The Alchemists of Mars

(Preview, Chapters 1-16)

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Author's Forward

The Alchemists of Mars is a novel set in the present. The year is not explicitly stated, but the time period could be any time in the first two decades of the twenty-first century.

A reconnaissance satellite discovers a hot spot in Valles Marineris in the Tharsis region of Mars. Back on Earth, archaeologists are investigating another hot spot, a thousand year old man-made underground radioactive source in Germany. The Martian hot spot is found to have signs of human habitation, and there appears to be a link between it and the archaeological site on Earth.

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This book is dedicated to my wife, Anne, who has had to live with a pastiche of some of the characters of this book for many years; and to my son, Michael, daughter, Marianne, and son-in-law, Jeff, who read the final draft and noted improvements.

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1 Valles Marineris

It was not that far a walk to the well. The real work happens after his arrival - descending into the crevice, scooping up the pure white snow in one bucket, the blue snow in the other, and then hauling the buckets back to the surface. He didn't hate the work. What he really hated was passing the spot where his brother, Spenz, had died. All that remained of the event was the disturbance in the soil. The body had long since been removed, mourned over, and buried in the community plot. Alain had inherited his brother's clothes, most of which were still too large, but when he wore them, he was the image of his brother. They said it was a rock that killed his brother. Spenz had stumbled, fallen, hit his head, and then lost consciousness. The bubble protects you when you're conscious, but it disappears when you're asleep. Spenz never realized what had happened to him. It was a warning to Alain to keep his eye on the path, especially when hauling the big buckets.

Alain, since he was so strong, was always given both the white and blue buckets for his trips. Most of the others carried just the white. The need for the white snow was great, and he would often meet others on the path who were on the same errand. The community had discussed how they might extend themselves closer to the well, but there seemed to be no point to that, other than eliminating surface trips. The current habitation was well protected, and it was close to their other important resource – the rocks that gave heat for warmth and cooking. The white snow was melted for water. The blue snow was also water, but as it melted, it bubbled, and the bubbles gave the air a fresher smell. There was not as much blue snow as the white, so blue snow was gathered just occasionally. Alain needed to go deeper each time to fetch it. Perhaps no blue snow would be found after a time. An inconvenience, perhaps, but what if the white snow were depleted? Would that be the end of the community?

Of course, the white snow was thought to be abundant. Great quantities were supposed to exist at greater depths, but light would be needed below a certain point. Occasional lighting was not a problem, since the light incantation was one of the first learned by children. Such methods were good for exploration, but they were impractical for a bucket trip. The problem was that the incantation would only work if invoked by three individuals, and none of these could work a bucket. Imagine, wasting the work of four people for a bucket trip! It would be done only out of desperation, and such desperation seemed a long time into the future.

After the snow was collected, Alain hauled himself and the two buckets out of the crevice and headed home. He decided on his return trip not to gaze again at the place where Spenz had died.

2 Dresden

Keller was walking to the next welded pipe joint when the foreman called out a reminder to him.

"Keller, remember to reattach the safety line to your belt before you descend into the trench! I'll have no accidents on my watch!"

"Yeah, yeah," He shouted back. "I know the procedure."

The pipe was only twelve feet down, but the trench was still treacherous. Keller had seen too many safety videos to know that he should be careful. Like the other welds, the soil around this one was nicely excavated to give both the welder and him an easy job. In his case, it would only take a half-hour, tops, to get the radiographs to certify the quality of the weld. He lowered the cobalt-60 source and camera into the trench and rappelled down the short distance. Following procedure, he checked for the presence of his radiation badge and placed the electronic radiation counter on the ground. The lead blankets he would place around the camera were more than sufficient to shield him from the radiation, but he always stood near the electronic monitor, ready to shut down the source with his remote if he heard any squeak.

Keller never took any chances, and his exposure badge confirmed his great care every month. He knew guys who weren't so careful. When they were in their fifties and had already logged their lifetime safe exposure, they were out on the streets looking for another occupation. He liked his job, and he intended to retire from it at the proper time, but not before.

When the instruments were set, he retreated to the electronic monitor and flipped the power switch. The device instantly emitted an ominous warning sound. The radiation level was still considered safe for short exposures, but why did this happen? The cobalt-60 source was still on mechanical safety. Was the shielding damaged? He slowly walked the monitor closer to the source, and the radiation level diminished. None of this was making any sense. He walked the trench in the direction away from the camera. The radiation monitor seemed to peak at a specific location.

Keller had read the history of the Nazi atomic bomb project. It was nowhere near the size of the Manhattan Project, but there were scientists and labs in Germany working with radioactive uranium in World War II. Perhaps he stumbled on the bombed-out remnants of one such laboratory. Well, whatever it is, he would warn the foreman, have the trench closed, and report this incident to the Bundesbüro für Strahlenschutz. With any luck, he would get a several day's paid holiday while this was being investigated, a gold star on his employment record, and, at the very least, an early lunch.

3 Survey

The rain had just cleared as Ulrich Stammler stepped off the train at Dresden. The trip from his laboratory in Mainz was as uneventful as it was long. It had taken quite some time to unload his equipment from the train and then locate the constabularies who were waiting for him at the train station. The construction site was fully across town from the train station, and he used the time for an informal orientation from his drivers.

"So, who was it that discovered the radiation, Herr Constable?"

"Herr Doctor Stammler, I can speak only second hand, but it was the man in charge of welding inspections on a rather large natural gas line leading across the border to the Czech Republic. His name is Eberhardt Keller. Herr Keller had a radiation monitor, and it registered the presence of some unknown radiation source. The area has been sealed, and he will meet you at the site to show the location."

Stammler's mind raced ahead. Could it be a misplaced medical source from decades ago? Is the source dangerous? Will he need additional men for the clean-up?

"Herr Constable, did the inspector give any indication of the seriousness of the matter?"

"Herr Professor, he only indicated that it was his duty as a licensed radiologist to report it to the Federal Office for Radiation Protection, that the site should be closed, and that the Office would investigate."

"Yes, yes. My presence here confirms that. All finds of unexpected radiation must be investigated."

The rain had returned as a light mist as Stammler exited the police car. Fortunately, his radiation survey equipment was sealed against water, but his shoes were another matter. The ground was very wet and very muddy. Construction sites were like that, and the mud was as much of a reason for the workers to wear heavy leather boots as the errant nail or sharp metal edge. He asked the constabularies to fetch his instruments. A lone figure stood alongside a trench, and Stammler walked in that direction. He greeted Stammler as he approached.

"I am Keller."

Stammler extended his hand.

"Pleased to meet you, Herr Keller, I am Stammler. I must first commend you on your decisive actions with regards to the unknown radiation source."

"Thank you, Herr Doctor. I was just doing as I was trained."

"And very well indeed. May I see your survey instrument?"

Keller reached downwards to a leather satchel, removed the instrument and switched it on. There was a short squeal, and then a few clicks each second.

"You can see, Herr Doctor, that we are at a safe range. The meter is fully in the green."

Stammler wrinkled his face slightly and hoped that Keller hadn't noticed.

"Yes, yes. I see the green - but your instrument is a beta detector. It is calibrated well for your Cobalt-60 beta radiation, but not for others. Your meter may have seen only secondary radiation, and not the primary beta radiation."

"Herr Doctor, what do you mean by secondary radiation?"

"A different type of radiation source, a neutron source, may have activated minerals in the soil. You may have been seeing that radiation, but not the radiation from the source."

Keller's face took a whitish cast. Schoolhouse stories about radiation danger, likely exaggerated to promote an enhanced respect for the radiation sources the students would eventually handle, were now bouncing around inside his head.

"Herr Doctor, are we in danger?"

"Not to worry Keller. Unless this is something really unusual, the soil provides adequate shielding, at least for short periods. I suspect you may have found some forgotten piece of medical equipment. People were not very careful with waste disposal in the early days. This is a place well away from the city, and it would have made a convenient tipping point for unwanted equipment. Perhaps they buried it, just to be safe, but they left no records. Such medical equipment would use Cobalt 60, just like your own radiation source, so your meter would be accurate. My instruments will tell us more."

The constabularies had just arrived with Stammler's equipment. Unlike Keller's simple satchel, these instruments were contained in finely finished wooden boxes. When Stammler had first started using such instruments, he wondered at the extravagance of such packaging. He soon realized that, as a percentage of the cost of the instrument, it was a small cost indeed, and the added protection was essential. Wood was a wonderful material. It was soft enough to cushion delicate instruments against occasional bumps, yet hard enough to allow transport in a vehicle trunk.

“Herr Keller, would you be so kind as to assist me in my measurements?”

“Herr Doctor, it would be an honor!”

Stammler then addressed the head constable.

“This survey may take some time for Herr Keller and me, perhaps two hours. If you have other duties, it's permissible for you to leave now and return later.”

“Yes, Herr Doctor, we will return promptly in two hours.”

Stammler wished that the Mainz folk were as polite as these Drezdeners. He wasn't certain if it was because of the Dresden culture before unification, or the fact that rural people were always more polite than the city dwellers. Whatever the reason, it was nice to feel once again that a PhD still held some respect, somewhere.

Together they unpacked the radiation meter, and Keller's eyes grew wide with excitement. The meter was portable, just like his, but that was nearly where the similarity ended. In place of a simple analog meter with green, yellow and red markings, there was a full display screen with computer control. The unit measured not just the level of radiation, but it displayed the energy spectrum of the radiation. It was designed to identify the element causing the radioactivity. Stammler pushed a few buttons and waited a few seconds for the radiation counter to integrate enough data to display a meaningful spectrum.

“Well, Keller, we can rule out medical equipment. Cobalt-60 emits gamma rays at 1.17 and 1.33 MeV, which would be about here.”

Stammler pointed to the curve on the screen. There were no peaks. He pushed a button to change the display.

“We are now in beta mode. Cobalt-60 also emits an electron, or beta radiation, at about 315 KeV. Beta radiation is what your meter is designed to detect. As you can see, there is still no large peak on the curve at that energy. Now, uranium-235, when it decays to lead, goes through a complicated decay chain of many isotopes that emit beta energies at various places. Our instrument has nicely labeled all the peaks for us at four, maybe five, places. It appears that our source is uranium. The uranium betas are what your meter detected.”

“A natural source?”

“Quite unlikely. The geology of this area is not indicative of large quantities of natural uranium. Depending on the distribution and quantity of radiation observed, it might be a cache of natural pitchblende ore, stored during the war as part of an atomic program. Herr Keller, we have a mystery on our hands. But, one last check.”

Stammler pushed another button. This time it took much longer for the display to show peaks, and the peaks were quite faint.

“Here we have an alpha decay at about 4.68 MeV where U-235 decays to Th-231. Uranium is confirmed. All that's left now is for us to locate the source for the excavation team.”

“Is there any danger from the uranium?” Keller asked nervously.

“Not likely, but my instrument will squeal if things get too hot.”

Stammler carefully placed the survey instrument in its box and proceeded to unpack another instrument. He explained to Keller that they would use GPS for the survey, but GPS itself was only accurate to a few meters. This other instrument was a short range GPS transmitter that would allow them to use a technique called differential GPS to obtain centimeter accuracy of position relative to the transmitter.

“The important thing, Herr Keller, is to locate this transmitter near a prominent landmark, or drive our own survey stake as a reference. Since the radiation source appears to be in that area...” Stammler waved his arm “...and there are no obvious landmarks, we shall drive our stake here. It's as good a place as any. Oh, did I mention it should be outside the survey area? Well, this place will work.”

Keller drove the stake, a yellow rod with a red ribbon affixed to the top, Stammler set a tripod over it and affixed the transmitter to the top.

“The elevation is important, too. Keller, get a measurement between the top of the stake and the base of the transmitter, where that yellow line is, and write it down. Measure also the length of stake above ground level. That will be a check to determine if the stake has been driven deeper later. The excavation team will place their GPS transmitter at this same place.”

Keller complied and then followed Stammler into the field. Stammler carried a different instrument without a spectral display.

“Since we have determined that our source is uranium, we will now use this logging intensity meter.”

The grass was thick in the survey area, and Stammler was thankful for that, since it cut down the mud considerably. After a quick walk around the area, Stammler found the approximate center of interest, marked it with a tall marker stake, and then paced off approximate radials of a hundred paces in eight directions, jumping over the occasional log or bush as he paced. He was accustomed to this procedure, and he knew how to focus on an object at the horizon to maintain the accuracy of his step. He affixed other tall marker stakes with huge flapping ribbons at the ends of the radials and then returned to the central stake.

“The way this works, Herr Keller, is that we walk with the meter in sixteen radials from the center. I've marked only eight, but it shouldn't be too hard to walk the other eight in between those markers. Our smart little meter has a differential GPS built into it, so we log both position and intensity. We just need to walk at a normal pace, and let the equipment do the work. I'll analyze the data back at my Mainz laboratory. As you can see, this is a lot of walking, so it's good I have your assistance here. You will walk the marked radials, and I'll walk those in between.”

Stammler took the more difficult task for himself. He wanted a good data set and trusted his own skills over another's. It took nearly an hour for them to walk the radials, and then another fifteen minutes to pack and secure the equipment. Stammler offered a dinner to Keller, but he declined, pointing to his current dress, which was in a muddied state. Stammler said he would write a commendatory letter to Keller's employer, and Keller beamed with pride.

