw Guenter light up, and in my mind I saw an intricately shaped ring of silver which would focus the <worldenergy> to create the proper melt zone.

We could go into the crystal-making business, supplying people with wafers of a purity level they'd never seen before!

But part of me said that was a trap -- I knew from my shared history with Guenter how careful they'd been, how cautious. That was required here as well.

"*Was für ein System!*" Guenter spoke, stroking his chin.

My turn for the big smile! I moved quickly to the whiteboard. Yes, by treating something as a system, we can do so much! I dove into transform theory, showing how we could use the computer to measure and then correct for so much. I started into Fourier optics, pulling in other areas.

I knew I was working their new knowledge, helping them integrate it. As I did, I realized I understood some areas much better now myself, their connections. And I had so many connections with what I'd pulled out of Guenter in that split-second flash.

## Short Story - With Dwarves

The dinner call came in just as I was about to dive into holography. As we walked down the hall to our meal, my breath caught as I realized I could make holograms of those crystals. A crystal, a pair of goggles -- one look, and ....

I was quite hungry. Interesting -- the dark-haired gal's hair had weird splotches of color in it. Then I remembered a friend who took some pictures at a wedding with color infrared film, and how certain ladies looked -- she was coloring her hair! To "normal" vision, it looked fine!

After dinner, Steffen and Willy wanted to know more about the tunable source. We spent pretty much the rest of the "day" on that.

Finally Guenter threw up his hands -- too much for one session. He wanted me to work with Jay to buy for them a new technical library.

I asked if they wanted German or English -- and as I did, I realized their English was now much, much better, and so was my German.

In Progress  
4/29/2004

Short Story  
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