# Grantville Gazette-Volume XIX

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# Jim Baen's Universe
# Grantville Gazette, Volume 19


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# What is this?
# About the Grantville Gazette

## Written by Grantville Gazette Staff

The *Grantville Gazette* originated as a by-product of the ongoing and very active discussions which take place concerning the 1632 universe Eric Flint created in the novels *1632, 1633* and *1634: The Galileo Affair* (the latter two books co-authored by David Weber and Andrew Dennis, respectively). This discussion is centered in three of the conferences in Baen's Bar, the discussion area of Baen Books' web site. The conferences are entitled "1632 Slush," "1632 Slush Comments" and "1632 Tech Manual." They have been in operation for almost seven years now, during which time nearly two hundred thousand posts have been made by hundreds of participants.

Soon enough, the discussion began generating so-called "fanfic," stories written in the setting by fans of the series. A number of those were good enough to be published professionally. And, indeed, a number of them were—as part of the anthology *Ring of Fire* , which was published by Baen Books in January, 2004. ( *Ring of Fire* also includes stories written by established authors such as Eric Flint himself, as well as David Weber, Mercedes Lackey, Dave Freer, K.D. Wentworth and S.L. Viehl.)

The decision to publish the *Ring of Fire* anthology triggered the writing of still more fanfic, even after submissions to the anthology were closed. *Ring of Fire* has been selling quite well since it came out, and a second anthology similar to it is scheduled to be published late in 2007. It will also contain stories written by new writers, as well as professionals. But, in the meantime . . . the fanfic kept getting written, and people kept nudging Eric—well, pestering Eric—to give them feedback on their stories.

Hence . . . the *Grantville Gazette.* Once he realized how many stories were being written—a number of them of publishable quality—he raised with Jim Baen the idea of producing an online magazine which would pay for fiction and nonfiction articles set in the 1632 universe and would be sold through Baen Books' Webscriptions service. Jim was willing to try it, to see what happened.

As it turned out, the first issue of the electronic magazine sold well enough to make continuing the magazine a financially self-sustaining operation. Since then, nine more volumes have been electronically published through the Baen Webscriptions site. As well, *Grantville Gazette , Volume One* was published in paperback in November of 2004. That has since been followed by hardcover editions of *Grantville Gazette* , Volumes Two and Three.

Then, two big steps:

First: The magazine had been paying semi-pro rates for the electronic edition, increasing to pro rates upon transition to paper, but one of Eric's goals had long been to increase payments to the authors. *Grantville Gazette* , Volume Eleven is the first volume to pay the authors professional rates.

Second: This on-line version you're reading. The site here at http://www.grantvillegazette.com is the electronic version of an ARC, an advance readers copy where you can read the issues as we assemble them. There are stories posted here which won't be coming out in the magazine for more than a year.

How will it work out? Will we be able to continue at this rate? Well, we don't know. That's up to the readers. But we'll be here, continuing the saga, the soap opera, the drama and the comedy just as long as people are willing to read them.

—The *Grantville Gazette* Staff

# It's Getting Closer . . .

## Written by Paula Goodlett

As I mentioned back in *Grantville Gazette* , Volume 17, a lot of the 1632 crew are going to be at Albacon, in Albany, New York, October 10 - 12. And I'm mentioning it again, since we want as many of the fans of the series as possible to attend.

So far the panels we have planned are:

Time Passed in the Past—Knights in Shining Armor Are Passé:- presenter Virginia DeMarce

What Didn't Happen: Who Didn't Do What to Whom: presenters Virginia DeMarce and Eric Flint

How to Get Published in the Gazette: presenters, the whole crew (since we'll probably ask new authors to tell their stories)

Weird Tech - What Can We Do and When Can We Do It: presenter Rick Boatright

Renaissance Boogie—Court Dances of the Seventeenth Century: presenter and demonstrator, Iver Cooper

The Economics of 1632—It Costs *What* !: presenter Gorg Huff

Snerking the Plots: presenter Eric Flint

And we're likely to come up with more, now that I think about it.

Here's the url for Albacon: http://www.albacon.org/hotel.html

And I'm reminded by the folks running Albacon to ask you to make your reservations right now. They're

2/3 full on their block of rooms, so you really need to get in there soon, please.

I'll keep you updated. Come see us. It'll be fun

Paula Goodlett

# The Anaconda Project, Episode Seven

## Written by Eric Flint

"So, what you think?" asked Piccolomini. The Italian general from Florence who was now in Austrian service raised his cup.

The man sitting across from him at the round little table in the small but very crowded restaurant frowned down at the cup in front of him. He'd only had a few sips of the dark liquid contained therein. He still didn't know what he thought of the stuff—and he certainly would never have ordered it himself, as expensive as the concoction was.

His name was Franz von Mercy. He came from a noble family in Lorraine, not Italy, as did his table companion. But in other respects, they were quite similar. Like Piccolomini, von Mercy was a general. They were long-acquainted, as well, almost if not quite friends.

There was one critical difference between them, however, which explained part of von Mercy's

skepticism toward the black substance in his cup. Octavio Piccolomini was gainfully employed—very gainfully, by the Habsburg ruler of Austria—and von Mercy was not.

In fact, he was not employed by anybody. Just a short time earlier, he'd been in the service of Duke Maximilian of Bavaria. But after the traitor Cratz von Scharffenstein surrendered the fortress of Ingolstadt to the Swedes, von Mercy had taken his cavalrymen and fled Bavaria. He'd known full well that, despite his own complete innocence in the affair, the murderous duke of Bavaria would blame him for the disaster and have him executed.

So, he'd come to Vienna, hoping to find employment with the Habsburgs. But he'd been turned down, with only this bizarre new hot drink offered by way of compensation.

He looked up from the cup to the window. He'd wondered, when they came into the restaurant, why the owners had defaced perfectly good window panes by painting a sign across them. And he'd also wondered why they chose to call their establishment a *café* instead of a restaurant.

Now he knew the answer to both questions.

"God damned Americans," he muttered.

Piccolomini winced at the blasphemy, even though he was known to commit the sin himself. Perhaps he felt obliged to put on that public display of disapproval, since he was now quite prominent in the Austrian ranks. They were, after all, right in the heart of Vienna—not more than a few minutes walk from either the Stephensdom cathedral or the emperor's palace.

"Damned they may well be," said Piccolomini. Again, he lifted his cup. "But I enjoy this new beverage of theirs."

"Coffee," said von Mercy, still muttering more than talking aloud. "We already *had* coffee, Octavio."

His companion shrugged. "True. But it was the Americans who made it popular. As they have done with so many other things."

He set the cup down. "And stop blaming them for your misfortunes. It's silly and you know it. They had nothing to do with Scharffenstein's treason—they certainly can't be blamed for Maximilian's madness!—and it's not because of them that the emperor decided not to hire you. That, he did for the same sort of reasons of state that have led rulers to make similar decisions for centuries. About the only connection the Americans have to the affair is that they've provided us with a rather delicious new expression for it.

"And speaking of delicious . . ." He paused while he picked up the cup and drained it. "I happen to love coffee, myself. The expression is 'cold-blooded,' and it's pretty apt."

He gave his fellow officer a look of sympathy and commiseration. "Tough on you, I know. Tougher still on your men. But look at it from Ferdinand's perspective, Franz. He's expecting a resumption of hostilities with the Swede and his Americans by next year. No matter how badly Maximilian has behaved and no matter how much the emperor detests him, do you honestly expect Ferdinand to take the risk of escalating the already-high tensions between Austria and Bavaria by hiring a general who—from Duke Maximilian's peculiar point of view, I agree, but that's the viewpoint at issue here—has so recently infuriated Bavaria?"

He shook his head and placed the cup back on the table. "It's not going to happen, Franz. I'm sorry, I really am. Not simply because you're something of a friend of mine, but—being honest—because you're a good cavalry commander and I'm sure I'm going to have need of one soon enough."

Glumly, von Mercy nodded. He realized, in retrospect, that he should have foreseen this when he left Bavaria. He knew enough of the continent's strategic configurations, after all, being by now a man in his mid-forties and a very experienced and highly placed military commander.

He'd have done better to have accompanied his friend von Werth to seek employment with Bernhard of Saxe-Weimar. Bernhard would certainly not have cared about the attitude of the Bavarians, seeing as he was already infuriating Maximilian by threatening to seize some of his territory. Or so, at least, Maximilian was sure to interpret Bernhard's actions—but, as Octavio said, it was the Bavarian duke's viewpoint that mattered here.

Nothing for it, then. He'd have to head for the Rhine, after all, and see if Saxe-Weimar might still be in the market. Von Mercy could feel his jaws tightening a little at the prospect of leading a large cavalry force across—around—who knew?—a goodly stretch of Europe already inhabited by large and belligerent armies. Most of whom had no reason to welcome his arrival, and some of whom would actively oppose it.

Alternatively, he could head for Bohemia and see if Wallenstein might be interested in hiring him. But . . .

He managed to keep the wince from showing in his face. *That* would be certain to infuriate his Austrian hosts, who'd so far been very pleasant even if they'd declined to employ him and his men. He had even less desire to fight his way out of Austria than he did to fight his way to the Rhine.

He heard Piccolomini chuckle, and glanced up. The Italian general was giving him a look that combined shrewdness with—again—sympathy and commiseration.

"I have another possible offer of work for you, Franz. And one that is rather close at hand."

Von Mercy frowned. "The only possibility I can think of, close at hand, would be Wallenstein. And why would you or anyone in Austrian service be sending me to Wallenstein? Like as not, a year from now, you'd be facing me across a battlefield."

A waiter appeared. Piccolomini must have summoned him, and Franz had been too pre-occupied to notice.

"Another coffee for me," the Italian general said. He cocked a quizzical eyebrow at von Mercy. "And you? What's in your cup must already be cold."

Franz couldn't see what particular difference the temperature of the beverage would make. Hot or cold, it would still be extremely bitter. But . . .