As promised, the local constabularies had returned after two hours, and they were waiting at the roadside for Stammler. They loaded his equipment into the car and proceeded to ferry him to the train station for the long journey back to Mainz. Stammler reviewed the day's activities as the car traveled along the expressway. The uranium had to be a remnant of a World War II program, and there were several reasons why the location might not be that unusual. However, tracing its provenance through government records and historical archives would be fruitless because of Dresden's existence as part of

East Germany before the Unification.

The German military program of World War II had evolved from Uranverein, The Uranium Club, of which Heisenberg was a principal member. Heisenberg's laboratory was originally in Berlin, as were the laboratories of most physicists. There was also the proximity to the source of uranium ore, the Joachimsthal Mine in the Czech Republic. As the war progressed, most of the Berlin operations were transfered to facilities in the far southwest, at the edge of the Black Forest, far from Dresden. However, an experimental atomic pile was kept in Berlin, possibly because of the difficulty in its relocation.

The one thing that troubled Stammler was not his finding a uranium stockpile at Dresden, but finding any uranium at all after all these years. The German atomic effort was never very large, since it was never thought to be critical to the war effort. At its peak in 1942, there were less than a hundred scientists working on nuclear physics, and less than half that number working directly on uranium fission. It was always believed that the distribution of uranium was represented by the distribution of atomic scientists, but Dresden was quite outside their usual territory. Yes, this was a mystery, but scientists were paid to solve mysteries, whether in the laboratory, or elsewhere.

He remembered one of his first assignments, shortly after he started working at the Bundesbüro. He was fresh out of graduate school, and as a newly hired member of his radiation safety group, he was given just routine assignments. This particular assignment was to investigate a finding that the radiation badges for an entire university department showed an unacceptable exposure. Stammler saw that the only radiation-producing instrument in the department was an xray diffractometer. He did the usual checks on the machine. Shields in place? Safety interlocks working? Everything was in order. Upon interviewing some of the users of this equipment, he learned that many of them had not used the equipment in months, yet their badges had been exposed. A mystery!

Stammler's first thought was that it was a freak accident involving the badges, only; or perhaps a malicious prank. A prank was quite unlikely. Something like this would be grounds for dismissal. The next step was a radiation survey. Stammler had one of the graduate students load a specimen and start the equipment, just as he would do when doing an xray scan. Stammler waved his detector all over the outside of the apparatus. Nothing but the occasional cosmic ray triggered his survey meter. On a whim, he changed to an alpha detector and noticed an increased background level. Walking around the room, he noticed that the radiation level was highest near the xray exposure badges! The badges were on a small shelf near the xray machine, and he noticed that most of them were placed on a thick sheet of metal. The metal was a low-level alpha emitter!

Removing the metal plate for examination, Stammler noticed that it seemed much heavier than an iron alloy. Using equipment available in this laboratory, and nearly every other laboratory, he weighed the plate, then dipped it into a large beaker of water and noticed the volume displacement. It was a simple matter to calculate the density – about twenty. This was uranium, likely depleted uranium, the remnant of U-235 production. It was not strictly radioactive or harmful, but radioactive enough to expose a radiation badge sitting right on top of it for a month! Upon inquiry, he discovered that one research project at the university involved depleted uranium armor. This sheet had been left in the room as a standard, and left on the radiation badge shelf so that it wouldn't be misplaced.

The periodic rumble of the train wheels on the track was having an effect. Stammler closed his eyes and slept for much of the trip back to Mainz.

4 Four Sources

The trip back to Mainz allowed Stammler time for some needed rest and to catch up on a few journals he had been neglecting. He arrived at the Mainz train station at about 4:00 AM. He was surprised at how many people were up and about at that hour. Over the years, the morning and evening commuting times had extended to meet each other, then merged into a single mass of harried travelers. He had his equipment sent ahead to the laboratory, and he proceeded by cab to his apartment. He carried with him, in his inside coat pocket, the data pack with the radiation survey data. The equipment could easily be replaced – at a cost – but the data would take time to replace if it went missing along with the equipment.

Stammler left a voice mail message with his assistant that he had returned. He reported that the measurements went well, there was a need for an excavation team, and he would arrive at the laboratory a little late. His internal clock told him it would be much later.

Stammler arrived at the laboratory at 1:30 PM and entered the building along with the lunchtime crowd. The data pack was in his attaché case, but when he arrived at his office, the first task was to clear his e-mail – only forty messages. He considered himself lucky that none of them were urgent. He had always loathed e-mail, since it was an intrusion upon his work flow. He had tried a recommended time management technique to open his mail only once each day, at the end of the day, but that often resulted in his remaining at the office late some days to handle some urgent request. These were typically from management and were urgent mostly because the managers sat on something for several weeks before acting. He was always annoyed by the messages that had the dreaded by the end of business today tag.

With his busy-work out of the way, he copied the data to his computer and immediately made a backup copy on the laboratory file server. This would time stamp the data unequivocally and would solve any corruption problems later. His assistant, Konrad, a computer geek, had written a program to aid in analysis. It read the (x,y) data points of position and intensity and produced a contour graph much like those on a topographical map. All this processing took time. First, he was using differential GPS, so there were calibrations along the way and then a global optimization. Konrad called this final optimization, the Maximum Entropy Method. This seemed like a strange name for something whose purpose was to reduce error, but that's what it was called, and that's what worked. Stammler decided to grab some coffee and touch base with Konrad.

Konrad was at his usual position, in his laboratory, hunched over a computer terminal. Canned software was useful, but the most useful stuff was that written by Konrad. Konrad had the knack of locating the relevant open-source software, stripping out what wasn't needed, and inserting his own tweaks. It was almost like magic to Stammler, and he considered himself lucky to have found an assistant like Konrad. In return, Stammler made certain that Konrad was treated well, since he didn't want to lose him to some software startup company.

“Konrad, how goes the battle?”

Konrad looked up from the screen.

“Herr Doctor, good to see you back. How was Dresden?”

“Dresden is probably very nice, but I didn't see any of it. It was round trip from the train station to the survey site and back; that was all. In any case, it was raining. The radiographer who detected the radiation source helped with the survey, so things went quickly. We did a GPS survey. The data is being analyzed as we speak.”

“A survey was needed?”

“The source was uranium! Hard to believe, but true. You and I will likely need to return to Dresden, together. The data analysis must be completed by now. If you aren't too busy, return with me to my office and we'll see the extent of the contamination.”

When they arrived at Stammler's office, his display was in screen-saver mode. His management didn't like the fact that his screen saver was video of some US above-ground atomic weapon tests, but they didn't insist on its removal, so he maintained it as his little joke. Stammler moved his mouse to exit the screen saver and then stared in disbelief when the graph appeared. He had expected a single source, possibly a mound of cached pitchblende remaining from some wartime or Cold War program. Instead, he saw four separate sources in a perfectly symmetrical arrangement.

The software had a feature that used the GPS data to overlay aerial photographs and topological features on the radiation contour plot. There was a small, apparently bombed out, provincial church building at the perimeter of the survey field. Stammler had used it as his first horizon point while laying out the survey radials. He also saw that the sources were aligned with the points of the compass. Without any idea of the source intensity, it was hard to judge the depth of the sources. However, the depth could not be much greater than the distance between the peaks on the contour plot – almost ten meters. He realized that this would not be a routine excavation and that his services might be required at Dresden for an extended period.

Konrad, who was silently looking over Stammler's shoulder, understood what the data were telling them.

“Konrad, what do you make of this?”

“Herr Doctor, it's good that the weather at Dresden is generally nice this time of year.”

5 Excavation

"Could it be the remnants of a WWII atomic bomb laboratory?"

"Yes, that must be the case, Konrad. The uranium radiation signature, the underground location, the symmetrical layout of storage bins - it all makes sense. The Soviets scattered remote monitors that were powered by radioisotopes throughout the block countries, but they never used uranium. It's too inefficient as a thermal source."

"What about pottery?"

Stammler needed a moment to understand what was being asked.

"Yes, some yellow glazes did contain salts of uranium. That was one of the few uses of the element before atomic energy. Fiestaware, American dinnerware, will excite a Geiger counter, but the radiation levels are just slightly elevated above the background. It's certainly nothing like this. And why would it be symmetrical?"

"Plates are always stacked."

Stammler and his assistant, Konrad Maurer, both laughed. They were proceeding by train to the excavation site at Dresden. The regional radiation hazmat-equipped excavation team had begun operations the prior day. That should have been enough time to move the needed equipment onto the site and prepare for excavation.

The construction site had dried considerably since Stammler's last visit, so mud was not a problem. A barrier fence had been constructed, and the field was littered with flags that outlined the location of the area of interest. Stammler and Maurer clipped their photo identification badges to their coats, and they were issued yellow hard hats as they entered the area. Stammler was happy that all this was occurring in the Spring – he did not like winter excavations.

There was a crew of four men on the site. Their initial work had gone smoothly, and they had been waiting quite a while for Stammler to arrive. Alcohol, of course, was not permitted at such sites; but this was Dresden, and Stammler could smell a faint odor of beer. It was possibly from a mid-morning break after the initial work. No matter. These men were experienced, hard working, and they knew their limits. Stammler didn't comment.

There was a short planning meeting between Stammler and Erzbereger, the principal engineer. Erzbereger was quite experienced with radiation sites, so there was not much to discuss. A bore hole would be carefully drilled in the center of the four objects and radiation readings would be taken. The idea was to drill past the level of the objects so that the drop in radiation would indicate their precise depth. Erzbereger had anticipated the plan, and the bore rig, resembling a miniature oil derrick mounted at the rear of a truck, had already been placed at the proper location. Stammler checked the location of the differential GPS transmitter and verified the intended location of the bore hole with his personal GPS unit. He gave Erzberger clearance to begin work.

Stammler had estimated a depth of about ten meters, so the boring operation would take at least two hours. Stammler carried a cellphone, as did Erzberger, so he asked him to call when the operation was completed. Stammler and Maurer would be doing some explorations at the old church. As he was speaking, a thought hit him. A graveyard? He mentioned this half jokingly to Erzberger, who was now informed of another possible complication with the excavation.

The church was a short walk, about 200 meters away. As he and Konrad approached, Stammler could see that his interpretation of the structure from the aerial photographs was wrong. The church was not bombed out. Instead, it was ancient – probably hundreds of years old. It was the passing of time, and not an errant bomb, that had reduced the church to rubble. About half a bell tower was still

standing, as was most of the wall adjacent to it, but the roof and other walls were completely collapsed.

The church courtyard was littered with several neat piles of the church stonework. These were possibly the start of a reconstruction effort that was subsequently abandoned. There was little left of the structure but stone, and no indication of the name or denomination. Perhaps it was listed in some local history that survived the war. There was no real way for the two to enter the church because, for all intents, there was no church. Stammler and Maurer were scouting the forest on the side of the church opposite to the excavation site when Stammler's cell phone rang. It was Erzbereger.

"Stammler here."

Erzbereger's voice was excited.

"Herr Doctor, we have found something, possibly a chamber. The drill was normal for about six meters, and then there was no resistance. We stopped. You should return."

"What's the radiation level?"

"High, very high. The readings were as you predicted, until we broke through to the chamber. I needed to change scales several times to get a reading. I had hoped that a chamber would make our work much easier, but this radiation changes everything."

"How many Becquerels?"

"It seems to fluctuate, but it's definitely in the tens of millions, perhaps hundreds of millions."

"Erzbereger, Herr Maurer and I will return immediately, but it will take about ten minutes walking time. Keep everything exactly as you have it now."

"Herr Doctor, this is understood."

After they broke the connection, Stammler briefed Konrad, and the two headed back towards the excavation.

"Konrad, just when life seems too routine, the unexpected brings us back on track! Now we have something interesting for our monthly report!"

"Herr Doctor, I'm puzzled by one thing. Why would the radiation level increase sharply upon entry to the chamber? Soil is a uniform shield."

"Yes, Konrad, that puzzled me for a moment, until I realized that the chamber ceiling must have some shielding, probably lead. This is definitely a human artifact. The symmetrical sources, the high radiation levels – This must have been an experimental atomic pile, although the construction is quite peculiar."

"Why here? Why so hidden?"

"The American parallel is Los Alamos, New Mexico, which was about as remote as one could be and still be within the limits of the United States. Secrecy was paramount during the war effort, and having your laboratory at a remote location was a positive factor. But the American effort was huge. What we have here is very small, perhaps just a laboratory. The staff must have been just a few. I can see no houses near here."

"In that case, this isn't just a normal excavation for us. It could have historical significance. Herr Doctor, we should proceed with caution!"

"Konrad, do you mean more caution than we use when working with intense radiation sources? I think one caution follows from the other."

Konrad laughed.

"Yes, you're right. What was I thinking?"

6 Therm-All

Jim was working the graveyard shift, again. He didn't mind. Since his undergraduate days, his biological clock had shifted to a wakeful period from noon through about 6:00 AM. This wakeful period would perhaps be better defined as a not-quite-as-sleepy period. This period was followed diurnally by a dead-to-the-world period from 6:00 AM to Noon . A graduate student now, he found that his odd sleep habits were paying off. He worked in the solitude he enjoyed, while at the same time being a hero for occasionally manning the time slot no one else wanted. For these few hours each night, Therm-All was his.

The All-Band Thermal Imaging System, called Therm-All, a corruption of "thermal," was a multi-spectral camera aboard the fabulously successful Mars Sequential Survey spacecraft. Jim was commander of the infrared camera that looked at enough discrete wavelengths of infrared light to measure the temperature of the surface of Mars. The resolution was not that good, about 300 feet per pixel, but the view was spectacular. Mars, as encoded in a data stream from JPL, appeared as a moving strip on his monitor. His task was to analyze any unusual infrared features. He could follow up by viewing the same data taken with the visual camera. The visual camera, useful only during Martian daylight hours, had about five times the resolution of the infrared camera, but the resolution was still only good enough to see a house. Houses on Mars – now there's an idea past its time!

They had tried using software to accomplish Jim's task, but there were so many false positives, usually caused by data glitches, that analysis of the computer selected candidates took longer than a human watching in real time. Jim was relieved that his raison d'etre wasn't preempted by a computer chip the size of a pea, but humans weren't as slavish to their tasks as computer chips. Fortunately, his display had a playback feature that allowed Jim the occasional coffee and restroom break.

This monotonous task gave Jim time to reflect on how his conception of science had changed over his lifetime. While he was a child, he read biographies of some of the great scientists. Since these biographies were written for children, they concentrated on the discoveries these people had made, and they necessarily omitted the politics, vicissitudes of funding, and hours of fruitless experiment or observation. The scientific life was painted as noble and glamorous. Now that he was practicing real science, Jim was being educated in the other half of the profession, principally the boring parts.

Therm-All had been designed to search for water on Mars, whether in the form of ice at the poles, or underground hydrothermal vents. Polar water was found, and that was almost anti-climactic, but underground hot springs were the most exciting, and most elusive prey. None had been discovered as yet, but if they were, it would be Jim's discovery. At this point, Mars appeared to be a cold, airless, generally nasty place.

Jim was anticipating another coffee break, when an orange patch caught his eye. Orange was an unusual color, since it indicated an intermediate temperature, somewhat warmer than the daytime surface temperature, but still much colder than a vent. He placed his cursor on the patch and clicked to store the location. In a frame buffer at another monitor he retrieved the stored image and went to maximum resolution. The patch was huge! It did not seem to have any central peak in temperature, as would be characteristic of something like a vent. The entire patch, except for the inevitable diffusion area at the perimeter, was about the same temperature. He roughly traced the perimeter and checked a menu to calculate the area. It was at least twenty hectares!

Jim retrieved the visual image. Fortunately, the low angle of the sun allowed for considerable topographic contrast. Blurry though the image was at this resolution, he could see it was a mound, considerably elevated above the local terrain. The mound was located near a chasm. Jim realized that

he had no idea where he was on Mars. To that point, it had been data, just data. Suddenly it became interesting. Another click on a menu revealed the orb of Mars overlaid with a small red circle and a name - Valles Marineris – with coordinates. The Valles Marineris name was nearly a useless descriptor of position, since the feature circled an entire quadrant of Mars, but it did give a general idea of where he was. He was near the Martian equator.

Valles Marineris was named after the Mariner spacecraft that discovered it. It's a huge Martian canyon, much deeper and more impressive than any on Earth. The Martian canyon is a tectonic rift, a giant crack in the Martian surface. It wasn't formed by flowing water, as canyons on Earth, but there were features that suggest occasional water or carbon dioxide outflows. This was definitely thermal vent territory. This was a region of geological change on a grand scale.

Jim hit print to make a backup of last resort and reached for the telephone.

“Three AM. Do you think he'll mind?”

7 Discovery and Mystery

When Stammler and Maurer arrived at the excavation site, the crew was advisedly sitting well away from the bore hole. Although Stammler didn't think there was any possibility of an exposure, he was happy that their identification cards doubled as dosimeters. Stammler produced a radiation meter and surveyed the site. Unless he was right alongside the bore hole, there was no significant radiation. The trace elements in the bore drill were becoming radioactive, and once the drill was removed, it would need to be disposed as low level radioactive waste. Luckily, the thick steel drill provided shielding for all those above ground. The core drill radiation meter was reading steadily in the mid-millions range. Erzbereger had understandably shut off the audible alarm.

"Herr Erzbereger, you did well. The radiation readings are all safe away from the bore hole."

Stammler turned to Maurer.

"Konrad, we need to see what is there. What are our options?

Maurer had already thought about the problem and responded immediately.

"Herr Doctor, the prescribed method is to use one of the radiation hardened cameras at the Mainz laboratory. This would involve at least two days transit. We could just return and bring it back with us by hand. But I have an untested idea that may work. We would need to travel into Dresden for supplies. I suggest we send for the camera, but follow up on my idea instead of sitting on our hands."

"Will we need the crew?"

"At least the bore drill operator. I suppose that Herr Erzbereger must remain, also."

Stammler talked to Erzbereger, and two of the men departed shortly thereafter. Stammler returned with the bore drill operator, and Erzbereger remained to guard the drill.

"Herr Maurer, this is Herr Steinhauer, our capable drill operator. He has volunteered to help on your quest for supplies. He's a native Dresdener."

Maurer extended his hand.

"I am Konrad. May I call you..."

"Kristopf. I am Kristopf. I am very pleased to meet you Konrad."

Now that formalities were discharged, the air was lighter as they approached the car. Kristopf had volunteered to drive, a sensible idea, since he was a native. Stammler thought that it was a wonderful idea, until they got underway. Apparently, Kristopf fancied himself as a racing car driver, at least on the back roads. He was somewhat less aggressive as they neared the city.

"So, Konrad, what do you need."

"Well, I need a camera, a computer camera with certain capabilities, so a large electronics store with many choices would be suitable, like a shopping mall store. Actually, a shopping mall would be good for another item. I think I may find it in a china or gift store."

"Ah, the Altmarkt is the perfect place. I may not be properly dressed for such a place, but I'll try to blend in. It is just across the Elbe. All expressway. We will be there soon."

Stammler noted the time.

"Kristopf, it is nearly noon. Is there a place there for a quick lunch?"

"Oh, not there! Far too expensive. I will take you to a place for a real lunch!"

Kristopf did not think in terms of expense reports. It was on trips such as this that Stammler and Maurer tried to mollify the inconvenience of being away from home with restaurant fare they weren't usually able to afford on their own. Rather than ruffling any feathers, they decided to accept Kristopf's choice of restaurant. They exited the expressway still at a distance from the city. Maurer had used the travel time wisely, calling for the camera equipment from Mainz and making the request sound

especially urgent. Perhaps it was. After traveling a few provincial streets, they arrived at an old inn in an area apparently untouched by the war. Stammler noted from the topography that some nearby stony hills would have created a natural firebreak.

Kristopf must have been a frequent visitor, since the barmaids greeted him by name. He was handsome, unmarried, and in his mid-twenties. He would certainly have no trouble attracting young bar maids. Stammler now thought that he was brought here as part of a plot. This young man of the bar maid's eye is important enough to be in the company of scientists! Stammler didn't mind. He rather respected the young man for his ambition.

They were seated at a table near a window. One beer with lunch was the custom in the area, so it was three beers for the table. Stammler and Maurer let Kristopf select the brand. The beer arrived chilled, but not cold, and it was excellent. They ordered lunch, and Stammler started the conversation.

"Kristopf, how did you come to work for the Bundesbüro für Strahlenschutz?"

Herr Doctor, I actually work for the Bundesklima-Agentur. My crew, or I should say Herr Erzbereger's crew, is on loan to the Office of Radiation Protection from the Federal Environment Agency. Aside from a few waste sites left over from the Soviet days, a radioactive site is rare. We work mostly with chemical sites."

"Yes, I can see the logic in having a cross functional crew. So, how did you enter this line of work?"

"A very short story, Herr Doctor. I was never very good in school, but my parents insisted I finish the Gymnasium. After graduation, I worked in general construction for a while. I like the outdoors. But the problem with general construction is that it's seasonal. No one wants to dig a hole in the winter. I heard from a friend that by taking a few courses at the university, I would qualify for specialty excavation. He said that the downside is that there would be some danger involved, danger from chemicals and radiation. Danger! I think working on the top floor of a partially assembled skyscraper is more dangerous. I had no problem with the chemicals or the radiation. We are so careful how we work. Nothing is left to chance. I've been doing this work for about four years, now."

"Herr Erzbereger has worked in this area for many years. I'm certain he is very experienced with the safety aspects. I'm also certain he's assembled a fine team."

They ate quickly after their food arrived. Maurer wanted to make good use of the remaining daylight, so he tried to rush them along. Stammler reminded him that a beer must age in the stomach as well as the vat, so a compromise pace was set. He had just lectured them about safety, but they all had ordered a beer, and one of them would be driving. Slowing the pace was his compromise between Dresden tradition and sober driving.

It was another twenty minutes by car to the Altmarkt. Kristopf wanted to find some parking on the street, to save money, but Maurer convinced him that time was more important than money – and, after all, this was an NEA expense. They parked in the parking garage adjacent to the building.

As they left the car, Kristopf advised, "Remember to hide your badges. We should not look like tourists!"

Their first stop was a large electronics store. Maurer approached a salesman and told him of his general needs. The salesman advisedly called for the store's resident computer expert. After brief pleasantries, Maurer laid out his specifications.

"Eight or twelve megapixels would be nice. It needs a built-in flash, a remote trigger from the keyboard, and it must be at least fifteen meters from the computer."

"Well, a cable will not work at that length. It's not recommended beyond three meters, since this is a high data rate. You need a wireless camera with a receiver card for your laptop. You could get a hundred meters reception easily. I hear that spies, or at least suspicious wives, use these."

"Yes, I can see the advantages! Can I get a receiver card with a remote antenna, removed at least three meters?"

Maurer zeroed in on the ideal candidate after a few subsequent rounds of questions interleaved with examination of various cameras and components. An NEA credit card paid for it all – nearly 900 Euros. Stammler clutched the receipt like gold, since it would become an essential part of his expense report. After purchasing the camera, they searched for a glass shop that Maurer had seen in the store directory. Stammler had a good idea what he was up to, but Kristopf was perplexed.

"A gift for the wife?"

"No, it's for the camera. The radiation level is so high that the camera electronics would be destroyed almost immediately. We have lead sheets at the excavation site – that will protect the body of the camera - but we need some lead the camera can see through. Fortunately, leaded glass will work, although I think I'll need to use separate pieces for the lens and the flash. A single piece would couple light from the flash directly to the lens."

Once the glass shop was located, they scouted around for flat, thick items. A modern looking candle holder would have been ideal, except for the fact that they had no way to cut it into pieces. Finally, they found some paper weights of the right size, thickness, and optical clarity. Not relying on any labels, Stammler took a laser pointer from his pocket and did a rough refractive index measurement. Yes, the lead oxide content was high. Kristopf was fascinated by the way these scientists operated. He was reminded of the McGuyver television show, still in reruns. Clutching another credit card receipt in hand, Stammler wondered how he would report these items on his expense report – "Leaded glass paperweights, forty and thirty Euros."

As they walked along the corridors of the shopping mall on the way to their automobile, Stammler was impressed by the shops and the shoppers. The electronics shop and gift shop they had visited were just two of many purveyors of higher end merchandise at this location. There were many young housewives, fashionably dressed, walking the corridors. Some of these women had children in tow or in carriages, and these children appeared not to want for anything. Unification had been especially good to Dresden, probably because of its established industrial base and prime geographical location. Stammler did see a few middle-aged men sitting with no particular place to go. Unemployment was still a problem.

They reached the car, and Stammler felt both the beer buzz and the post prandial sluggishness subsiding. It was now back to work. Perhaps there will be enough of the day left for them to see what's really underground.

8 Hot Spot

Moldovan's eyes adjusted to the darkness as he locked his front door and proceeded to his car. When he volunteered to take Jim under his wing as a graduate research assistant, his decision was well reasoned. In his first years in graduate school, Jim had shown himself to be a capable student; but more importantly, a self-starter who seemed to like handling problems by himself. While other students would run off to their professors every time some piece of software gave an unusual result, Jim would analyze the issues himself and only take matters to a higher level when he knew it was reasonable. In short, Jim was low maintenance, and that was the way Moldovan liked his students. All the more reason for him to consider this middle-of-the-night telephone call very important.

It was a very short drive to the university, so Moldovan traveled in silence. On longer trips he would take his collection of eclectic mix disks – everything from Prokofiev to Miles Davis, with a little Styx thrown in for balance – but he preferred to think in silence during his commute to the university. Therm-All had been both a triumph and a letdown. Water at the poles was a wonderful discovery, but it wasn't his discovery. He was working on the high risk, high reward task of finding local sources of water, and possibly being on the ground floor of the discovery of life itself on Mars. Perhaps Jim's unusual hours had some advantages. Moldovan used to work many nights himself as a student.