Piccolomini was obviously in an expansive mood, and under the circumstances Franz felt it prudent to encourage him. "Yes, certainly. And thank you."

After the waiter was gone, Piccolomini leaned across the table and spoke softly.

"Not Wallenstein directly. In fact, part of the agreement would be that you'd have to be willing to give me your oath that—under no circumstances—would you allow yourself or your soldiers to be used

directly against Austria. But . . . yes, in a way you'd be working for Wallenstein. He wouldn't be the one paying you, though, which—"

He gave von Mercy a vulpine grin. "—is always the critical issue for we mercenaries, isn't it? Or 'professional soldiers,' if you prefer the circumlocution."

Franz felt his shoulders stiffen, and forced himself to relax. He *did* prefer the circumlocution, in point of fact. If that's what it was at all, which he didn't believe for a moment. The difference between a mercenary and a professional soldier might be thin, but it was still real. A mercenary cared only for money. A professional soldier always placed honor first.

As Piccolomini knew perfectly well, damn the crude Italian bastard—or he wouldn't have made this offer in the first place. He'd take Franz von Mercy's oath not to allow himself to be used against Austria as good coin, because it was and he knew it. He'd certainly not do the same for a mere mercenary.

"Who, then?" he asked.

Piccolomini seemed to hesitate. Then, abruptly: "How do you feel about Jews?"

Von Mercy stared at him. His mind was . . .

Blank.

Piccolomini might as well have asked him how he felt about the natives in the antipodes—or, for that matter, the ones that speculation placed on the moon but which Franz had heard the Americans said was impossible.

What did Jews have to do with military affairs? They were the least martial people of Europe. For any number of obvious reasons, starting with the fact that most realms in the continent forbade them from owning firearms. About the only contact professional soldiers ever had with them involved finances, and that was usually only an indirect connection.

Belatedly, Franz remembered that he'd also heard some rumors concerning recent developments among the Jewry of Prague. They'd played a prominent role in repulsing the attack of General Holk on the city, apparently. That had allowed Wallenstein to keep most of his army in the field and defeat the Austrians the previous year at the second battle of the White Mountain.

They were even supposed to have produced a prince of their own, out of the business. An American Jew, if he recalled correctly.

Throughout the long pause, Piccolomini had been watching von Mercy. Now, he added: "Yes, that's right. Your employer would be a Jew. An American Jew, to be precise, who is now highly placed in Wallenstein's service."

Franz rummaged through his memory, trying to find the name. He knew he'd heard it, at least once. But, like most such items of information that didn't seem to have any relevance to him, he'd made no special effort to commit the name to memory.

Piccolomini provided it. "His name is Roth. Morris Roth." He smiled, a bit crookedly. "Or Don Morris, as the Jews like to call him. They fancy their own aristocracy, you know. At least, the Sephardim always have, and it seems the Ashkenazim as well."

Franz noted—to his surprise; but then, he didn't really know the man that well—that Octavio knew that much about the inner workings of Jewry. So did Franz himself, from a now-long-past friendship with a Jewish shoemaker. But most Christians didn't, certainly not most soldiers.

He realized, then, the purpose of Piccolomini's probing questions. And, again, was a bit surprised. He wouldn't have thought the outwardly very bluff—almost to the point of brutal—Italian soldier would have cared about such things.

"I have no particular animus against Jews, if that's what you're wondering." He smiled crookedly himself. "I admit, I've never once contemplated the possibility that one of them might wish to hire me. For what? In the nature of things, Jews don't have much need for professional soldiers."

"Or a need so great that it is too great to be met," said Piccolomini. "But, yes, in times past you'd have been quite correct. But the times we live in today are ones in which the nature of things is changing. Quite rapidly, sometimes."

The waiter returned, bringing two hot cups of coffee. Piccolomini waited until he was gone, and then picked up his cup and leaned back in his chair. Still speaking rather softly, he said: "Well, then. Let's savor our coffees, and then I'll take you to meet someone."

"Roth?"

Piccolomini shook his head. "No, Roth himself is in Prague, so far as I know. The man I'll be taking you to is one of his agents. Uriel Abrabanel, of the famous clan by that name." The Italian blew on his coffee. "Famous among Sephardim, anyway."

Quite famous, in fact. The Jewish shoemaker whom Franz had known in his youth had once told him, very proudly, that he himself was—admittedly, rather distantly—related to the Abrabanels.

Von Mercy's grin was probably on the vulpine side also. "Famous to many people, nowadays. Seeing as how the wife of the prime minister of the United States of Europe is an Abrabanel. And has become rather famous herself—or notorious, depending on how you look at it."

Piccolomini nodded, and took an appreciative sip of his coffee. "She has, indeed. The redoubtable Rebecca Abrabanel. I've been told that Cardinal Richelieu himself remarked upon her shrewdness—which, coming from him, is quite a compliment."

"Yes, it is. Although many people might liken it to one devil complimenting another on her horns and cloven hoofs."

"Oh, surely not," chuckled Piccolomini. "The woman is said to be extraordinarily comely, in fact. So I'm told, anyway."

He chuckled again, more heavily. "What I know for certain, however, is that she's the niece of the man you'll be meeting very soon. So do be alert, Franz. Uriel Abrabanel would be described as 'comely' by no one I can think of, not even his now-dead wife. But he's certainly very shrewd."

It was Franz's turn to hesitate. Then, realizing he simply needed to know, he asked: "At the risk of being excessively blunt, Octavio, I must ask why you are doing me this favor?"

Again, the Florentine issued that distinctively heavy chuckle. "Good question. You'd really do better to ask Janos Drugeth. Know him? He's one of the emperor's closest advisers."

Von Mercy shook his head. "The name's familiar, of course. He's reputed to be an accomplished cavalry commander and I try to keep track of such. But I've never met him and don't really know much about him."

"Well, Janos is also one of Ferdinand's closest friends, and has been since they were boys. This was his idea, actually, not mine." Piccolomini made something of a face. "For my taste, the reasoning behind it is a bit too convoluted. Quite a bit, being honest."

Franz cocked an eyebrow. "And the reasoning is . . . Indulge me, if you would."

Now, Piccolomini hesitated. Then: "I suppose there's no reason you shouldn't know. Drugeth is not in favor of continuing the hostilities between Austria and Bohemia, and thinks we'd be wiser to let things stand as they are. Personally, I disagree—and so does the emperor, for that matter. But Ferdinand listens carefully to whatever Janos says, even when he's not persuaded. And Janos suggested this ploy as a way of encouraging Wallenstein to look elsewhere than Austria for any territorial aggrandizement. We know that he's appointed Morris Roth to expand his realm to the east. But how is Roth supposed to do that without a military force? So, Drugeth thinks we should help provide him with one."

Von Mercy nodded. Up to a point, he could follow the reasoning. War had a grim and inexorable logic of its own. Once the Bohemians began a real effort to expand to the east, in all likelihood they would find themselves getting drawn deeper and deeper into the effort. The more they did so, the less of a threat they would pose to Austria to the south.

There came a point, however, at which the logic began to crumble. Granted, Franz was more familiar with the geography of western Europe than central Europe. Still, one thing was obvious.

"'Expanding his realm to the east' will take him directly into Royal Hungary, Octavio."

Piccolomini grimaced. "So it will, indeed—and don't think I didn't point that out to the emperor and Janos both. I thought that would end the business, since the Drugeth family's own major estates are in Royal Hungary. But Janos—he's an odd one, if you ask me—didn't seem to feel that was much of a problem. In the end, the emperor decided there was enough there to warrant making the connection between you and the Jew in Prague."

He gave Franz a stern look. "But I stress that we will want your vow not to take the field against us."

"Yes, certainly. But you understand, surely, that if I enter—indirectly or not, it doesn't matter—the service of Wallenstein, that I will simply be freeing up some other general and his forces to come against you."

The Italian shrugged. "True enough. But they're not likely to have your skills, either. I think what finally convinced the emperor was Drugeth's point that if we simply let you roam loose as a free agent, since we didn't want to hire you ourselves, the end result was likely to be worse for us than having you leading Wallenstein"—he waved his hand toward the east—"somewhere out there into the marshes of the Polish and Lithuanian rivers."

Once more, that heavy chuckle. "It was hard to dispute that point, at least."

* * *

# The Anaconda Project, Episode Eight

## Written by Eric Flint

After they left the restaurant—or "café," rather—Piccolomini glanced up at the sky, which had grown leaden.

"Snowing soon," he said, reaching up and drawing his cloak around him more tightly.

Von Mercy followed suit. The temperature wasn't too bad, but there was something of a wind that added considerably to the chill. "Where are we headed? Unterer Werd?"

Piccolomini shook his head. "No. The ghetto would be too far from the center of things for Abrabanel's purposes. And he's got plenty of money." With his chin, he pointed straight ahead down the street. "Just up there a ways. Less than a five minute walk."

Franz was a bit surprised, but only a bit. Although Jews in Vienna usually lived in the ghetto located on the island formed by the Danube and one of its side branches, the city did not enforce the provision strictly if the Jew involved was wealthy enough.

As they walked, Franz noticed two other restaurants sporting the new title of "café."

"I swear, it's a plague," he muttered.

Glancing in the direction of von Mercy's glower, Piccolomini smiled. "If you think it's bad here, you should see what it's like in Italy. My younger brother is the archbishop of Siena and he told me there was almost a public riot there a few months ago, because of a dispute involving the rules in a game of soccer."

"A game of . . . what?"

"Soccer. If you don't know what it is, be thankful all you have to contend with is the occasional restaurant with pretensions. And pray to God that you never have to deal with the intricacies of baseball."

"Intricacies of . . . what?"

"Never mind. Stick to the cavalry, Franz."

A few dozen yards further along, Piccolomini pointed with his chin again. This time, at a small shop they were nearing. There was a small sign over the door, reading: *Sugar and Things*.