Moldovan reminisced about his own student days, quite a few years ago. He started in Physics, but his first love was radio astronomy. Unfortunately, there were too few radio observatories, too few employment opportunities, and no openings for graduate students. He wanted to continue in astronomy, so he assessed his options. Even traditional optical astronomy was migrating to satellite telescopes, so space platform studies it would be. He started on a team developing radar mapping instruments for a Venus probe, published a few papers, and landed his professorship after getting his degree. He hated having to pass his hat for funding on an annual basis, but the government money was still flowing, so he couldn't complain. He had enough assured funding to shepherd Jim through his PhD.

Not surprisingly, parking was easy when he arrived. Plopping his jacket on his office chair, he resisted the urge to boot his PC and went directly to the laboratory. Jim was not there, but there was a note taped to his monitor.

Professor Moldovan, I'm at the large screen. Jim

The large screen was a developmental workstation that was not quite ready for routine analysis. As its name implied, the workstation possessed a huge screen that could show multiple items simultaneously, and Jim was helping with the development. The large screen was in its own room a little further down the corridor. When Moldovan entered, Jim was feverishly typing, and he looked up only after finishing. The screen was full of images and charts.

“OK, Jim. What do you have?”

Jim gave a short overview of the discovery and then went to the screen. He pointed out the discovery image and the visible image. The visible image was naturally a letdown. Egyptian pyramids they would be able to see, but not much smaller. Jim had also done the relevant checks. This wasn't a data glitch, since the error correcting codes showed only clean data and no interpolations or point corrections. The very size and shape of the hot spot was indicative of something real.

“I was able to extract data from other missions. Here's the region scanned by the Mars Orbiter Laser Altimeter.” Jim pointed to a contour map. “The region is considerably uplifted from the local terrain. If this were earth, I would anticipate that a volcano was on the way. But this is Mars. Let's be optimistic. Perhaps it's some water, heated from below, pushing against the surface for, let's say, millions of years?”

Moldovan stared at the images, rolling through theories in his mind. Water would be nice, but how could they be sure? His reverie was broken by the realization of all the work that needed to be done before they could make a case for water. He tapped one image with his finger for emphasis as he replied.

"We need more resolution. Of course, in the IR, this is all we have. But it was good enough to get us to this point, so that's OK. We need more visible resolution. Something like the Mars Reconnaissance Orbiter."

"I've already checked. Not unexpectedly, no data in that area. It just isn't an interesting area."

"I understand NASA politics, and even this wouldn't make it an interesting area. We need a lot better reason to convince NASA that it's worth a high resolution scan. Fortunately, NASA isn't the only show in town. There's the High Resolution Stereo Camera on the ESA Mars Express. Not quite as good as MRO, but much better than what we have. I know someone at ESA. It must be mid-day in Paris. I'll see if I can reach him by telephone."

Jim's excitement abated somewhat as Moldovan left the room. NASA wouldn't consider his hot spot a major find? Crap! What does a guy need to do for some recognition. Well, the Old Professor has an ESA connection. He'll know how to work this through the back channels to get the data they need. Jim's shift was not finished yet, and his automatic recording had been in progress for more than an hour while he was at the big screen. He would need to finish his shift at the Therm-All screen, and then stay an additional hour to review the recorded images that were made during this diversion. He tried to convince himself that they were in a field of thermal vents, and he would find at least one more that night; but in the back of his mind he knew the remainder of the night would be an utter bore.

9 First View

Stammler, Maurer and Kristopf returned to the excavation site at about 3:00 PM. Erzbereger was standing guard over the equipment and the bore hole, and he was happy to see their return. He didn't mind honest work, but all this waiting was wearing on him. A security guard would arrive at about 6:00 PM, and another would relieve that guard at midnight. These men were trained for radiation hazards. Stammler said that Kristopf was all he would need for the rest of the day. Erzbereger was free to leave if he wanted, so he did, saying he would be back all the earlier in the morning.

Maurer's first task was to get his newly purchased camera working above ground with his laptop computer. Shielding the camera and inserting it into the bore hole would come later. Stammler and Kristopf busied themselves with a procedure to lower the camera into the bore hole. The bore drill was now somewhat radioactive, but most of the radiation was at the tip, inside the chamber. As long as they stayed clear of the the drill tip and the bore hole itself, the radiation level would be safe. They decided to remove the drill, place it on the ground at a distance, and then use the derrick mechanism to lower the camera through the inside of the bore hole on a rope. Kristopf had first considered a chain, since the weight of a chain would make the descent through the hole easier, but Stammler knew that the rope would become much less radioactive than the chain and would be easier to dispose as radioactive waste. The lead weighted camera would have sufficient weight to allow an easy descent through the hole. The entire operation would be done in radiation suits, but with filtered air instead of a breathing unit. One man, in this case Maurer, would be standing out of range should any emergency arise.

The drill removal went much better than Maurer's installation of the camera software. The camera program couldn't find a file. Finally, he decided to install the wireless card first, reboot, and then install the camera program. Success! When Stammler and Kristopf removed their suits and looked over Maurer's shoulder, they saw a crisp image of themselves working the drill. Now it was time to shield the camera. Lead sheet is very soft. It can be cut by an ordinary scissors and shaped by hand. Maurer attached the leaded glass paperweights to the camera lens and flash lamp with packaging tape, and then wrapped lead around the camera body, cutting openings in front of the leaded glass shields. The antenna was somewhat problematic. It was built into the camera. Maurer's solution was to use a lead strip, suitably insulted with more packaging tape, to couple the radio signals from inside the lead box to the outside world. Using a radio intensity meter built into the wireless software, he was able to position his antenna strip for best results. A field test proved communications with the camera over many tens of meters. With a tap of a key on his laptop, Maurer could snap images with the camera.

They affixed the camera to the rope in a way that the camera was not quite horizontal, but sloped down somewhat for a better field of view. They needed to add some lead sheet to balance it to the right angle. They didn't want to lower the camera much below the roof of the chamber. Twisting the rope would allow a panoramic view of the chamber.

With the rope looped over the top of the derrick, Kristopf maneuvered the derrick into place over the bore hole. It was his idea to tie the rope off at a length that would prevent the camera from falling to the floor of the chamber, wherever that might be, if the rope got away from them. The remote antenna was placed at the top of the derrick, pointed down at the hole, and the cable length allowed Maurer a seat in the cab of the truck. He did a few test exposures above ground, and then they slowly lowered the camera into the hole. Maurer watched the signal strength meter, and he was getting strong reception on the way down the hole.

They had marked the rope at the approximate depth of the top of the chamber. When they reached that point, Maurer snapped a photograph. They were apparently still within the bore hole, since the

computer screen showed a dull gray with a slight brightening near the edge where the flash was mounted.

"Kristopf, a few more centimeters – fifteen or twenty."

Stammler held the rope while Kristopf untied the end, played out a little more rope, and then retied the end. Maurer tapped the space bar for another shot. Now he saw an image. He didn't know in which direction the camera was looking – it was all up to chance and the twist of the rope – but from this direction the room seemed to be quite large. The walls were covered with some unknown symbols, and he could see a pedestal adorned with a sphere about a quarter meter in diameter and the edge of another sphere several meters away from the first and to its right. The sphere was very reflective, like metal. He saved the image.

"Rotate a little to the right."

"Stammler and Kristopf put a slight torque on the rope to twist it to the right. Maurer waited a few seconds for the movement to stabilize and snapped another image. Yes, it was another sphere identical to the first. He could see more symbols on the wall. After several more rounds of this procedure, Maurer had a complete panorama of the chamber. They continued this a second time, in case they had missed something on the first. Stammler and Kristopf retrieved the camera and placed it alongside the irradiated core drill. Perhaps it would be useful one day, but not again for the near future. The rope was not expected to retain much radioactivity, so it was placed by itself somewhat removed from the camera and core drill. While his colleagues removed their radiation suits, Maurer made a back-up copy of all the images onto a memory stick, and he placed the stick in his inside pocket for safe keeping. Then they reviewed the images together.

The room contained four metal spheres on pedestals oriented on a central square several meters on edge. There was no question that these were the uranium sources. Stammler's initial surface survey showed four equal sources.

"What puzzles me, Konrad, is that these spheres are shiny. If they are uranium, then they must be have been alloyed or coated. Uranium is a very reactive metal. The spheres should have crumbled into piles of uranium oxide after any extended period."

Maurer replied, "Only if you assume that the atmosphere in the chamber is air and not an inert gas."

"Konrad, must you always remind me when I stupidly forget something?"

Maurer laughed, "Herr Doctor, it is my duty!"

Stammler turned to Kristopf. "Kristopf, would you be so kind as to re-suit and plug the top of the bore hole as best you can. It should be airtight. The chamber seems quite large, so we haven't disturbed the atmosphere too much in the past few hours. We will run a gas analysis when the other equipment arrives."

Kristopf complied. Stammler and Maurer continued their review of the photographs. Aside from the spheres, the room was barren. It looked as if there was a corridor at one end of the room. Did it lead to a similar chamber? Perhaps their job here had doubled in scope. They didn't know what to make of the symbols on the walls. The walls themselves must be shielded with lead. It was the only explanation for the low surface radiation as compared to the radiation level in the room. It would be easy to scratch designs into lead.

At this point, the night guard on the six to midnight shift had arrived. Stammler showed him around the site, pointing to the bore hole that Kristopf had just plugged, and the contaminated core drill and camera. The guard assured him that he would not wander around the site. He would spend most of his time in his vehicle keeping warm. Stammler offered Kristopf a dinner, but the young man said he had plans for the evening. A young lady would be involved, and it was not something he could pass up; so, he said his goodbye until morning. Maurer packed their vehicle, Stammler did one last safety check around the site, and they made their way back to their hotel. Stammler made a mental note to inform

the authorities that the pipeline construction would be suspended for some time. Perhaps they could work farther down the line. He suspected they would be wise to start a plan to reroute around the area. This mitigation process would take quite a while.

Both of them were eager to do a more careful examination of the photographs, so they decided to have only a quick dinner in the hotel restaurant. Stammler took the precaution of buying some antacid tablets in the hotel gift shop before proceeding to his room. After necessary ablutions and a quick change of clothing, he met Maurer in the hotel lobby. Their meal was definitely not haute cuisine but it was adequate, and fast. Clutching another expense report receipt, Stammler followed Maurer to his room.

Maurer booted his laptop and dragged all the images of the underground chamber into a slideshow viewer. They examined each of them in detail, with Maurer pulling some into an image manipulation program so he could enlarge, increase contrast and save images of each symbol etched on the walls. The only obvious feature of the corridor was the entrance. The flash could not illuminate that far into the darkness.

Maurer reasoned, "The robot camera will reveal more."

"I've been thinking about the robot camera, Konrad." We will need a rather large hole to deploy it, much larger than the bore hole. That operation would disturb the room too much. If we could dig into the corridor, the robot could just roll into the room, but we don't know anything about the corridor. It might not be a corridor at all, just an anteroom. We need more information. What we need is a survey using ground penetrating radar. I'm acquainted with someone in the Electrical Engineering Department at the Technische Universität Dresden. If I know his habits correctly, he will still be in his office. He might know of some equipment that can be used. Let me make a call."

Fortunately, Maurer had ordered an internet connection when he registered for his room. While Stammler was on the telephone, he searched for the symbols on the internet. He had no idea of what they might relate to, so he just searched for Ancient Symbols. None of them appeared in the first few pages of images, so he waited for Stammler, who was just finishing his call.

"I was able to reach Gaspard at his university office. When I called him a workaholic, he asked me who was calling whom about business at that hour. I guess we scientists and technologists are all cut from the same cloth. Well, he says he can get us help from an archaeologist, of all people! One of Gaspard's colleagues collaborated with the archeology department on building some ground penetrating radar equipment. I gave him my cellphone number, and he will call me in the morning."

Maurer told him about his unsuccessful search for the symbols. He showed Stammler the composite image he had made of all the unique symbols they had found.

"Well, here's one that's recognizable. It's the symbol for man or manhood. This one, the circle with the arrow."

Maurer snickered, "Are you sure he's carrying an arrow, or does that represent something else?"

"Yes Konrad, point well taken! Let's start our search here – male symbol."

Maurer typed in the search box, and the image appeared. There was also the companion female symbol, a circle with a cross under it.

"OK, I understand the vertical smile, but what about the extra horizontal line?

"It's simple, Konrad. A horizontal line is the universal symbol for Eingang Verboten!

They laughed. As they paged through the image search pages, they saw that there were captions other than the male symbol. This same symbol was also the symbol for Mars and the alchemical symbol for iron. They quickly homed in on a web site that had an entire page of alchemical symbols. Nearly every symbol on the underground chamber walls that Maurer had photographed was found on that page.

"Konrad, I think you found a clue. The chamber is related to the ancient practice of alchemy. All I

know about alchemy is its quest for the Philosopher's Stone, the material that turns lead into gold."

"The ancients did have strange ideas. They even believed that if you buried metal underground, like a seed, it would grow larger."

"We seem to know so much more, but I often wonder what people even a hundred years from now will think of our strange ideas."

"What puzzles me, Ulrich, is the location of the chamber. It's in the middle of nowhere. And where is the entrance? That corridor might point in the direction of the ruined church. Could there be an underground tunnel from the church to this chamber?"

"Such a construction would be a major undertaking, and why so far? If you wanted access to the church, you would build the chamber near the church."

"Well, there's the radiation. The farther, the better, in that case. But a simple bend in the corridor would offer the shielding of the earth. There must have been some other reason."

"Here we are, Konrad, talking around the main mystery and concentrating, instead, on the little mysteries. So much uranium, and for what purpose? Perhaps the symbols on the walls will offer clues. The robot may find some papers, perhaps the entire construction plan, and maybe operating instructions for our supposed nuclear reactor."

"At this point, many questions. I hope that our robot will supply some answers."

10 ESA

"Weber, here."

"Horst, this is Matt Moldovan calling from Arizona."

"Matt! What brings you awake so early! It must be something important."

"Well, yes it is. Can you talk for a while?"

"Yes, certainly. Give me a second."

English must be the semi-official language at the ESA, since Moldovan could hear Weber make apologies to some visitors in English and then close his office door.

"OK, Matt. What's up with you?"

Moldovan summarized Jim's discovery and his desire for some high resolution imagery. Weber was silent for a moment, and then spoke, almost in a whisper.

"Matt, I hate to pressure you about this, especially not at such an early stage. This will take some work on my end, mostly political work and not much of the fun science stuff. Is this worth a co-authorship?"

Moldovan laughed.

"Horst, at this point, you and I have done equal work on this – namely, none at all - so a co-authorship seems very reasonable. My graduate student, Jim, made the discovery and has done the real work. He must be lead author."

"Matt, thank you very much! I won't let you down! Let me check the archive. Read me the coordinates while I type."

Moldovan read them off while Weber repeated them as he typed, mumbling some of them in German. When the right and left brains fight for attention, it seems that a compromise is reached.

"Well it looks like we have a low resolution image in our archive. The solar angle is not that good, so the contrast is not there. I would need to spend some time on the image processing. It's just some raw data now. Did I tell you I've had good processing results with a modified maximum entropy program? Now, the next good orbit, when we could do super-resolution, is still a hundred and nineteen days away. I would need almost that amount of time to secure the necessary permissions. How should we proceed?"

"Are those Martian days, or Earth days?"

"Ha, Matt! Always the optimist! I'm sorry, but those are Martian days."

"Well, Horst, work up the low-res image data, and send it along. Let's just keep things quiet for now. Things are still very preliminary. If anyone asks, perhaps you could say you have an indication that some recent meteorite impact may have exposed some fresh bedrock, you're testing your new image algorithm, or something like that. If the low-res image is interesting, you could pursue the super-resolution shot. We couldn't publish without it. Horst, would you remind me of the resolutions you can get?"

"Well, the normal resolution – what you call low-res – could be as good as a 10 meter by 10 meter square. As I said, the lighting conditions were not that good, so we can expect less. The super-resolution is about 2.5 by 2.5 meters, something like an automobile."

Matt closed off and tried to align his thoughts. They would have some images in a few days, but a hundred and nineteen days is a long wait for the high resolution stuff. Well, better just do the routine and let Horst handle the extraordinary, at least for now. Perhaps Horst's low-res image would convince NASA to use the MRO camera, but he doubted that the waiting time would be much better

11 Radar Survey

Stammler's university friend, Gaspard Poussin, telephoned in the morning while they were traveling back to the excavation site. Gaspard's archaeologist, Felix, was surprisingly in the country, an unusual state for one of his profession. Felix admitted that he was also bored, so he quickly volunteered to do a survey with the ground penetrating radar. Gaspard asked for directions. He and Felix would arrive before 11:00 AM.

Stammler and Maurer arrived at the excavation shortly after 10:00 AM. Erzbereger and his crew had been there probably since 7:00 AM. For want of something to do, they had been fortifying the perimeter fence and added extra radiation signs so that there would be no confusion to anyone that this is not a place to trespass. Stammler had always thought that the universal symbol for radiation, the circle with three radiating arcs, was too abstract. A skull and crossbones was far more illustrative. He imagined a composite symbol of a skull with a radiation symbol on its forehead.

People were still trying to devise universal symbols for proposed long-term radioactive waste depositories. In this case, the symbols would need to be understood by humans tens of thousands of years in the future, possibly at a time beyond our age of technology when all understanding of science and history had vanished. Some had even proposed a type of priesthood with rituals that might survive great cultural change and maintain knowledge to protect our progeny. Stammler thought that was a ridiculous idea, considering the fact that all religions were losing followers at an ever increasing pace in the modern world. He, himself, was still a churchgoer. All but a few of the congregation were even older than he was!

Kristopf greeted them warmly. From the young man's cheery attitude, Maurer surmised that Kristopf's evening with the young lady had gone exceptionally well. Erzbereger caught sight of them and jogged over for instructions. Stammler greeted him.

“Herr Erzberger, good morning! I presume Kristopf briefed you on our recent adventures. I have photographs!”

Stammler pulled a folder from under his arm and used a truck bonnet as a table. Inside the folder were prints of the photographs that Maurer had taken. Between breakfast and their arrival there, Stammler and Maurer had taken a memory stick to an instant photo place near the hotel. They knew that the photo attendant would see the images as they came off the printer, so Maurer devised a cover story. They told the attendant that these were crude images of scenery for a video game they were making. Stammler was hesitant to use his government credit card, so he paid cash for the photos and once again clutched an all-important receipt for his expense report.

As Erzbereger was reviewing the photographs, Poussin and his archaeologist friend, Felix Halpern, arrived. It had been a while since Stammler and Poussin had talked face to face, so after introductions, there were many pleasantries required before work actually started. They had both aged a bit, and they had each bubbled to the top of their organizations. “Have you seen Richard, lately,” etc... Just as the rest of the group was starting to tire of all this, Poussin suggested that they start unloading the equipment as they talked, and everyone eagerly lent a hand.

The ground penetrating radar was much larger than Stammler had expected, but a moment's reflection convinced him that it had to be. First, the wheels must be large for smooth travel over uneven ground. Then, the radar power must be large to penetrate to great depth in soil. This meant a large and heavy battery pack, although a wired diesel generator was often used in extensive field work. Finally, there was the most important reason of all. In order to penetrate to great depths, the radar wavelength must be as long as feasible without spoiling the imaging resolution. This long wavelength

requirement translated to a large antenna.

The radar equipment came in boxes, in pieces, since this was the only possible way to transport such a large unit by air. Although the radar was in pieces, it was easy to assemble. The designers knew that their intended users, although well educated, were not engineers. Assembly manuals always are lost, so the equipment was labeled with large numbers in circles. Attached to each circle was an arrow pointing to a hole, clamp or other connector. The idea was to match numbers and do the obvious connections in numerical order. Maurer noticed the resemblance of the arrowed circles with the alchemical symbol for iron they had found in the chamber. Humans tend to recycle the same symbols.

The radar was assembled in record time, possibly because of the unusually large team that assembled it, and the presence of an electrical engineer. The device looked more like a floor sweeper than a radar. There was no dish-shaped antenna. The antenna was a flat plate. Poussin explained that this was a phased array patch antenna, and the shape of the probing and receiving beams were synthesized using a mathematical model. Stammler understood the optical analogy of what was happening, but the technology was beyond him.

Felix rolled the unit to a conveniently level spot and activated the radar. The ground-penetrating radar went through a diagnostic and calibration cycle and gave a reassuring beep.

“Now comes both the boring and the exciting parts,” said Felix. “The boring part is having to move this around the field in a regular pattern of overlapping scans. The exciting part is learning what's down there.”

The data handling system on Halpern's radar wasn't as sophisticated as that on Stammler's radiation mapper. Although it had a positioning system, the radar wasn't designed to build a map of the underground area like Stammler had done for the radiation data. The radar would simply store any image the operator found interesting and label it with the geographical location. Archaeologists were typically interested in small plots they could excavate, not huge underground areas. If he wanted, the archaeologist could assemble a montage of these images at a later time. Of course, at the depth they wanted to image, the resolution wouldn't be that good, so a detailed map was probably overkill. Stammler was interested in the boundaries of the chamber, so they wouldn't disturb it much when they excavated to place their robot. Their primitive camera had seen what looked like another room, or a corridor possibly leading in the direction of the church. Whatever it was, the radiation survey showed that it did not contain radioactive sources, so Stammler was quite interested in finding its extent. That might be a good place to excavate a hole to lower their robot.

Fortunately, the ground was quite level, and it was painted with just the barest coating of fine grass and weeds, which made the mapping operation very easy. Halpern pushed the unit with Stammler alongside watching the display. Maurer and Kristopf walked behind at a respectful distance carrying a hammer and stakes with prefixed yellow ribbons. When Stammler signaled, they stepped forward and placed a stake to mark the boundary between solid earth and a chamber wall. Although Halpern and Stammler lingered for a time above the center of the chamber, there wasn't enough resolution in the radar image to see anything.

It took only half an hour to map the underground chamber that way. Its dimensions, which were indicated approximately in Maurer's photographs, were now exact. The chamber was 12 meters by 16 meters, and it had a single entryway at one end. As they mapped the area on the other side of the entryway, a pattern began to emerge. Stammler thought there might be an anteroom there, perhaps with an access port to the outside that they would discover. Instead, the mapping indicated a long corridor. It appeared to be a tunnel leading to the ancient church that Stammler and Mauer had investigated on their first visit. It would be too difficult to map the tunnel completely to the church, but Stammler decided that wasn't necessary. The final exploration would be done on the inside, by the robot.

While the survey was being done, Maurer had extracted an air sample which he analyzed on a portable residual gas analyzer. It was normal atmosphere, perhaps with a little more humidity, which raised the question of why the uranium hadn't oxidized in all those years.

As the survey progressed, Stammler had hatched an excavation plan in his head. First, they would drill another survey hole, this time a few hundred meters up the tunnel, away from the radioactive chamber. The ground-penetrating radar indicated a very uniform reflection through the tunnel, which indicated both an intact roof and a level floor. It seemed as if great care had been taken in construction of the chamber, and he hoped that this same care had been taken in construction of the tunnel. If the survey hole showed a clear path to the chamber, they would excavate an opening large enough for them to lower the robot.

It was well after noon, and it was too late to undertake drilling the second survey hole. The radiation-hardened high resolution camera was scheduled to arrive that day, and preparations were being made to crate and ship the robot. Fortunately, the robot would be shipped via a bureau truck directly to the survey site. Stammler outlined his plan to the accompanying troop, and they disassembled the radar unit for transport. Stammler thanked Halpern, guards were posted, and they retreated for the day.

12 Robotic Survey - Earth

Stammler and Maurer, knowing that the drilling crew started work fairly early in the morning, arrived at about 8:00 AM after a quick breakfast. The sun had been up for nearly two hours, and sometime in that interval the crew had placed the drilling rig precisely over the spot that Stammler had marked the day before. Stammler had instructed them to use the same drill string they had used for the initial hole, cautioning them about the slightly radioactive tip. No use filling the radioactive waste dumps prematurely when double-duty could be had for this piece with just a little more care. Not only that, but the bureau's budget officer would be thankful.

Erzbereger and Kristopf manned the drilling rig, and since they had the experience of the first survey hole and knew what to expect, they punched through the ceiling of the tunnel in short order. The drill pipe was removed, carefully placed to one side, and marked appropriately as a radiation hazard. Erzbereger examined the drill tip for evidence of the the material used in the construction of the tunnel ceiling, and he found splinters of wood, an obvious building material for the ceiling of an ancient tunnel. Maurer used the derrick mechanism to lower a radiation probe into the hole. The radiation was far less due to the distance to the source, but it was still quite high. Maurer advised all to exercise caution. It was time to lower the camera into the survey hole for a look.

The radiation-hard camera they had was designed for a dual purpose. It was shaped for easy insertion into such survey holes, and it had an integral mirror so that the downwards pointing camera could have a panoramic sideways look at its surroundings. It could then be mounted on the robot, and with the mirror removed it had a high resolution image of where the robot was headed. There was a high intensity light built into the camera housing, but the robot had its own floodlights that offered a wider field of view.

Maurer lowered the camera gently, and when it broached the level of the tunnel ceiling, they got their first view of the tunnel. The surprising thing was that it was not just a tunnel. Mounted on the walls was some sort of piping, interrupted at intervals by what appeared to be thin glass jars that reached to the floor. Both ends of the tunnel were dark, but the tunnel appeared to be intact and passable.

“Herr Erzbereger,” asked Stammler, “Is there a torch on site, and some rope?”

“Kristopf?”

“Herr Doctor, there are both in a truck. I'll get them.”

“ Kristopf, it would be best if the rope didn't have any metal attached to it. If there's no metal, then the rope will be useful afterwards. The torch, unfortunately, will be radioactive after use, and it must be disposed.”

Kristopf returned in a few minutes with a rope slung over his shoulder and a compact light-emitting diode light.

“Perfect,” said Stammler. “Kristopf, put on a radiation suit, attach the torch to the rope, switch it on, and lower it into the first survey hole. The chamber roof is at six meters, so knot the rope at six and a half meters so we'll light the chamber without disturbing anything. And tie the rope to your belt so the torch doesn't accidentally drop into the chamber.”