"There's the real money," said the Florentine general. "That shop's owned by a partnership between two local merchants and one of the American mechanics whom the emperor hired recently to keep his two automobiles running. Sanderlin's his name—although it's really his wife who's involved in the business."

"They are sugar importers?"

"Yes—but mostly they process it into something called 'confectioner's sugar' and sell it to the city's wealthiest residents and most expensive restaurants." He shook his head. "Sugar is already worth its weight in gold. What they do with it . . ."

He shook his head again. "But people are besotted with things American—especially anything they can find involving Vienna in those tourist guides. So, they say Vienna needs its cafés with coffee and pastries—and the best pastries require confectioner's sugar."

"A plague, as I said."

"May as well get used to it, Franz," Piccolomini said heavily. "When Wallenstein's Croats failed in their raid on Grantville, all of Europe was doomed to this lunacy. Even in Paris, I'm told."

He stopped in front of a nondescript doorway. Just one of many along the street, marked in no particular way.

"And here we are."

* * *

Uriel Abrabanel proved to be, just as Piccolomini had said, a man whom no one would think to call "comely." He was saved from outright ugliness only by the fact that his animated and jovial spirit imparted a certain flair to his coarse and pox-marked features. It was hard to believe, though, that the man was closely related—uncle, no less—to Rebecca Abrabanel, reputed to be one of the great beauties of Europe.

But von Mercy was skeptical of that reputation, anyway. He didn't doubt the woman was attractive, probably quite attractive. But he was sure that the near-Helenic reputation given to her appearance was mostly the product of the same glamorous aura that surrounded almost everything American by now, almost four years after the Ring of Fire. An aura that was just as strong—probably stronger, in fact—among the peoples who were the USE's enemies than those who lived under Stearns' rule directly or counted themselves as his allies. Unlike the Swedes or the Germans or the Dutch, who had had many occasions to encounter Americans or their Abrabanel associates directly, for most Austrians or French or Italians—to say nothing or Spaniards or Poles—they remained mostly a matter of legend and hearsay.

And if much of the hearsay and many of the legends involved their wicked ways and nefarious schemes, there was no reason those couldn't be combined with other qualities. So, if Mike Stearns was a relentless savage bent upon destroying all that was fine and sensible about Europe's social and political arrangements, he was also surely the most cunning and astute barbarian who had stalked the earth since Attila raged out of the east. So also, if his Jewish spymaster Nasi was evil incarnate he was also intellect incarnate—just as Stearns' Jewish wife combined the appearance of a goddess with a spirit fouled by the

demons of the Pit.

For, indeed, the same aura extended to those closely associated with the Americans, even if they were not American themselves. That was especially true of the Jews, especially the Sephardim of the widely-flung and prominent Abrabanel clan.

Franz believed none of it. He'd read some of the philosophical and theological speculations concerning the nature and cause of the Ring of Fire. But, in the end, he'd come to the same conclusions that, by all accounts, the Americans had come to themselves. Namely, that they had no idea what had caused the miraculous phenomenon, and they were certainly not miraculous themselves. Just people, that's all. Granted, people from a distant future possessed of incredible mechanical skills and knowledge. But no more exotic, for all that, than visitors from Cathay.

Less exotic, in fact, in most ways. They spoke a well-known European language, and most of them were Christians. And all of them except a handful of African extraction were even of European origin. Solid and sturdy origin, at that: English, German, and Italian, for the most part.

As von Mercy had been ruminating over these matters, Abrabanel had spent his time studying Franz himself. Eventually, he seemed to be satisfied with something he saw, if Franz interpreted his expression correctly.

"Not a bigot, then," Abrabanel said softly. "Octavio told me as much"—here he gave the Florentine general a sly glance—"and I was inclined to believe him, even though he is an Italian and thus of duplicitous stock. So unlike we simple and straightforward Hebrews and even simpler and more straightforward Lorrainers."

Franz couldn't help but laugh. Partly, at the jest itself; partly, at the truth lurking within it. For, in point of simple fact, the seemingly-bluff Piccolomini was a consummately political general, as you'd expect of a man from a prominent family in the Florentine aristocracy. He'd spent a good portion of his years as a military officer serving more in the capacity of a diplomat or even—in truth if not in name—as what amounted to a spy.

Duplicitous, as such, he might not be. But Franz didn't doubt for a moment that lies could issue from Octavio Piccolomini's lips as smoothly and evenly as a gentle tide sweeps over a beach.

He recalled himself to the matter at hand. "No, I am not a bigot. I claim no particularly fondness for Jews, mind you. But I bear no hostility against you, either. What I don't understand, is what any of that has to do with your purpose in asking me here." He nodded toward Piccolomini. "Nor why you needed to use him as your conduit."

"In answer to the second question, I am not actually using Octavio as my conduit to you. It would be far more accurate to say that I am using him as my conduit—say better, my liaison-at-a-comfortable-distance—with Emperor Ferdinand."

The logic was clear enough, once Franz thought about it. "Ah. You feel that if you employed me directly, the Austrians might fret themselves over the purpose of the employment. And then, out of anxiety—"

"Oh, that's far too strong a term, Franz!" protested Piccolomini. "Don't give yourself airs! We would—at most—be motivated by reasonable caution."

He bestowed a fulsome grin upon von Mercy and Abrabanel both.

Franz returned the grin with a thin smile. "Out of reasonable caution, then"—he looked back at Uriel—"they would take steps that you might find annoying."

"Oh, ridiculous!" boomed Piccolomini. "That he might find disastrous to his plans! Utterly destructive to his schemes. Might lay waste his entire project for years to come." The grin returned. "That sort of thing. Much the better way to put it."

"Indeed," said Uriel, smiling also. "This way, at every stage, the Austrians are kept—to use a handy little American expression—'in the loop.' I think that will serve everyone nicely."

Piccolomini brought a fist to his mouth and cleared his throat noisily. "Except . . . well, Wallenstein, perhaps. If he finds out that I'm involved in any way. I assume he's still holding a grudge?"

"Well, yes. Of course he is, Octavio. His name is Albrecht von Wallenstein and you *did* , after all, plot and carry out his murder."

Piccolomini waved a meaty hand. "In another world! In this one, it never happened! And that, only according to a detestable play by a German of very dubious reputation. Why, the man hasn't even been born yet. How can anyone believe a word he says?"

All three men laughed, now. In truth, Friedrich Schiller's play *Wallenstein* was now one of the best-known plays in central Europe and very widely published and performed—despite the fact that it wouldn't have been written until the year 1800 and only one copy of it had existed in Grantville. Partly, because the subject was still alive and now King of Bohemia, a position he'd never achieved in Schiller's universe. And partly—such was the universally held suspicion—because Wallenstein secretly financed the play's publication and many of its performances. Although *Wallenstein* had its criticisms of the man who gave the play its title, the portrait of him was by and large quite favorable.

When the laughter died away, Uriel shook his head. "But I saw no reason—and see none now—for Wallenstein to know anything of your role in this business. All he will know, if all goes well, is that I met a fortunately-unemployed cavalry commander of excellent reputation in Vienna and hired him on behalf of Don Morris."

Piccolomini grunted. "So much is easy to explain. How about the other two?"

Franz wondered who "the other two" might refer to. But he decided to say nothing, for the moment.

Uriel shrugged. "They're only a colonel and a major, Octavio, and unlike General von Mercy they come alone, not accompanied by a complete regiment of cavalry. I doubt if Wallenstein will even think to inquire."

Piccolomini rubbed his jaw for a moment, and the nodded. "Well. You're probably right."

Uriel turned back to von Mercy. "My proposition is simple enough, General. As you may or may not know—and I suspect you do, at least the gist of it—the King of Bohemia has entrusted Don Morris Roth to see to Bohemia's interests to the east. Among those interests—this is at the center of Don Morris' own concerns, as well as my own—is included a reasonable and just resolution of the Jewish issues involved."

Franz managed not to wince. He could think of several possible resolutions to what Abrabanel was very delicately calling "the Jewish issues involved" in the politics of the Polish-Lithuanian Commonwealth and the sprawling lands and peoples of Ruthenia. But neither "reasonable" nor "just" was likely to be part of them.

A small number of immensely wealthy and powerful Polish and Lithuanian magnates lorded it over vast estates worked by Ruthenian peasants—serfs, to call things by their right name—and used Jews as their absentee managers and rent-collectors. How was anything either reasonable or just supposed to issue from those premises?

But all he said was, "Not so easily done. And if it can be done, it won't be done by cavalry."

Uriel now grinned. "And an honest man, too! No, General, it can't be done by cavalry. In the end, in fact—such is Don Morris' opinion, and I share it—the matter can't be resolved by any sort of military force. But what cavalry *can* do, as we wrestle with the problem, is keep someone else from imposing their own very unreasonable and unjust solution."

"Possibly. Although it will take more than one regiment of cavalry."

"Quite a bit more, in fact." Abrabanel leaned forward in his chair. "But here's the thing, General. We can train—so we believe, at least—a powerful enough military force out of our own resources."

Franz raised an eyebrow. "From Jews? Meaning no offense, but I find that unlikely."

Abrabanel shrugged. "It was done in another universe. But it won't simply be Jews, in any event. The Brethren are with us also, and—"

"Socinians." That came from Piccolomini, who, for all his cosmopolitanism and sophistication, still had more than a little in the way of straightforward Italian Catholic attitudes. The word was practically sneered. "Heretics who make Lutherans and Calvinists look sane."

"As it may be. But whether they are heretics or not—and as a Jew, I would not presume to judge such Christian matters—I can assure you that they are quite capable of fighting, Octavio. They did very well, actually, against Holk's forces last year."

He turned back to von Mercy. "But here's the thing—as you well know from your own experience. Without the traditions involved, there is no way we can forge a good cavalry force on our own."

After a moment, Franz nodded. At least, this Don Morris and his Abrabanel agent were not so wildly impractical as to imagine they could conjure up good cavalry from the ranks of ghetto-dwellers and rustics.