Kristopf attached the ring end of the torch to the rope, used a tape ruler to measure out a proper length, and tied a knot. He put on a radiation suit, tied the rope about a meter above the knot to his belt, and then walked to the first survey hole about three hundred meters away. He had been trained well. Instead of standing over the hole to lower the rope down, he found a heavy piece of pipe left from the previous drilling and laid it alongside the hole. The pipe would guide the torch into the

chamber, and he would stand safely back.

Kristopf signaled when the torch had reached the chamber, but that wasn't really necessary. Maurer could see the light at the end of the tunnel on the display screen. The tunnel path to the chamber was apparently unobstructed. The next step was the excavation of a larger hole to lower the robot into the tunnel. It was nearly 11:00 AM. Amid consultation with all team members, Stammler decided that they would break for an early lunch, hopefully complete the excavation in the afternoon, and work with the robot in the next morning. One of the workers volunteered to stand guard over the site, provided that someone brought him back some lunch. Stammler quietly informed the crew as they were leaving that beer could not be part of a takeout lunch. No beer bottles would litter his work site.

Stammler invited Erzbereger to lunch with him and Maurer, asking him to select a convenient place for a fast meal. Erzbereger knew of a nearby Vapiano. Stammler could see from his facial expression that Konrad would have preferred to milk the expense report a little more, but Stammler knew they should return to the site quickly. He wanted the excavation to be completed before nightfall, and without problems. Without Erzbereger, the crew couldn't do anything.

“Vapiano, a good choice,” said Stammler. “We can get better acquainted over a pizza, and perhaps a very small beer, early in the meal. I'm sure it won't hurt.” After all, this was Dresden. When in Rome...

It was a mere five minutes to the restaurant, and once the pizza style had been decided, they had time to chat.

“ Erzbereger, we are now familiar. Please call me Ulrich. And, how may I call you...”

“I am Karl.”

“Karl, Konrad and I are quite intrigued by the site. I'm sure you haven't seen anything like it yourself. We should be very careful in our explorations, and that's why I located the excavation point at such a distance from the chamber. We must keep everything in very pristine condition, maybe for scientific, but certainly for historical, reasons.”

“I fully agree, Ulrich. I have an excavation plan already. First, six meters to the tunnel top is not that deep. We will certainly not drive any heavy equipment over the tunnel, and we will definitely not park any over the tunnel. There is too much likelihood of collapse.”

Konrad interjected.

“Yes, six meters is shallow, but it is still necessary to bring that last bit of dirt up six meters to the surface. It wouldn't be safe for your workers to be in the hole with shovels without radiation suits, and how could they shovel with the suits on? Have you some equipment for this?”

“Fortunately, the hole required for the robot is small. We will use a small backhoe. The hole will be larger near the surface, and we'll shore that with a casing, at least for the first few meters. That will prevent a collapse of dirt into the tunnel. Since I anticipated the requirements, all this equipment is presently at the site.”

“Excellent, Karl,” said Stammler, just as the pizza and beer arrived. Stammler found that a small beer, by Dresden standards, was quite impressive.

They were back at the excavation site shortly after noon, and Erzbereger immediately got the crew organized. Since they had done similar operations in the past, there were just a few additional caveats, such as not driving over the tunnel, that Erzbereger conveyed. When the backhoe was in place, the initial excavation was an approximately square hole about three meters on a side and two meters deep. The workmen, lashed to supporting cables in the event that the ground gave way beneath them, fixed the interlocking panels that made the hole casing.

Additional boards attached the top of the casement to the ground surface, ostensibly to prevent the casement from slipping into the hole. When this top casement was in place, the hole was deepened by about the same depth, but to a slightly smaller size. A second casement was applied to the lower part

of the hole, and it was interlocked with the top casement by a small shelf.

Now came the interesting part. Since they were within two meters of the tunnel ceiling, work proceeded more slowly. First, the backhoe bucket was replaced with one that was a smaller size. Unlike the original bucket that scooped the earth in a sideways motion, this bucket clawed the earth a bucketful at a time. Kristopf, who manned the backhoe controls, made certain that he didn't ram the bucket hard into the ground, since this would likely collapse the ceiling of the tunnel. After a time, a wooden plank was visible, and one of the workmen entered the hole with a shovel to do some clean up of the remaining dirt.

At that point there was a discussion of how to penetrate the wooden planks of the tunnel ceiling. Kristopf wanted to just bang the bucket and smash his way through, reasoning that the wood was so old it would just break into a powdery mass. Stammler was worried that the damage of such an operation would spread too far. In the end, a worker dressed in a radiation suit and very securely fastened on a line, took a reciprocating saw and cut the ceiling to match the hole size. Screws had been attached to the wooden planks to capture them and remove them to the surface, but the wood was so weak that nearly all fell to the bottom of the tunnel.

"No matter," said Stammler. "The robot can climb obstacles much worse than those."

Maurer had been exercising the robot on a level patch of ground while the excavation was proceeding, so it was ready to be lowered into the tunnel. The robot was attached to a single cable on the same derrick assembly that was used for the drilling, it was slowly lowered into the hole, and then to the floor of the tunnel. Also on the cable was a radio transmitter used to relay communications between the robot and Maurer's computer. Before the cable was detached, Maurer activated the camera and floodlights for an initial view. He had activated the lights at full intensity for their first peek into the tunnel, but he knew that he needed to switch to a lower intensity in a minute to conserve power. The battery power was good for just a few hours even at the low intensity setting.

Maurer rotated the camera 360-degrees to get a high resolution view of the tunnel itself. The robot's camera confirmed what the survey camera had seen. There was some sort of piping mounted on the sidewalls of the tunnel. The piping was interrupted every ten meters or so by thin glass jars that reached to the floor. One of the glass jars was broken, either by their activities, or by years of subsidence-induced stress, to reveal what appeared to be a metal cylinder.

"Leyden jars, perhaps?" said Konrad. "The piping is actually an electrical conductor?"

"That would be interesting," replied Stammler, "Since Leyden jar capacitors were invented just a few hundred years ago, and this tunnel might well predate them. But we also have the example of the uranium, another anachronism."

When Maurer was certain that the essential parts of the robot were active, he keyed the computer to release the cable, reduced the intensity of the floodlights, and signaled the robot forward, towards the chamber. The tunnel was in exquisitely good shape. It had apparently been created with great care at a time when all labor was manual. There were no caved-in areas, although the detritus was somewhat higher in certain patches, since exposed spaces between the ceiling planks allowed some silt to sift downwards.

The robot's trek down the tunnel was uneventful. Especially curious was the dryness of the tunnel. At such a depth, they would have expected water on the floor. Stammler reasoned that shipbuilding techniques had been used to seal the tunnel, and the hard clay soil of the region likely helped. The walls contained the piping and glass cylinders throughout its length. At one point, a pipe had fallen away from the wall to reveal its inside construction. It appeared to contain a pipe inside a pipe. The pipes were not corroded, as they might have been if they had once contained liquid, reinforcing the idea that these were electrical conductors.

The robot's speed was about ten meters per minute. Allowing time for Maurer's stops for detailed

photographs, it reached the chamber in a little more than half an hour. At the chamber's entrance, the piping on the walls gradually slanted downwards and disappeared into the ground. Maurer paused the robot at the chamber entrance and did a 180-degree scan with the camera. As had been revealed in their earlier, crude photographs, the chamber was essentially empty, except for the four pedestals in the center holding the uranium spheres. The walls were everywhere festooned with alchemical symbols.

"Maurer," said Stammler, "When we enter the room we need to photograph every square inch of the wall surface. Also, although it may go without saying, don't knock over the pedestals!"

"I will give them wide berth. I think it would be best to hug the wall for now, and photograph the opposite wall from that vantage. If there's anything of special interest, we can travel to it for a better look."

Maurer decided on a counter-clockwise survey of the chamber, so he turned the robot towards the right and positioned the camera accordingly. Because of the angle of their camera, one thing they hadn't seen in the initial survey was the chamber ceiling. As soon as the robot entered the room, it was apparent that the ceiling, too, contained symbols, but these were alphabetic letters. The ceiling had a text!

"Maurer, the ceiling!"

"Yes, Herr Doctor, I see it!"

The chamber must have predated Gutenberg by several hundred years, since the words were written in a bold script, and not in a stylized typeface. Some of it looked German, but not enough that it could be read. Maurer was careful to capture the text in overlapping images so that it could be accurately reassembled and perhaps deciphered. The language used would allow an independent dating of the chamber.

As Maurer made his circuit around the chamber, snapping photographs as he went, Stammler was studying the uranium spheres. Everything else was an exciting distraction, but weren't the uranium spheres the primary reason for their being here? The pedestals were designed especially to hold the spheres, since there was a deep depression at the top of each on which the spheres were seated. Stammler had the idea that the pipes they saw in the tunnel, the ones that went underground at the chamber entrance, somehow connected to these pedestals.

Maurer's robot circled the chamber counterclockwise, stopping at intervals to snap photographs. When the robot had again reached the chamber entrance, it was time to examine the spheres more closely. Maurer commanded the robot to inch forward to the center of the room, and he stopped it about two meters from one of the pedestals. The camera scanned the pedestal from top to bottom, but there was no discernible structure. It was just a cylinder. It was topped with a sphere that looked to be about fifteen centimeters in diameter. From what they could tell, all the spheres were identical. Maurer's computer beeped.

"Herr Doctor, we are halfway through our battery charge. It's time to retreat."

"We have what we need for now, Konrad," said Stammler. "We can recover the robot."

Maurer backed the robot away from the pedestal to the chamber entrance, had the robot do a 180-degree turn, and started the robot on its travel back to the excavation hole. Stammler was considering the next move.

"Konrad, it would be an easy matter for us just to retrieve these spheres, one by one, and decontaminate the site. But that wouldn't be the proper way to handle this. There's the mystery of how the spheres came to be, their purpose, and the historical significance of the chamber and tunnel. We need to bring others into this case."

"Herr Doctor, I agree. But there is one other thing we might do."

"What's that?"

"The robot is in place, we've explored the tunnel leading to the chamber and the chamber itself, but

not what's at the other end of the tunnel. If the chamber is indeed a power source, then what did it power? The pipes clearly lead back through the tunnel."

"Konrad, you're right, but the day has nearly ended. That must wait until tomorrow."

"No matter. We still need to recharge the robot. Overnight is a good changing interval."

The robot returned to the excavation site in about twenty minutes, but Stammler now had a problem. Since the robot had been in the chamber with the uranium spheres, it was temporarily radioactive, so removing it to the surface would be a chore. A wire needed to be attached to recharge its batteries; but after recharging, the robot would just need to go back into the hole for tomorrow's excursion to the other end of the tunnel, the end at the church. After consultation with Maurer and a conversation with Kristopf, Stammler decided to have Kristopf, suitably protected with a radiation suit, lowered into the excavation hole to attached the charging cable. Kristopf performed the operation quickly without any problem, and the team disbanded for the night.

13 Transmutation

Back at their hotel, Stammler and Maurer reviewed the results of the day's exploration.

"Ulrich, after we see what's at the other end of the tunnel, what's your plan?"

"Well, Konrad, that might depend on what we find, but I suppose what's there will be just as much a mystery as what's in the chamber. I think the chamber holds the only radiation source, but it's good that we're here to check. That's our real job, although we've been acting like amateur archaeologists. It might be near the time to call in some real archaeologists, although the presence of radiation will make their work a chore, and it may involve us still. I wouldn't disturb anything until they've been consulted."

"Ulrich, at this point I don't think we can be certain that the chamber is the only radiation source. The tunnel leads back to the church, but what if there are other tunnels that radiate from the church? Your survey was only in this area. I would draw a circle around the church at the distance of this one chamber and search for others."

"Excellent point, Konrad. Perhaps our exploration towards the other end of the tunnel will indicate whether what you say might be true. It would be interesting if we find some other tunnels intersecting."

"This amateur archeology, as you call it, has been so interesting! The symbols, the mystery! There seems to be alchemy involved, but uranium? What would an alchemist know about uranium?"

"Newton was a closet alchemist. The science attracted his great mind, so why not others? About Newton, we know. Were there other, unknown Newtons who had an enhanced understanding of Nature? And still..."

"What, Ulrich?"

"Science is one thing, and technology is another. You can know of uranium, but amassing such a quantity of uranium a thousand years ago to form what might be a primitive atomic reactor – That's impossible. Then there's the problem of handling the radioactive material safely."

"Perhaps the spheres were not uranium when they were made. They may have been made from a more common and workable metal, like lead, and then changed. Isn't that what alchemists were supposed to do?"

"Lead transmuted into uranium? Let's be serious here, Konrad!"

"Right, the conventional way makes much more sense! First, locate suitable mineral deposits of uranium. You won't find any around here. Africa might be a good place to look. Second, mine the deposits, refine the ores and smelt the uranium. An expensive proposition, but not as expensive as the next step. Third, isotope separation of the uranium with middle ages technology, leaving no environmental footprint. Finally, fourth, safety handle the highly radioactive material to fashion the spheres. This makes as much sense as harvesting the spheres from a crashed alien spacecraft, and then knowing exactly what to do with them."

As Maurer flipped through the images on the computer screen, Stammler had him stop at a photograph of the sphere.

"Konrad, can we get an accurate measure of the diameter of the spheres from these photographs?"

"I think I can."

Maurer stepped back a few images to a photograph of the base of the pedestal.

"This image shows both the front part of the robot and the base of the pedestal. I know that the width of the robot is 125 centimeters from the size of the hole we needed to dig."

He placed the image in one corner of his screen and flipped back to the photograph of the sphere.

“The robot was in the same place when it obtained this image.”

He put the sphere photo in another corner of the screen and opened both images in another program. Using the computer mouse, Maurer marked points on the images, worked with the program menus and a calculator, and came back with a number.

“Using some basic trigonometry and pixel counting, each sphere is between sixteen and seventeen centimeters. I could be wrong by a small percentage.”

Stammler paled.

“Konrad, I'm sure the spheres can't be over seventeen centimeters! But so close! If the material is very pure, the critical mass of a U-235 sphere is seventeen centimeters!”

“But what if two spheres touched!”

Stammler thought for a moment, and then relaxed.

“Not to worry, Konrad. The neutron flux would still be too small for an explosion, even if all the spheres were gathered together. There is one other thing we observed that may be important; rather, I should say, there is one thing we didn't observe.

“Much like Sherlock Holmes' non-barking dog?”

“Yes, Konrad, exactly. We didn't see any evidence of rodents. If the tunnel were open at the other end, we should have seen some traces. If some unfortunate rat had wandered into the uranium chamber, his skeletal remains would have been in the tunnel somewhere. Either the tunnel is collapsed at the other end, or there is a secure door to whatever is left of the church.”

“There must be a door at the other end, Ulrich. The tunnel construction is quite superb. I can't see how the tunnel would have collapsed. If there were a collapse, unless the collapse were major and very early in its history, there would still be some remains.”

“Perhaps the chamber was abandoned because of a collapse. It might be that the only people who knew about the chamber were killed in such a collapse. In any case, enough speculation for one night. Let's get some sleep so that we'll be alert in the morning.”

Saying good night and actually having a good night are two different things. The uranium spheres weighed on Stammler's mind, and he had a restless night.

The next morning, Stammler and Maurer had a quick breakfast in the hotel restaurant and arrived at the excavation site just as the other workers were arriving. Maurer connected his computer, checked the charge state of the robot and told Stammler, “Herr Doctor, the robot is charged.”

Kristopf was sipping his coffee and chatting with the other workers. Stammler motioned him over to dress in a radiation suit and detach the charging cable from the robot. This was as easy for him to do as the initial attachment. “Ah,” thought Stammler, “The joys of youth!”

Maurer did his routine check of the robot functions, and he commanded the robot to move forward, towards the unknown end of the tunnel. The aspect of this new portion of the tunnel was no different from what they had already seem. The same piping, interrupted by the glass vessels. The trip was becoming monotonous.

“Maurer, how many meters from this point?”

Maurer checked the display screen.

“About five hundred meters, Herr Doctor.”

“How far to the church?”

Maurer stopped the robot momentarily, and he pulled up a satellite image of the area that marked the location of the initial survey hole, where the chamber was located.

“Since the tunnel appears to be very straight, I can estimate that the robot is here.”

Maurer pointed to a place on the satellite image a little more than a hundred meters from the church.

“Well, if the tunnel does terminate at the church,” said Maurer, “We should be there in about ten minutes.”

Soon, the piping on the walls started sloping downwards as they had done before the entrance to the uranium chamber. Maurer commanded the robot to stop, and he turned the lights to full intensity. Just ahead, they could see that the tunnel terminated in another chamber. Maurer checked the radiation meter.

"Herr Doctor, no increase in radiation. Shall I proceed forwards?"

"Yes, Konrad," Stammler replied, "but very slowly. This may be an anteroom connecting the church to the tunnel, or perhaps something significant. Stop when the entrance is reached."

The robot proceeded at a walking pace to the entrance to this new chamber, and Maurer commanded it to stop. Maurer scanned the camera through a shallow angle. The piping entered the ground, as it had in the uranium chamber, and the room appeared to be of the same size. Ahead, in the center of the room was a single pedestal, about a meter off the ground, surrounded by what seemed to be benches. The room was festooned with the same symbols that were found in the uranium chamber, and there was a door at the far end of the room. The central pedestal contained what appeared to be a jagged rock.

"Konrad, do a photographic scan as you did for the uranium chamber."

Maurer complied with Stammler's request, moving the robot counterclockwise along the chamber wall, stopping at intervals to photograph the far walls and the ceiling. Although the placement of writing on the ceiling and symbols on the walls was similar to what was found in the uranium chamber, they didn't have time to analyze the images at this point, since the robot was working from a fixed charge. Eventually, because of the absence of radioactivity, this chamber could be analyzed more carefully by people in shirt sleeves.

After photographing the walls and ceiling, Maurer brought the robot slowly to the center of the room to examine the central pedestal and the rock. Stammler conjectured that the pipes somehow came above ground and connected to the pedestal, perhaps to a mechanism inside. The function of the piping on this end was as mysterious as it was at the uranium chamber, but the fact that it connected the two chambers must be important to whatever function this system might have.

The rock appeared black and ragged, somewhat like a cinder. The rock appeared to have been placed on the pedestal as is, without any modification. Why would a rock dug out of the ground hold such a place of honor? If anything would give a clue as to the workings of these chambers, thought Stammler, it must be the rock. Taking the rock off the pedestal for laboratory examination wasn't an option at this point. A more thorough examination by people more skilled than he was in order, and it might even be months before even a small sample would be taken of this rock. As Maurer scanned the camera up and down the pedestal, Stammler noticed something on the ground.

"Konrad, on the ground, slightly to the left of the pedestal... Can you image that object?"

Maurer moved the camera with the control stick, and he twisted the stick clockwise to zoom the image. There was a small black pebble on the ground that appeared to be a small chip broken from the larger rock. Whether it had settled there when the rock was initially placed on the pedestal, or it was dislodged from the rock over the course of a thousand years, Stammler was certain that it was a piece of the rock.

"Konrad, can the robot fetch such a small piece?"

"The arm is able, but the benches around the pedestal may make it difficult to reach. I can try, but I need to reposition the robot."

Maurer reversed the robot, made a slight turn to the left and proceeded forward. He reasoned that he would have the best chance to grab this pebble if he parked the robot sideways alongside a bench. The robotic arms were mounted at the front of the robot, but the swivel point of each arm was closer to an edge than the front. The robot was apparently designed this way to move its center of mass and give it greater stability. Fortunately, the pebble was still visible to the camera in this position.

Maurer carefully elevated one of the robot arms and swiveled it in the direction of the pebble. The

arm was reticulated at two points, and there was another point at the gripper, but the control circuitry automatically adjusted the bend angles to conform to the direction that the operator wanted to move the gripper. It had been a while since Maurer had operated such a robotic arm, but, like riding a bicycle, it came back to him quickly. The gripper carefully snatched the pebble and brought it back to the robot. The robot had an integral pail at the rear for sample collection, and Maurer carefully dropped the pebble inside.

"Konrad, we're done here," said Stammler. "Time to move the robot back to the exit hole."

Once again, they decided to keep the robot in the tunnel pending further work in the uranium chamber. In any case, the tunnel would be a safe storage place for the robot while its radiation level subsided. Kristopf, dressed in a radiation suit, lowered himself into the hole, attached the charging cable and retrieved the pebble from the collection pail. Maurer, using two instruments to be sure, confirmed that the pebble itself was not radioactive. He used tongs to place it into a plastic bag and handed it to Stammler, who pocketed it and motioned Erzbereger to join them.

"Karl, I think Konrad and I have done all that we are able. The scope of this inquiry will necessarily go beyond the Bundesbüro für Strahlenschutz. You need to cover this excavation hole and fence off the area. At this point, I will arrange two security guards, one for this location and one for the original survey site, and I will put the extended investigation into motion. This will be difficult, since this appears to be an archaeological site of unknown purpose, but the uranium will need to be handled as well. They will likely build a barrier between the two parts of the tunnel. Archaeologists to one side, and the Bundesbüro to the other, at least at the start."

"And the pipeline people?"

Stammler paused, nearly forgetting what brought him to the site initially.

"The pipeline work is suspended. If they can reroute to the bureau's satisfaction, that's another matter. That particular decision must come from a much higher level than here."

14 Mainz

Back at Mainz, Stammler briefed his superiors at the Bundesbüro für Strahlenschutz. Since most of these were not scientists, he made special emphasis of the archaeological importance of the site and the need for professional guidance from archaeologists. Stammler didn't want the uranium spheres removed until their purpose could be ascertained. This meant a scientific inquiry, also, but Stammler had no idea what scientific disciplines would be relevant. He decided that a shotgun approach of having a team representing a cross-section of scientific and engineering disciplines, and including at least two historians of science, was appropriate. Not surprisingly, Stammler was given the task of selecting the team.

Then there was the pebble that he and Konrad had retrieved from the second chamber. It would be interesting to learn what it was; perhaps, that would indicate why the rock was so important to the people who built the chambers. An analysis was needed, but what sort of analysis?

"Well, it's a rock," thought Stammler. "Who studies rocks? Geologists, of course."

Stammler placed a call to a friend at the Institute for Nuclear Physics at the nearby Johannes Gutenberg University.

"Institut für Kernphysik, Rolf Zimmer speaking."

"Rolf, this is Ulrich Stammler. Smashed anything besides atoms lately?"

"Ulrich! Only you're old enough to use a term like atom smashing, and only I am old enough to understand what you mean! You must have been busy lately. You usually attend the monthly seminars, but I haven't seen you."

"Work is work, but it's become interesting of late. Know any geologists there?"

"I've got a contact at Geowissenschaften, a young professor. What do you need with a geologist? You aren't going to site a waste repository in my backyard, are you?"

"No. Purely scientific. I have a very small rock, and I need to know what it is."

Zimmer gave him a telephone number, and the two chatted a bit. Stammler had been amiss in not attending the Institute's seminars. He needed to keep in better contact with the local scientific community. He added the next seminar to his schedule and hoped he would have time to attend. The way the Dresden matter was unfolding made that quite unlikely.

Stammler arranged a meeting the next afternoon with Zimmer's contact, Professor Gerbert Muench, in the Geology Institute. Stammler was familiar with the campus, but he had never ventured near the Geology Institute. When he saw the building, he knew that no geologist had been consulted on its construction. It should have been built from something like granite. Instead, it was fabricated from the cheap glazed brick that was popular in constructing institutional building of its age. Geology apparently was able to pay its own way, since it was a huge building. An assistant in the Institute office telephoned down to Muench. It was apparent that Muench's office was nearby, since he appeared in less than a minute.

"Stammler from Bundesbüro für Strahlenschutz. Please call me Ulrich."

"Call me Bert. This must be interesting. The Bureau must have its own corp of geologists, but you came here, instead?"

"They are good for certain purposes, but this is more of a scientific problem." Stammler hesitated for a moment, since he was reluctant to tell Muench the full story of the Dresden site. "I was at a remediation site near Dresden several days ago, and I found this unusual rock." He withdrew the rock from his pocket. "It seemed out of place, and I thought it would be interesting to find out what it was."

Stammler handed the plastic pouch to Muench who examined it by eye. In earlier days, geologists

likely had small magnifying glasses in their pockets to examine rocks at a moment's notice. Now, their magnifiers probably occupied a substantial portion of a room.

"Dresden, you say? How far underground?"

"Just a few meters," replied Stammler.

"Yes, it is unusual. The surface rock there would be sedimentary or moraine. Moraine is the leaving of glaciers, so you would get some igneous material from the north. This rock doesn't appear to be of either type, although it does look as if it was exposed to heat."

"Yes, I noticed that it looks superficially like a cinder. Could it be an artifact, perhaps from a smelting process?"

"Iron making is an ancient art, so that type of material does occur at scattered sites. Remains of that process would have a glassy surface, and this does not. Can I slice this for analysis? The usual first step to identification is to use a petrographic microscope on a polished section. After that, a quick elemental analysis would be in order. We have all the equipment."

"You can use your usual techniques, but it might be important to save all the pieces. Just a usual precaution."

"No problem. I'll telephone in a few days with the results. This is the number?"

Muench pointed to the business card that Stammler had taped onto the outside of the pouch.

"Yes, that's the number. Thanks for your interest, and I'll await your call.

Muench telephoned two days later, and Stammler detected some excitement in his voice.

"Ulrich, you found a meteorite. I was confused at the morphology, at first, but one of my colleagues positively identified it. It's not just any meteorite. It's an SNC meteorite, specifically a Nakhlite. What you've found is a little piece of Mars."

Stammler tried to understand what Muench was saying.

"What do you mean, a little piece of Mars? How can that be?"

"The SNC meteorites were always an oddity, but it wasn't until we actually sent spacecraft to examine Mars that enough evidence was assembled to make the case that these meteorites were from Mars. The current consensus is that an asteroid impact millions of years ago dislodged material from Mars, and some of it still rains down on Earth, As you can imagine, these SNC meteors are rare. I think a search should be made around the area where you found this. What you gave me may have been a small piece that broke away from a larger body that fell."

How right you are, thought Stammler, but he had to backpedal on Muench's suggestion.

"Unfortunately, I recovered this from a radiation remediation site, so such a search is out of the question, at least for now. Perhaps when the radiation is cleared. How significant would the find of a kilogram-sized meteorite of this type be?"