Infantry . . . maybe. Perhaps even artillery, if not too much was demanded of it in the way of maneuvering. But cavalrymen, like archers, almost had to be born to it. At the very least, they had to have spent years learning all the necessary skills.

"So. And for that, you seek to hire me. Yes?"

"Exactly."

"And the terms?"

Abrabanel's description was short, clear and to the point. When he was done, von Mercy studied him for a few seconds.

"And all this is going to come from the purse of *one* man? Who is not even a duke, much less a king. Pardon me, but I find that hard to believe. I'm not a village peasant, who thinks a 'rich Jew' is some sort of devil-summoned creature with bottomless coffers."

Uriel smiled. "You might be surprised, actually, at how rich some of these up-timers have gotten. The Roth fortune derives largely from cut jewelry, of which at the moment they have an effective monopoly and is a rage sweeping Europe. More than one monarch—and any number of dukes—are opening up their coffers to obtain the new gems. And, at that, Don Morris' wealth is small compared to the fortune being amassed by the Stone family with their pharmaceutical and chemical works. Still—"

He waggled fingers in a gesture that simultaneously dismissed the problem and cautioned the need for discretion. "Not all of the funds, of course, will come from Don Morris himself. Probably not even most of them. I said that Wallenstein was not *directly* involved here. I did not say he was not involved at all."

Von Mercy leaned back in his chair. And felt the tension caused by the Austrian emperor's refusal to hire him begin to ease. It seemed he would be able to keep his regiment intact, after all. Some of those men had been with him for years and would have been very difficult to replace quickly if at all.

In fact, he *had* heard tales of the wealth of the man Roth in Prague. The intricately-carved new jewelry he and his partners had introduced to Europe was, indeed, all the rage—at least, among those circles who could afford such gems at all. But there were a lot of noblemen in Europe, many of whom were very wealthy themselves—and it seemed as if each and every one of them was bound and determined to acquire one of the dazzling new "Prague jewels," as they were now being called.

And if Wallenstein was also involved, even if only at the level of providing funds through the back

door . . .

Yes. Roth *could* afford to employ an experience general and a regiment of cavalry, even on the munificent terms he was offering.

"Done," he said. "Where do you want me to take my troops? And by what date, and by what route?"

"As to where, Brno. As to when . . . there is really no great hurry. Two months from now would be ideal, but three months would be acceptable if you need that much time."

He made a little grimace. "The tricky question is by what route, of course. Given the unfortunate state of hostilities between Austria and Bohemia."

He glanced at Piccolomini.

"I'm afraid not," said the Florentine officer. "To allow Franz and his troops to pass directly from Austria into Bohemia would be just that little too blatant and obvious. So I'm afraid he'll have to take the longer route."

"That's time-consuming but not difficult," said von Mercy. " *Provided* I'm given free passage through the USE. I'll need to pass through the whole of the Oberpfalz and enter Bohemia at Cheb."

Uriel's good cheer was back in full force. "Not a problem."

Piccolomini and von Mercy both gave him skeptical looks.

"Johan Banér's in command of the USE army in the Oberpfalz," pointed out Piccolomini.

"And he is, by all accounts," added Franz, "choleric to the point of lunacy."

"Banér." Abrabanel spoke the word much the way he might have named an insect. "Merely a general. Meaning no offense. Did I mention that my niece dotes upon me? And she, in turn, is doted upon by her husband?"

After a bit, his grin was met with two smiles.

"Well, then," said Piccolomini. "All seems to be well."

* * *

# The Creamed Madonna

## Written by Kerryn Offord


## *Late summer 1635, Jena*

Dr. Phillip Gribbleflotz was at a bit of a loose end. He'd finally concluded that there was something fundamentally wrong with the theory that pyramid power could be used to invigorate the *Quinta Essentia* of the human spirit, and had regretfully given up on that line of research. He desperately needed something new to work on. Something interesting. Something impressive. Something that would prove to the world that he was in fact the World's Greatest Alchemist.

He sat back in his chair and surveyed his office, looking for inspiration. There was the large portrait photograph of his beautiful young wife, Dina Kastenmayerin, in pride of place over the fireplace. That was certainly inspiring, but not in any direction that would impress the academics at Jena University. On either side of the fireplace were bookshelves. It looked like he was going to have to do a lot more reading to get what Jonathan Fortney called the "killer application" that would forever cement his place in history.

Phillip looked up hopefully when the door opened. He was hoping it would be Dina, but it was only his secretary with the mail. "Anything interesting?"

Frau Beierplaced one envelope on his desk. "This one was marked personal and confidential, so I didn't open it. The rest are just the usual. Begging letters, inquiries about licensing agreements, and requests for you to endorse various products. I have prepared the usual responses."

Phillip sighed. Advertising was the curse of the new business environment. He reached for the envelope. The first thing he noticed was the excessive use of scent. He rubbed his nose and looked up at Frau Beier.

"I assume it is from a 'lady.'" The emphasis she put on the word indicated she thought the author no such thing.

"Do we know a Velma Hardesty, in Haarlem, the Netherlands?"

Frau Beier shook her head. "No, but I assume it is one of the up-timer females. Though what she wants that is private and confidential, I can't imagine."

Phillip had had much the same thought. He'd received a few letters from up-timers before, but never one claiming to be personal and confidential. *Oh well. There was surely one way to find out what Velma Hardesty wanted.* If he could make out the overly curly penmanship.

## *September 1635, Cora's cafe, Grantville*

Priscilla Fortney put down her cup of coffee, looked around to see who might be listening, and leaned closer to her fellow members of the Red Cross Sanitation Squad seated around the table. "You'll never guess what I overheard at the library this morning."

"No, we'll never guess. What did you overhear that you weren't supposed to hear, Prissy?" Minnie Frost asked.

Prissy sniffed delicately. That was Minnie, always trying to act like she didn't listen to gossip. "Dr. Gribbleflotz is going to make . . . well, you know. That sex pill. Via-something."

"Wow! Viagra? Are you sure?" Evelyn Paxton asked. "My Lacy's husband could sure use some."

"I heard Clara offer the job to the freelance researchers myself," Prissy said.

"Oh! So it's still in the research phase?" Evelyn asked.

"Well, yes. But this is Dr. Gribbleflotz we're talking about. The Aspirin King himself."

* * *

Richard Somers put his finger to his lips, signaling Carl Duvall to hush so he could listen in. The conversation from the other table was interesting. If he could get in on the ground floor of one of Dr. Gribbleflotz's inventions he could make a fortune. He was still cursing the fact that he missed the early days of the aspirin rush. And as for the Kirlian Image interpretation industry, he'd dismissed that as a foolish fad until it was too late. This time he was going to get in on the ground floor.

After a few minutes he gave up on listening to the old women and returned to his discussions with his old partner in crime. Not that they were discussing anything important. One visited Cora's to overhear the gossip, not to be overheard. He could ask Carl what he knew about this business later.

## *HDG Enterprizes, Jena*

"Well?" Dina asked. "What does it say?"

Phillip passed the letter from the State Library over to his wife. "The whole synthesis is much too complex for my current capabilities. I've never made anything like the heterogeneous polycyclic structure I can see in the diagram, and I know I can't make the piperazine yet. The whole synthesis is much too complex for my current capabilities."

Dina tapped the folded letter against her teeth. Nice well-proportioned white teeth. She certainly didn't need the dubious benefit of a visit to the American dentists. He returned his attention to the letter. "I'm afraid I can't help Frau Hardesty with her little problem."

"Well, we tried. I'll write a letter saying we're sorry that she mistook the advertising for Gribbleflotz Sal Vin Betula as little blue pills of happiness to mean you were making the up-time kind of little blue pills."

Phillip broke the seal of the next letter. "Would you believe it? Some American claims to have overheard that I was going to be making sex pills, and please could he place his order now, to get in before the rush."

"Pass it over. I'll write a letter saying you aren't going to be making any sex pills."

Phillip shook his head and picked up the next letter. "Here's another one." He passed it to his wife and had a look at the rest of the day's mail sitting in his in-basket. Many more than normal seemed to have originated in Grantville. "Dina, I think you might want to wait before starting on those letters. There might be a few more."

"Why? Why is everyone so interested in buying those pills?"

Phillip just raised his eyebrows. Even he knew why there was so much interest in what a certain up-time little blue pill offered.

"Yes, yes. I understand men having difficulty performing their husbandly duties might be interested, but why do they think you're making it?"

"I can only imagine that someone heard about my making inquiries and they assume that I can make it."

"Are you sure you can't?"

The obvious belief in Dina's voice forced Phillip to reconsider the problem. After some thought, he shook his head. "You saw its insane molecular structure. Certainly I could make it, if I could afford to spend years working on nothing else and I had as many trained laborants as this 'Pfizer Laboratories' put on the task helping me. You don't see the Great Stoner everyone fawns over wasting time on something like this. No, he has better things to do than waste time on a drug of such limited utility, and so do we."

Dina nodded. "Pity. Oh well, I'll send an announcement to the newspapers telling them you aren't working on it. Maybe it will stop these silly letters."

"Thank you, dear."

## *A week later, Grantville*

Carl Duvall passed the newspaper across to Richard Somers, his finger pointing to a column. "It says here that Dr. Gribbleflotz is not working on producing sex pills."

"An announcement placed by the good doctor himself," Carl said.

"But then, he'd say that even if he was working on it, wouldn't he?"

Carl smiled. He'd thought exactly that when he saw the advertisement. Clearly Dr. Gribbleflotz was trying to divert attention from his latest project. "So what are we going to do about it?"

"Um. Talk to someone in his lab?"

Carl grimaced. "Impossible. I can't imagine what he did to create such personal loyalty, but none of them will do anything to hurt him."

"What about inserting our own man?"

"We can try." Carl answered.

## *HDG Enterprizes, Jena*

Phillip looked at the letters cascading out of the mail sack Frau Beier was holding. He picked up the first one. It was from Erfurt. *I wonder what they want.*

A few minutes later Phillip was at the end of his rope. Erfurt, Halle, Magdeburg, even Leipzig. Letters from all over and the authors all wanted the same thing. *There must be over a hundred of these letters!* He stuffed them into a basket went hunting for Dina.

* * *

"Dina, that announcement didn't have the effect we expected."

"What announcement?"

"The one where we said I wasn't making sex pills. It seems that nobody believes us."

Dina took the basket and started sorting through the letters. "This is ridiculous. What can we do?"

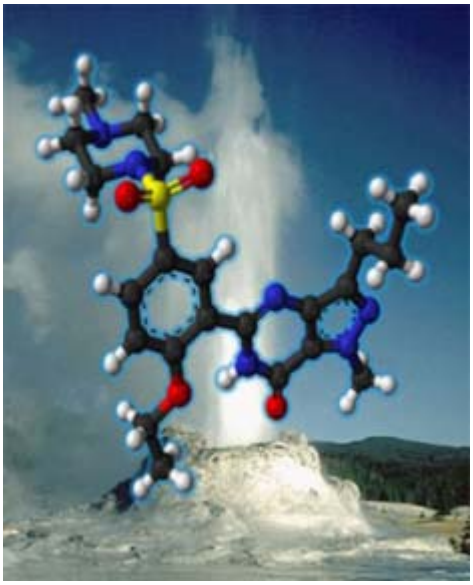
"I don't know. I guess I could to do some more research. Maybe there are alternatives."

## *State Library, Grantville*

There were a lot of books on sex in the library and, surprisingly enough, very few of them mentioned Viagra. Dina compiled a list of everything that was supposed to help, from special compounds such as ground rhinoceros horn, to special diets and exercises. Maybe she could prepare a suitable pamphlet. Certainly, given all the interest shown in those letters, there was obviously a demand for information on how to reduce the incidence of erectile dysfunction. Dina grinned at the term, so American in its wishy-washy manner of describing *impotentia coeundi* .

She paused to consider some drawings of different positions. Then, with a smile, she made copies to show Phillip. Some of them looked . . . interesting.

* * *



Phillip was also busy in the library. It seemed a bit wrong that *relaxation* of the muscles in the target area was what was needed, but that's what the notes said. It was the relaxation that allowed a greater inflow of blood, and thus an erection. Nitrous oxide reacted in the blood chambers, the muscle relaxed, and *poof!* there you were. Of course, there was also an off switch or . . . well, walking around that way all the time would be a bit uncomfortable. The up-time pill worked by turning off the off-switch.

Well, if he couldn't produce the inhibitor, he could surely increase the amount of nitrous oxide available, couldn't he? Of course, he'd have to make nitrous oxide, and he wasn't overly entranced with one of the methods described to produce the gas. Any method that warned of the potential for explosions wasn't going to be amongst his favorite processes. There were other options, but they seemed to have their own problems. Maybe Hans, his personal laborant, could be enticed into making nitrous oxide.

## *HDG Enterprizes, Jena*

"Hans, a moment of your time if you have it to spare."

"Of course, Doctor. I just need to add one last data point."

Phillip walked over to the large graph Hans was updating and considered what it indicated with interest. "I see the yield seems to be increasing as the pressure is increased."

"Yes," Hans Saltzman agreed. "Just like Le Chatelier's principle suggests."

"How soon do you think before you can commence industrial scale production of spirits of hartshorn from air?

Hans shook his head and gave Phillip a wry smile. "A while yet, Doctor. There is so much we don't understand. Have you heard anything more from Fraülein Drahuta? She would be of immense value to our research program."

"She expects to visit us in late February next year." Phillip paused a moment. "That is about when Dina is expecting to give birth. If I'm not in Jena when she arrives I expect you to make Fraülein Drahuta so

welcome she wants to stay, Hans."

"Of course, Doctor. Now, you wanted to talk to me? You have a new project?"

"Yes. If you'd like to join me in my office, I'll go over what I want you to do."

* * *

With Hans in charge of making the nitrous oxide, Phillip set out to investigate ways to introduce it into the human body. The experiment Hans was running in the secure laboratory had given him an idea. The experimental apparatus combined gases under pressure to force the production of spirits of hartshorn. What if he used nitrous oxide under pressure? Could that increase the production of the chemical responsible for the relaxation of the smooth muscle? But how to introduce it? Phillip turned to his books.

The article on diving suggested a pressure vessel large enough for a married couple might do the trick. It was certainly worth trying . . . not that he and Dina needed it. But, as a special service for couples having marital difficulties, it offered promise.

The real problem with a hypobaric chamber of sufficient size was that it would be beyond the pocket of all but the most wealthy. What was needed was something everyone could afford.

Phillip made a few notes and wrote a memo to look into the economics of building a suitable chamber before returning to the diving article. He could try making a pressure suit. Something like the new hard-hat rubberized diving suits, only without the helmet. The pressure the suit could be safely inflated to couldn't be high however, otherwise it would burst like a . . .

Phillip grabbed his pen and made a note before he forgot this idea. A balloon. A rubber balloon, just like the ones he used in some of his demonstrations. Surely he could make a special balloon. Something like a pair of rubber pants that could be inflated with nitrous oxide.

* * *

Dina Kastenmayerin chewed on the metal cap of her fountain pen. Frau Hardesty's request for the other type of blue pill of happiness had opened her eyes to a problem she hadn't really thought about. One heard about men finding it difficult to perform their husbandly duties, but it wasn't the kind of thing wives talked about in the presence of the unmarried daughter of their pastor.

She wrote a short memo to remind her to talk to Step-mama. She would surely have had to counsel

wives whose husbands were unable to perform their duties properly. What was really needed was a pamphlet. Something that any wife could easily access for help. But what to put into it?

She wrote down a heading. *What Wives Should Know About Marital Health and Vigor.* Then she proceeded to construct a list of all the things she thought should be included.

## *Several days later*

Dina had a good fire going to take the chill of the air and was kneeling in front of it, powdering the rubber pants with talc. Beside her was the cylinder of nitrous oxide.

"Are you nearly finished, Dina?" Phillip asked.

She looked up, a look of happy anticipation on her face. "Just about."

There were traces of white talcum powder in her hair and on her face. She looked delightful. Right then Phillip didn't think he needed any additional nitrous oxide, but a true scientist must complete his experiments.

The now well-powdered rubber pants had been made to a carefully considered design, with strong waist and leg bands to stop the pressurized gas escaping when they were inflated. This was the moment of truth. Phillip started to put them on. There was a stifled giggle from Dina. She'd obviously noticed how little he needed any extra help.

The gas-tight leg and waist bands made it difficult to pull the pants on, but finally, with sweat starting to bead on his body, he got them on. He sniffed delicately at the amused look on Dina's face. "Connect me to the gas, please."

Dina connected the short rubber umbilical cord from the pants to the gas cylinder. Phillip took a deep breath. Time to test his theory. "All right, dear. Open the valve."

Cold didn't begin to describe the sensation. Phillip screamed.

*Pop!*The pants burst, sending a cloud of talcum powder around the room.

"The gas . . . turn it off," Phillip cried.

Dina scrambled to shut the valve, then looked up. She fell backward, laughing like a maniac.

Phillip ignored his wife's laughter. He had more important things to worry about. He disconnected the umbilical cord and made a dash for his dressing room.

* * *

He was a sight to behold. The pants were still on, but the front had blown out revealing all his shrunken glory. The nitrous oxide gas had had a definite effect all right, but it sure wasn't the effect he was looking for. He'd forgotten that gas stored under pressure could be extremely cold when it was released.

It seemed fair to say that the experiment had been a complete failure. The details of the write-up of this experiment would require considerable thought, if not outright creativity. There were some things the

world's greatest alchemist did not want recorded for prosperity.

## *Next day, an apartment in Jena*

"He's running late," Richard complained.

Carl checked the time on his wristwatch. "It's only just after five, Richard. Give Thomas a chance. He's said before that he doesn't finish before five, and sometimes has to stay late."

"Gribbleflotz is supposed to be a good employer, and very strict about overtime."

Carl nodded. "Yes. But Thomas is working with a research group, and you know you can't stop an experiment just because a clock says it's time to knock off."

Richard did know this. For a while there, a couple of years ago, he'd thought he'd had it made, siphoning off some of the explosives production in Grantville. But that damned female the company installed had instituted "quality control" testing and the Hart brothers had discovered the machine that cut the explosive into pound blocks was giving short measures. Worse still, they were checking the weight of the blocks regularly, so he and Carl couldn't reset the cutters back to the short measure. That had been a nice little earner, and it could have made him and Carl rich. But no longer, more's the pity.

* * *

Thomas Brückner dawdled as he made his way to the meeting with the two men from Grantville. Initially it had seemed like a good idea to take money from them to spy on Dr. Gribbleflotz while also drawing a wage working for the good doctor. Now he wasn't so sure. He was the one taking all the risks while they took none.

He walked up the stairs and used the special knock that meant it was him at the door.

"You took your time. Have you any idea how long we've been waiting?" Richard demanded.

"I am most sorry. I got here as fast as I could, but I had to wait for Dr. Gribbleflotz to leave before I could check his journal entry for the day."

"You have access to his journals?"

"It is very risky. I have to sneak into his personal library to access them, but yes, I have been able to read some of his journals."

"So how is the old fraud planning on pulling this off?" Carl asked.

"The Doctor is not trying to make the up-time drug. The chemistry is too complex. However, he believes that he can achieve the same result by increasing the availability of nitrous oxide to the body. His latest experiments are based around wearing a specially made pair of rubber 'pants' into which nitrous oxide is injected."

Carl started laughing. Thomas stared at the up-timer. "What is so funny? Last night the doctor was scheduled to test his new rubber pants."

"And did they work?" Carl asked.