"From what my colleague tells me, fewer than ten Nakhlites are known. Another large chunk of Mars here on Earth would be wonderful! Can I hold your specimen here for further study? We would need your clearance on any publication, since the location of the find would necessarily be in any published paper."

"Yes," said Stammler. "I'll trade the specimen for any data you obtain. The data will only circulate within the Bureau, for now. Send me a summary of this analysis - pretty pictures, the works - for my management. Perhaps I can get you some money for these studies."

Stammler ended the call and assessed how his life had changed in just the span of a week. Dresden had become a deepening mystery, and it looked as if it would be his principal occupation for the near future.

15 Waiting

Moldovan told Jim that his ESA contact could get some medium resolution images of the area within a few days, but they would need to wait a hundred and nineteen days, Martian days, for some high resolution images. One hundred and nineteen days! On an astronomical scale it's but the wink of an eye, but for them it would be too long of a period to just sit on their hands. There must be something to do in the meantime.

"Jim, using a typical thermal diffusion model, Laplace and all that, we can calculate how close the source is to the surface. We'll need to assume it's water at a hundred degrees coming up a small tubular crevice, and we can make some good guesses for constants for the rocks. Get a good data set of the surface temperature so we can calculate gradients. Oh, and some representative data from surrounding areas."

"I can get the heat capacity from day-night readings of nearby areas."

"Yeah, that's the stuff. I'll scratch out some equations for you. It's nothing you couldn't do yourself, but I'm hours early for work and I need something to do."

Moldovan went to his office, booted up his computer, and reached for one of his undergraduate textbooks. While many of his friends sold their books back to the campus bookstores for a small fraction of what they paid, Moldovan was in this field for the long haul, and he knew there would be times like these when he needed a refresher course in thermodynamics, or the like. With the basic equations in hand, it was a simple matter to extend them to their particular application. He tried to make the model general enough without too many complications. After all, they would be working with imprecise data, and there's the old computer saying, garbage in, garbage out. He was hoping for a lesser form of refuse. He e-mailed his worksheet to Jim, closed his door, and settled down for a short nap.

It must be his age, or perhaps his irregular working and waking hours, but Moldovan had become accustomed to napping in his office chair. In fact, when a nearby colleague vacated his office at retirement, Matt had swapped office chairs. That chair, with its headrest and padded arm rests, was the perfect napping chair! Matt had always coveted that chair and he had wondered how his colleague had been able to requisition it. Matt had even considered somehow damaging his own office chair in the hopes of being able to replace it with the same type. It wouldn't take too much effort to break off one of its four wheels, but he was worried that the facilities staff would just try to fix it, but in a less than satisfactory way. His patient waiting had paid off.

A soft rap at the door woke him close to noon. He opened the door to discover Ingrid, another of his students, and he realized he had promised to meet with her at 10:00 AM.

"Jim said you were here. He said I should knock."

"Yes, yes. Sorry, Ingrid. Jim and I had some unexpected work last night." He wondered whether Jim was as reticent as he was about publicizing the discovery. Adding Horst as an author was one thing, but would there be a line of people outside his door claiming a part because of their work on the greater program on which the discovery was based?

"He said you were running some trial data sets through the large screen to get some feedback for the development team. I guess things like that need to be done after hours."

Moldovan felt relieved, but also a little guilty. He had started an international conspiracy, and it wasn't even lunchtime. So much for science being an open process.

Ingrid's research involved the influence of sand dunes on the thermal properties of the Martian surface. Unlike Jim's work, which was observational, Ingrid's research was theoretical with an

underpinning of computer modeling. It was one thing to train a thermometer on Mars, but it was another to make sense of the readings. That was Ingrid's research program.

Since the satellite temperature readings were weighted heavily towards the surface, but they were really interested in what might be below the surface, they needed to understand surface thermal properties and what might affect them. The Martian surface was hardly a static place, and dust storms were frequent in some areas. A side effect of these dust storms was the creation of arrays of regular sand dune features that looked like a surface corrugation. Moldovan had realized very early that study of these could be an easy way to calibrate the thermal properties of the dust, since there were thin sections alongside thick sections, and the corrugation became shallower towards the edges. He enlisted Ingrid to do these studies.

Ingrid, like Jim, was self-motivated and quite capable. One advantage of Moldovan's reputation was that he was able to attract good funding and the best students. Ingrid required very little direction, and Moldovan viewed his job as that of a facilitator and mentor, rather than a director. Her current problem was getting more time on a particular computer, which was something he could help her with. One side effect of Ingrid's visit was that Moldovan was now wide awake. Perhaps he would be able to finish writing that report he had pushed aside and start thinking about his next research proposal.

Several days later, Weber emailed the low resolution image Moldovan had requested. Horst was insistent in his message that the image not be called a low resolution image. ESA referred to these as normal resolution, but for Moldovan a ten meter per pixel resolution was low resolution, no matter what you called it. Horst had done some processing of the image to increase contrast, but, like a true scientist, he had attached both the unprocessed and processed images.

There appeared to be a mound centered on the hot spot, but not much more could be seen from the image. The top of the mound appeared to be rougher than the surrounding area. Some striations were apparent, and might be surface fractures caused by an uplifting of the terrain. This would be consistent with something below the surface, such as pressurized water, causing the mound. They would just need to wait the hundred and nineteen days – now, a hundred and fifteen days – for the higher resolution image.

Moldovan started to piece together the puzzle of the hot spot. There was a mound, quite large in size and uniformly warm, and it was situated near a deep chasm. The tectonic motion required to make a mound in normal terrain involved compression. The ground is essentially squeezed and it forms ridge structures like this mound. The formation of the chasm, however, depended on the opposite effect. The crust is pulled apart, not compressed. That these things were there on Mars, quite close to each other, was the first mystery. Of course, volcanic activity could cause both the uplift of the mound and the temperature, but Mars was not thought to be volcanically active. In their search for thermal vents, they had never expected to see something this large.

As usual, more data were required. It would be nice to send some sort of probe or rover to this particular spot, but for now their only option was to collect as much remote sensing data they could from instruments already in place. Weber's high resolution image would help, but Matt wasn't that confident that a better optical view would tell them anything. If they saw some lava flows, or recent water channeling, that would be nice, but he wasn't that hopeful.

16 High-Res

Horst Weber had nearly forgotten about his request for a high-res image of coordinates at Valles Marineris. It had been quite a few months. The automated system sent him an e-mail that his data were in, along with a direct link to the accession number. There was so much data, he was surprised that even the automated system could keep up with it. He clicked the link, and the raw image was opened by his desktop image processing program. The sweep was quite large, and it filled more than one screen could handle. Fortunately, the program allowed him to "grab" the image with his mouse, and drag it around. After a few seconds of this, he accessed Matt's e-mail with the desired coordinates of the region of interest, and he popped up a window to enter the coordinates. What he saw on the screen was absolutely incredible.

He scanned the image carefully, looking for signs that the image had been manipulated. Scientists enjoy their little jokes. The image quality was exceptional, and if it was a manipulation, it was done with extreme precision. He then checked the header on the e-mail message – not the simple header with "from" and "to" that everyone sees - but the full header. The full header shows the path of the e-mail - every computer the message had been in or through. The message seemed to be genuinely from the automated system. Since he was a principal image specialist, he had password access to the image server and its logs. It took a while, but he was able to verify that the image had arrived a scant few minutes ago, directly from the ground station at New Norcia, Australia, and he was the only one to ever access this image. He was convinced. Now to convince Matt.

Matt was out of his office when Horst rang, but Jim was in the lab and answered the telephone. Horst convinced Jim to track Matt down and get him back to the office as quickly as possible.

"Doctor Weber, if this is about the high-res at Valles Marineris, I'm the guy who pin-pointed the area. If you'd like, I can receive the image and pass it on to Professor Moldovan."

Weber was strangely silent for a few seconds.

"Sorry, but I would rather talk about this with Professor Moldovan." There was a pause. "There are certain matters I need to discuss only with him. You understand, don't you?"

Unless this was how the Old Boys network operated, Jim didn't quite understand, but what could he do. He promised to track down Moldovan as quickly as possible.

Moldovan had never entrusted his cellphone number to Jim, so Jim took a chance and telephoned the house. When a female voice answered, Jim thought he had rung the wrong number. Professor Moldovan, as far as he knew, was unmarried. He asked for him, anyways, and he was told to wait.

"Matt, it's for you. Sounds like the university, Professor."

Moldovan picked up the telephone a few seconds later.

"Moldovan, here."

"Professor Moldovan, sorry to disturb you at home, but I received a call from Dr. Weber of the ESA. He asked whether you could come back to your office, immediately, and ring him up. He said he would await your call. I think it's about the high-res at Valles Marineris, but he wouldn't tell me much."

"Horst is quite formal. He's likely thinking he must go through proper channels so I won't feel slighted. Having a student relay important data is just not done in proper European scientific circles. Don't feel too bad. He really wanted me to get back to my office and not telephone from home?"

"Yes, he was quite insistent, and I think a little agitated. Perhaps we hit pay dirt on the thermal vent."

"OK, Jim. If he rings up again, I'm on my way."

It took Moldovan less than a half hour to reach the labs. He greeted Jim, who was still hard at work, and decided to grab some coffee. An empty pot! Well, it was after hours, but he thought the lack of coffee in the labs was exacerbated by too many tea drinkers. Fewer coffee drinkers logically leads to fewer pots. Finally in his office, he rang up Horst. Horst answered on the first ring.

"Matt, is that you?"

Jim was right, Horst was agitated.

"Yes Horst, it's Matt. How are you this evening, or is it morning your time?"

"It's morning." He paused. "Can we set up a teleconference?"

"Sure, ring me up. I'll launch the application."

"The connection will be a little slow. I'm using the highest level of encryption. When we connect, hang up the telephone and use the computer audio. That way the audio will be secure, also."

Matt was thinking that Horst must be following another of those interminable EU Directives. You can't sneeze in Europe anymore before reading five pages of Policies and Procedures.

"OK, Horst. Will do."

In a few seconds he saw Horst on the screen. The image was a little choppy when he moved, likely an artifact of the high powered encryption.

"Matt, can you hear me over the computer?"

"Yes, Horst. I'll hang up the telephone."

Matt, I'm going to show you the high-res you requested from Valles Marineris. The image is centered on your coordinates. I must preface all this by saying that this is definitely no joke. Here's the image."

What Matt saw on the screen was incredible. There was a mound. Sure, a mound could be a natural structure, but what was inscribed on the surface of the mound was definitely not natural. It was a pentagram, labeled at each point by a Greek letter. Owing to the frequent sandstorms on the surface, this artifact must be recent, or it had to be periodically maintained. Since high-res still meant rather coarse images that resolve features down to only a few meters in dimension, the pentagram must be huge to be so well defined. Matt's jaw was still agape as he tried to mouth some words to Horst.

"No joke, Horst?"

"No Joke, Matt. What are we to make of this?"

"I don't know, but I do know this – What we've discovered is a lot more important than a thermal vent. About how large is the mound?"

"Well, this is a rough estimate, based on counting pixels, but it's almost a kilometer long and about half a kilometer wide. Do you think there are people down there, inside the mound?"

"That would explain the hot spot. If there are people down there, they must be people from Earth. I doubt that the Martians ever spoke Greek. Horst, has anyone else seen the image?"

"No, no one else. And unless I point it out, no one will. We're drowning in a sea of data here. This image is just a drop in a huge ocean, not much of interest to anyone except the person who requested it."

"Horst, we must keep this a secret. Neither you nor I can guess the repercussions if the image is released prematurely."

"Matt, we can't sit on this forever. We must have a plan!"

"OK, here's a plan. You and I must get the attention of some people in authority, someone much higher up in our organizations than we are. After that, they can carry the ball. I think we can agree to forget the management types for now. I need to find a high level technical person I can trust at NASA, and you need to do the same at the ESA. This demands action, although I don't know what the proper action might be. Perhaps one of us will send a probe. Maybe it will be joint mission. That's not for us to decide."

“Alright, it's our secret for now.”

“Horst, it will be a three-way secret. I'll need to tell Jim. He was in on this from the start. Damn, he was the discoverer! I'll need to tell him, too. I'll also need to keep a copy of the image, but I'll encrypt it sixteen ways to Sunday! If this leaks to something like the Close Encounters people, we'll never get any rest!”

“Doesn't it make you wonder, Matt?”

“Wonder about what?”

“Who they are, how they got there, and why they're there?”

He was so caught up in the process, these questions never crossed his mind.

“Maybe they'll tell us.”

After their valedictions, Matt pulled the image into his encryption program and was prompted for a password. He remembered a movie he had seen as a child and typed, RobinsonCrusoeOnMars. It seemed to fit.

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About the Author

Dev Gualtieri received his PhD in 1974 and had a thirty-five year research career in physics and materials science.

He is listed as an inventor on more than thirty US patents, and on numerous international patents. His eclectic research interests included superconductivity, chemical thermodynamics, magnetism, electronics and computer science. At one time, he was an internationally recognized expert in crystal growth.

Dr. Gualtieri is now retired, and he resides in Northern New Jersey with his wife Anne. They have a son and daughter who reside with their spouses in Pennsylvania.