"Dr. Gribbleflotz has not yet written up the results of the experiment, but Frau Kastenmayerin was walking around all day with a very broad smile on her face."

"She's probably just remembering what her husband looked like all tricked out in his rubber pants. Either that or she caught a good snort of laughing gas."

"Laughing gas?" Richard asked.

"It's another name for nitrous oxide. I think the old fraud has out done himself this time. There is no way nitrous oxide can help sexual performance. Heck, the dentists use it as an anesthetic."

"So you think Dr. Gribbleflotz is not going to sell nitrous oxide as a sex aid?" Richard asked.

Carl shook his head. "No. There is absolutely no way he can sell nitrous oxide as a sex aid."

"That's a pity," Richard muttered. "I guess its back to Grantville and the explosives factory."

## *Jena*

Phillip was still trying very hard to convince himself that Dina's broad smile and giggles were a consequence of her inhaling a quantity of nitrous oxide. It was a losing proposition, though. The effects of the gas surely couldn't last this long. He was going to have to admit that she was still laughing at the image of him standing in their bedroom with a . . . well, thinking about it wasn't going to help him forget the experience. Fortunately there was only one witness and he could trust her not to spread the story.

The sound of the dinner gong dragged Phillip out of his retrospection. He hastily finished the entry he was making in his journal and put it away. When Frau Mittelhausen sounded the dinner gong that meant dinner would be served in five minutes, and she got upset when people were late. He'd have a terrible time finding another housekeeper of her quality, so he tried not to upset her.

* * *

After diner Phillip followed Hans back to the secure laboratories, not that he needed to check up on Hans, but rather to get away from that smile on Dina's face. He left with the image of Dina talking to a couple of female laborants while gesturing in his direction burning in his brain. He was pretty sure she wouldn't talk about last night. Surely she wouldn't. Would she?

"How is the research on the spirits of hartshorn process going, Hans?" he asked.

"Pretty well, Doctor. If you like we can check the graph in my office."

"Thank you. I would like to see your progress."

"Of course, Doctor. And how's your nitrous oxide research progressing?"

That question had sounded much too innocent. Had Dina been talking about last night? "Not very well," Phillip admitted.

"That's too bad. Did you have troubles with the rubber pants last night?"

Now Phillip was sure Dina had been talking. "They didn't work. The nitrous oxide was too cold, and the pants over-inflated and burst. Are you happy now?"

Hans nearly jumped back into the wall. "I'm sorry, Doctor. You were so hopeful, too. Will you try again?"

"No. There must be an easier way." To himself Phillip added, *and less embarrassing* . "I am going to the library."

* * *

Thomas Brückner shot to his feet, nearly spilling the glass at his side when Phillip burst into the library.

Phillip stared at the laborant for a moment as he processed faces and names. "Thomas. Thomas Brückner, the new laborant working with Hans?"

"Yes, Dr. Gribbleflotz. Do you want me to leave, Doctor?"

"What? Leave. No, stay where you are. What's that you're reading?"

"One of your old journals, Doctor. From when you first made the Sal Aer Fixus."

"Why are you wasting your time with that old stuff? The newer journals make better use of the new chemistry."

"I've just finished reading about your investigations into pyramid power."

"Ah! Not one of my better moments."

"But the research led to the Gribbleflotz Kirlian Imager, Doctor."

"I suppose some good came of it." Phillip sighed. He'd been so hopeful about pyramid power, too. "What's that you're drinking?"

Thomas held up his glass. "This? It's one of the new soda drinks, Sparkling Lemon. Would you like to try it?

"If you have it to spare."

Thomas pulled a bottle from the floor, used something to open it and poured some into a glass. "Here you go, Doctor."

"Thank you." Phillip lifted the glass, then hesitated. "Why is it bubbling?"

"They call it soda pop, Doctor. I believe they force a gas into the liquid under pressure, and when the bottle is opened the gas is able to escape, causing the bubbles."

Phillip studied his drink. What was the gas? Could nitrous oxide be forced into solution? A vague memory from that diving article flashed though his mind. Something about nitrogen entering the blood and

bubbling out if the diver returned to the surface too quickly. "Could I have a look at the bottle, please?"

Phillip searched the label for the name of the manufacturer. Maybe whoever they were could put nitrous oxide into a drink, then anybody could increase the amount of nitrous oxide in their body by simply drinking it. It was, even if he said so himself, a quite brilliant idea. But first he needed to a name, and there it was, "The Saalfeld Bottling Company." With the bottle still in hand he left the library calling out for Hans.

Thomas was left behind, wondering what had the Doctor so excited.

## *Several weeks later, Grantville*

Carl wasn't sure he believed what he was seeing. "'Gribbleflotz Revitalizing Tonic, for restoration of the Vital Humors.' Does that mean what I think it means, Richard?"

"What?"

"Vital humors. Does that mean what I think it means?"

"Is it a sex aid? Yes, that's what it means. Do you want to go in and ask for some?"

"No. But I wonder what it is."

Richard shrugged. "Wait here then. I'll go in and ask."

A few minutes later Richard returned with a pamphlet.

"Well?" Carl asked.

"Gribbleflotz Revitalizing Tonic is part of a complete program of diet and exercise aimed at restoring the Vital Humors," Richard read from the pamphlet. "Our special tonic contains nitrous oxide, a chemical identified by up-timer science as being important for successful sexual congress. Used in conjunction with a proper diet and exercise program Gribbleflotz Revitalizing Tonic will restore waning vital humors." Richard looked up. "It appears that the good doctor has found a way to sell nitrous oxide as a sex aid."

"What? Give me that. Nitrous oxide shouldn't have any effect on sexual performance." Carl grabbed the pamphlet out of Richard's hands and started reading. "Oh, the sneaky bastard. Whoever wrote this must have written copy for infomercials. The loopholes are big enough to sail an aircraft carrier through."

"You mean it's all a fraud?" Richard asked.

"You bet it is."

"How can you be so sure, Carl?"

"Follow me home and I'll show you."

* * *

Carl searched around in his chest of drawers before finally finding the small cardboard box he was

looking for. He pulled out a folded sheet of paper. "I told you Gribbleflotz was a fraud, and here's the proof. It says right there under "Clinical Pharmacology" that the important chemical is *nitric* oxide. *Nitrous* oxide is a completely different thing."

"Who is Pfizer Labs?"

"They're the up-time company that made Viagra."

"Oh! Um . . . ah . . . Carl, why do you have this pamphlet?"

Carl blushed. Something he couldn't remember doing since he was a pimple faced teenager. "Well, ah . . . I ordered some when I heard about it. Not that I needed it, but there was a lot of talk about the effects back then."

"Of course you didn't need it, Carl."

Carl glared. That agreement lacked a little in the way of belief.

"Maybe the doctor means nitric oxide?"

"Why are you trying to give Gribbleflotz a break, Richard? It's a fraud, pure and simple. There's no way it can work."

"But people are buying it."

"Of course people buy it. It gives hope, and depending on what their problem is, maybe a change of diet and a bit of exercise will do them some good."

"So it's not a complete fraud?"

Carl sighed. "Okay, it's probably not a complete fraud. Are you happy now?"

"Not yet. If it's not a fraud then I'm not going to be happy until I have my share of Dr. Gribbleflotz' latest Big Thing. I missed out on the Kirlian Imager craze, I don't intend missing out on the revitalizing tonic craze."

## *Dr. Shipley's office, Grantville*

Dr. Susannah Shipley removed the blood pressure cuff from around Lacy Brumfield's arm and made a notation in her notes. "And how are things with Rick, Lacy?"

"Things couldn't be better since I started him on Dr. Gribbleflotz' Revitalizing Tonic, Dr. Shipley. These days he's always raring to go."

Susannah contemplated telling Lacy that there was no scientific reason Dr. Gribbleflotz' Revitalizing Tonic should have any effect, but no, something had put that contented look on Lacy's face. Sometimes a patient's belief was more important than being properly informed. However, she might as well make sure Lacy and Rick got the maximum benefit from those beliefs. "I hope you're both following the diet and exercise program Dr. Gribbleflotz recommends. The revitalizing tonic won't work nearly as well if the program isn't followed."

"I'll be sure to tell Rick that, Dr. Shipley."

* * *

Dr. Shipley followed Lacy out of her consulting room and headed over to Dr. Jeff Adams' room. "You got a moment, Jeff?"

"Sure, Suz. What's up?"

"Rick Brumfield, apparently. Lacy says they've been having success using the new Gribbleflotz Revitalizing Tonic."

Jeff nodded. "I've had a few patients saying the same thing."

"So you don't think we should go public saying it has no foundation in scientific fact?"

"Hell, no. It's not like the tonic is dangerous, and it does seem to be doing some good. I say we don't rock the boat."

"Well, we agree on that. What I can't figure out is where on earth Dr. Gribbleflotz got the idea he should be using nitrous oxide."

"You didn't get many guys asking about Viagra before the Ring of Fire, did you?"

"No. For some reason guys didn't come asking me to prescribe it. Why?"

Jeff pulled a folder out of a filing cabinet and handed it over. "You've probably only read the trade literature then. Take a look at some of the newspaper and magazine clippings in that folder."

Susannah picked up the first article, skimmed through it. She paused at one point and looked up at Jeff —he was smiling — then she returned to skimming through the articles. "What? The first one talked of nitric and nitrous oxide as if the terms are interchangeable, but this one only mentions nitrous oxide."

Jeff grinned. "Yep. There's a lot of poor information in the newspapers and magazines. Anybody looking at those clippings would have concluded that they meant nitrous oxide. Mind, there is one silver lining."

"And what's that?"

"We're not going to have a shortage of medical grade laughing gas, that's for sure."

## *Cora's Cafe, Grantville*

Minnie Frost passed the bank statement around the rest of the group. "We're going to have to do another fund raiser."

"Not another one," Evelyn Paxton complained.

"Yes, Evelyn, another one. And this time it might be nice if you actually turned up at the sausage sizzle."

"I was sick in bed, Minnie, as well you know."

Minnie snorted her disbelief.

"We really need something a bit better than a sausage sizzle, though, Minnie. I mean, we only raised two hundred dollars last time," Prissy Fortney said.

"Well, I'm open to suggestions."

A deep silence followed Minnie's statement. Then Prissy pointed through the window. "Evelyn, isn't that your Lacy's Rick over there?"

"Yes, that's Rick. I wonder where he's been."

"Judging by the fact he's holding a Nobili's Pharmacy bag, I can make a fair guess," Minnie said. "And if I was a betting woman, I'd be willing to bet five dollars I know what he's got in that bag."

"How can you know from here?" Prissy asked.

"Nobili's only uses their paper bags when the customers ask them to. And there's only one thing they sell that a guy is going to buy that needs a bag that big."

"Gribbleflotz Revitalizing Tonic," the three of them chorused.

"My Lacy swears by it you know. Rick's a changed man since she started him on the Gribbleflotz treatment."

"Now that's what we need for a fund raiser. Something like Gribbleflotz's tonic," Minnie said.

"Trouble is, Nobili's have the local market sewn up," Evelyn said.

"Yes, so it's another sausage sizzle, same time, same place, next Saturday."

"Yes, Minnie," Prissy and Evelyn mumbled.

* * *

Evelyn was a little fed up with Minnie and the incessant need to run fund raisers to keep the Red Cross Sanitation Squad with enough money to continue their good works. What they needed was a real moneymaker. Something, anything, that could take the place of endless hours sizzling sausages.

She found her husband lying back on the sofa listening to a record with his eyes closed, a dreamy look on his face. He looked so happy and relaxed . . . which didn't sit well with her current mood. So she turned off the stereo.

"What the hell?" Charlie muttered. "Why did you do that?"

"Minnie says we have to hold another fund raiser for the Red Cross Sanitation Squad next Saturday."

Charlie walked over to the stereo, removed the record from the turntable and examined it carefully. "Well there's no need to do that. You could have damaged my record."

Evelyn snorted. There was every reason to "do that." She wanted a fight to relieve her frustrations, but Charlie wasn't cooperating. Instead he was dusting the record and putting it back into its protective sleeve.

"Hold it!" Evelyn cried.

Charlie stopped, the record part way back into its slot. "What's wrong now?"

"That record. Let me see it."

Charlie shrugged and passed it over. "What's the problem? You've seen the cover often enough before. You've even laughed about it."

"Shush, I'm thinking." Evelyn stared at the cover. "Yes, I've seen it before, but not right after talking to the girls about Gribbleflotz Revitalizing Tonic."

"What're you thinking about now, Evelyn?"

Evelyn handed the record back to a bemused Charlie and went hunting in the pantry. "Charlie, do we have any gas cartridges for this? Doesn't it use nitrous oxide? Seems like I remember that." She held up a whipped cream maker.

"For what? Oh, the creamer. Yeah, I think so. Why?"

"Because I want to try something. Where are they?"

"In the garage somewhere." She gave him a look, so Charlie asked, "Do you want me to find them?"

Evelyn's foot was tapping a mile a minute. "Yes, dear. I do want you to go and find them."

"Okay, okay, I'll go. But why are you suddenly so all fire interested in making some whipped cream?"

"Just find them, Charlie, and all will be revealed."

## *Next evening, the Paxton residence*

"Girls, I've got a brilliant idea for the fund raiser to end all fund raisers. Not only will it make the sanitation squad some real money, it's also sure to offend our children and grandchildren."

"An offensive fund raiser?" Prissy asked.

Evelyn grinned. "I thought that would get your attention. Yes. Offensive to the delicate morals of our children and grandchildren, and a sure fire fund raiser."

"If it makes money I doubt *my* family will find it offensive," Minnie Frost said.

"Just wait and see," Evelyn said.

## *A month later, Magdeburg*

Milana Frost tugged on her mother's hand and pointed. "Look, Mommy. That woman's not wearing any clothes."

Richelle Frost swung around to look where her daughter was pointing, and released a sign of relief. She'd feared a naked woman might be sitting in a shop window, not that that sort of thing was suppose to happen in this area of Magdeburg. Still, you could never be too sure.

"What's revitalizing cream do, Mommy? And why is the woman covered in whipped cream?"

Richelle tugged at Milana's hand. "Come on dear. It's just an advertising poster."

"What is it they're advertising?"

"I have no idea, dear," Richelle lied. With the come hither look in the model's eyes, the finger licking the cream, and the close proximity to advertisements for Gribbleflotz Revitalizing Tonic, it didn't take a genius to detect the double entendre in the product being advertised. Revitalizing Cream, indeed.

"Is it advertising whipped cream, Mommy?"

"Yes, dear, it is advertising whipped cream."

"I like whipped cream, Mommy. Can we get some?"

"I'll buy some cream and make some when we get home. Now, come on."

"But it's a fund raiser, Mommy, for Grandma's Red Cross Sanitation Squad."

"What?" Richelle all but roared.

Milana pointed. "It says so at the bottom of the poster, Mommy. 'A proportion of profits go to the Grantville Red Cross Sanitation Squad.'"

Richelle gulped. That was just like her mother-in-law. She desperately hoped none of the parents who sent their children to her branch of St. Veronica's Academy ever made the connection."

* * *

Christian Köppe slipped discretely into the shop. A peek through the window only revealed an American women trying to control her daughter. He approached the man serving at the counter. "That poster in the window. Can I buy it from you?"

"The 'Creamed Madonna'?" I'm afraid I need to keep that for advertising, sir."

Christian glanced back at the poster in all its colored glory. He had to have it. He pulled out his wallet. "I'll make it worth your while."

The shop assistant glanced around the shop, and then leaned closer and whispered. "There's a spare in the storeroom I might be able to let you have for a small consideration."

"It's the same poster?"

"Yes, the very same. Paxton's sent a few just in case they got damaged in transit."

Christian put down some money, when the shop assistant failed to move he added some more. Several bank notes later, the assistant scooped them up and slipped into the back room, returning a few seconds later with a large sheet of paper.

"I really shouldn't be doing this you know."

Christian accepted the poster, and after gazing at it for a few seconds rolled it up. "It can be our little secret."

* * *

Richard Somers watched the man walk out of the shop with his copy of the Creamed Madonna poster. His new shop was doing well supplying the revitalizing products craze. He didn't even need the boost that Paxton's Revitalizing Cream gave his business, and as for those posters . . . That reminded him. He slipped into the storeroom and ran a thumb through the stack of posters. Barely two dozen left. He'd better add a request for another hundred or so to his next order from Paxton's.

## *Gribbleflotz residence, Jena*

Dina scooped some of the cream onto her finger and licked it. Then she scooped up some more and offered her finger to Phillip.

"I can feel the nitrous oxide starting to work already."

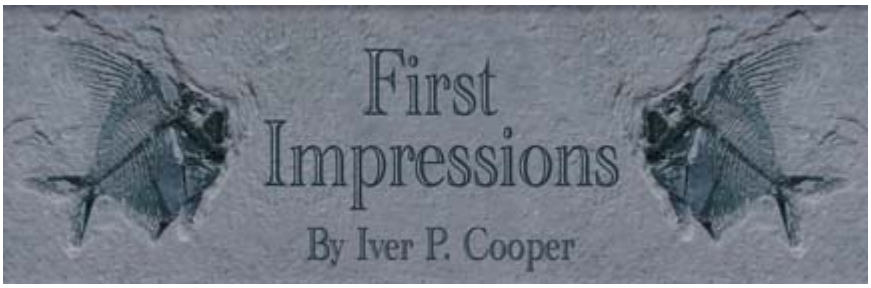
"I noticed."

Phillip felt Dina shiver, and looked into her eyes. Starting the revitalizing products craze might not be the killer application he needed to be remembered as the world's greatest alchemist . . . but it did have its compensations.

* * *

# First Impressions

## Written by Iver P. Cooper




The pickpocket thought he had spotted an easy mark.

First of all, he could tell from the fellow's clothing that he was a foreigner. So he wouldn't get the same kind of help if he raised a hue and cry that a citizen would.

Secondly, he was at the fair selling paintings. Artists were notoriously oblivious to the mundane aspects of life, like eating . . . or not getting their purses lifted. Of course, there probably wasn't a lot in that purse, but you couldn't have everything your own way.

Finally, he was distracted, talking to an extremely pretty girl. Tall, blonde and buxom. For that matter, she was doing a pretty good job of distracting bystanders, that might otherwise notice a cutpurse.

The pickpocket was having trouble staying focused himself.

He worked with the ebb and flow of the crowd, sidling closer without making his path obvious. He waited . . . then made his move.

The pickpocket should, perhaps, have paid closer attention to the subject matter of the paintings. They were detailed and realistic looking depictions of life in the New World. Including such subjects as Indian raids.

The painter whirled, and caught the pickpocket's wrist. A wrist which was, unfortunately attached to a thievish hand whose fingers were at that very moment gripping the painter's purse. It was, to be blunt, the very worst moment to have one's wrist grabbed and placed on public display. . . .

"Naughty, naughty," the painter, Felix Gruenfeld, said. His voice was relaxed, but his fingers weren't.

The blonde took in the scene and reacted in a less elegant but more practical way. "Help! Thief!"

The bystanders surged forward, eager to aid the damsel in distress, and tackled the unfortunate thief. They accepted the damsel's thanks, and then handed the criminal off to the market guards. He would probably be hanged before the fair was over.

If her helpers were disappointed to learn that the purse was the painter's, not hers, and that she was the painter's wife, at least they were too polite to say so.

* * *

"That was deftly done," said his wife, Birgit Wegenerin.

"Thank you," said Felix. "There are advantages to living several years in the wilds of America. And making friends with the Indians. They taught me how to sneak up on an animal, or a person, and how, um, to not get sneaked up upon. What's the up-time term? 'Situational awareness,' I think."

"Comes in handy in chess, too," said Birgit. "Too many players focus on their own attack, without minding where their opponents' pieces are marching."

Felix wasn't surprised by the chess reference. Birgit was from Stroebeck, the "Chess Village." Where girls as well as boys learned to play at a young age. And where a suitor had to play a village champion if he wanted to marry a Stroebeck maiden.

Felix had been such a suitor once. He was clobbered in the first match, but went to Grantville, learned up-time chess theory, and returned for a rematch. At which he won her hand.

They had just driven a wagon, loaded with Felix' sketches and paintings, to the Free Imperial City of Nurnberg, one hundred seventeen miles south of Grantville. They had arrived in time for St. Egidius' Day, September 1. While the town was Protestant now, and didn't celebrate saint's days in the Catholic manner, that day was still the beginning of a three week fair of international proportions. Felix's artwork had sold well. Well enough, obviously, for his purse to attract the attentions of a pickpocket.

* * *

The swordsman stood on a barrel, a sword in one hand, parrying dagger in the other. He mimed dueling, then placed the point of the dagger at his throat, as he aimed the sword skyward. After pausing for effect, he somersaulted off the barrel.

Birgit gasped.

The swordsman, now at ground level, held up the dagger; the crowd could see that he hadn't lost a drop of blood. They applauded, and the performer took a bow.

"I wouldn't want to try that trick," Felix said. "Not even with a paintbrush in place of the poniard."

"I wouldn't want you to."

"So, now what, Birgit? Listen to some pipers? Go bowling on Haller meadow? Watch a crossbow match on Schutt Island?"

"I think we should pack up now so we can leave for Solnhofen first thing in the morning."

The village of Solnhofen lay forty miles south of Nurnberg.

Felix frowned. "There's no rush. Perhaps I'll sell a few more paintings."

"You already said that was unlikely. That at best you might sell a few at the very end, to the bargain hunters that offer half-price, or less, in the hope the seller doesn't want to transport his merchandise back home."

"That's true. I suppose."

"So waiting around Nurnberg just costs us money in rent that could be better spent on starting up the new printmaking business."

The problem with painting, as he had told her in the early days of their courtship, was that it took so long to do each piece. And if one was popular, it took equally long to make a duplicate. Sketching was fast, but didn't command the same prices as paintings. If you thought the art could sell many copies, you could prepare a copperplate engraving, and make prints. But engraving a plate was much more time-consuming than painting.

Birgit was a practical sort of girl and, once he took her back with him to Grantville, she started asking the up-timers questions. Lots of questions. And the answers were the other reason they were in Nurnberg. She had persuaded Felix to try to duplicate lithography. Lithography was reputed to have many advantages, not least of which was that it was much cheaper, easier and faster to print drawings by lithography than by copperplate engraving.

"I'd feel more comfortable about lithography if, you know, we weren't the first."

"We aren't the first. The first was Alois Senefelder in 1796, old time line. The encyclopedia said so." Her tone was reverent.

"You know what I mean. First in this time line. Books are all well and good, but you don't learn to paint from books, and you don't learn smithing from books, so why should we expect to be able to learn lithography from books? I'd be a lot more comfortable with this scheme of yours—"

"—scheme—?"

"If even one of the up-timer art teachers were an expert with it. . . ." His voice trailed off.

Birgit took a deep breath, and expelled it slowly. "Felix. If there was already an expert around, then it wouldn't be as promising a proposition. We would have competitors. They would run up the price of the limestone. Or worse, persuade the Solnhofeners to give them an 'exclusive.'" Solnhofen's fine-grained limestone was Senefelder's original "litho"—stone. And was still used by printmakers two centuries later. The stones could hold fine detail and, unlike a copperplate, a Solnhofen stone could be ground and re-used to print a new design.

"If Solnhofeners were still quarrying limestone two centuries after Senefelder, then surely there's plenty of it to go around."

"Sure. But we want to get the choicest pieces at the best price. And we want to be the first on the market with lithographs, so the other artists are playing, um, 'catch-up.'"

"Still, it's a risk."

"Living is a risk. War, famine, and pestilence all around us, despite the up-time inventions. You already did what you could to bring down the risk. You read all the book entries. You sat down with all the art teachers, and found out what they remembered about lithography from their printmaking classes in art school. Eleanor gave you some tips that weren't in the books, as I recall."

"Still—"

Birgit glared at Felix. "I did not ride in a wagon for over a hundred miles just to watch you sell paintings in a square in Nurnberg. I could have stayed in Grantville and been productive. I could have gone to the library, and visited friends who have TV and air conditioning. I could have eaten ice cream every day. I didn't have to come here with you, husband."

Felix's up-time friends had told him how they had visualized German women before the Ring of Fire. Either wearing a "dirndl" and carrying a beer mug in each hand, smiling, or wearing a horned helmet and carrying a long spear, frowning. Birgit definitely fit the second image at this point. A Valkyrie, a chooser of the slain.

Felix decided that discretion might be the better part of valor. On the other hand, he did have his male dignity to consider.

"We'll leave. In two days. That will give me one day to dispose of some of the paintings. Give us more room for the limestone."

Birgit nodded curtly. "Fine. I'm taking a walk. I need to calm down."

* * *

Birgit strode off, turned the corner. After a few blocks, she stopped at a bakery and bought a *Lebkuchen* , a honey cake. When you're feeling down, eat a sweet, she figured.

As she munched, she thought about the complications of married life. Felix is a kind man, and funny, and a fine artist, but, really! He just hasn't learned that you have to put money to work if you want to make money. You have to learn to take a calculated risk.

Felix complains about how hard it is for painters financially, but doesn't want to do anything about it. And he knows that I have more of a head for business than he does, but he won't let me do so. Even though he grew up in Holland where "she-merchants" are taken for granted.

*Or he agrees, then gets cold feet. That's worse than just saying "no" in the first place.*

She made her way back in the *Haupmarkt* , where they had been arguing an hour or so earlier. Felix was gone. Back at the inn, she supposed. Packing. Painting. Sulking, perhaps.

Birgit strode over to the *Schoner Brunnen* fountain. It looked like a miniature cathedral, with a spire

She took hold of the famous golden ring. What had people told her?

"Turn the gold ring thrice; wish granted in a trice."

She turned it, three times, and stepped back.

"Bah!" she exclaimed. A passerby gave her a curious glance. *As if you could just need to wish for something, and it would happen.*

* * *

As soon as Birgit was out of sight, Felix started walking back toward the inn.

*Birgit's smart, but she's lived such a sheltered life, up to now*, he thought. Birgit had never been rich, but she had never had to miss a meal because she couldn't afford one. Felix had. Even before the siege of Amsterdam.

The Guild of Saint Luke's in Amsterdam wouldn't have elevated Felix to mastery if they hadn't thought there was room for him. *But art isn't like bread, or smith work. It's a luxury, not a necessity. If times are bad, then even master painters starve.*

Felix kicked a stone down the road, watched it skitter over the cobbles. When he met Birgit, all his worldly goods were in Amsterdam, the Spanish siege line rendering them as inaccessible as if they were in the New World he had once visited.

The newspapers in Nurnberg had just announced the peace treaty between the United States of Europe and the Netherlands. That meant the siege was over, Felix supposed. It didn't mean that his paintings, and other possessions, had survived the siege. They could have been stolen. Or burnt. If so, his resources were limited to the little he had accumulated in Grantville.

*And now I have Birgit to support, too. It can only be a matter of time, considering how long and how often I've been bedding her, before we have a child as well. Then I'll have three mouths to support. On just a painter's brush.*

A pack of children came running around the corner, laughing; Felix stepped out of their way, and watched them for a moment.

Birgit's father, Felix knew, thought he was just a vagabond. Within a week of the engagement, old Hans Wegener had second thoughts and started trying to talk Birgit into breaking it off. Prudently, Felix got her out of Stroebeck right away, before she, too, changed her mind. But that meant taking her to Grantville before Felix was entirely confident that he could support her.

*To start over in Grantville, I had to buy brushes, paints, canvas, and an easel. I had to rent a room that had good light. And rent, even outside the Ring, is astronomical.*

He recognized an approaching citizen as one who had purchased a "Battle of Wismar." It was a good seller in Magdeburg; the heroic Hans dive bombing the *Lossen* . He hadn't been sure that it would do as well here, so far from the sea, but the gamble of bringing a few had paid off well. Felix greeted the customer.

He suddenly thought of what he might do about the remaining paintings. He turned down a side street and went off to visit a fellow guildsman, a Nuremberger who came to Grantville from time to time and had bunked down in Felix's garret. Felix left the paintings with him. His friend promised to try to sell them in Felix's absence, for a commission, of course.

*Painting isn't like a regular job*, Felix mused as he stepped back into the street. *You don't get a*

*weekly paycheck. It takes time to paint and it takes time to figure out what paintings would sell. And when the work is commissioned, you can wait a long time to actually get paid.*

*Someone like Rubens, with high level patronage, can take risks. But I can't, can I? Just because the up-timers in their own time and place knew how to do something, doesn't mean that it can be duplicated here and now. Look at the microwave oven disaster!*

Felix had thought about working more for the Geological Survey. Full time, not just contract illustrations. But then he realized that if he did, he would hardly have time to paint.

*What would my life be like without Art?*

*What would it be like without Birgit?*

Felix hoped that this new lithography venture would work. For both their sakes.

* * *

Felix and Birgit went to bed quickly, without their usual banter. The next day, they talked, but a bit stiffly, confining themselves to minutiae like "how's your stew?" and "I wish it would stop raining."

The appointed day of departure, fortunately, was more pleasant; the morning sun warmed the stones of the Frauentor, the Ladies' Gate, and sparkled on the dancing waters of the Pegnitz as they steered their wagon southeast, along its northern bank.

The sun also seemed to have a warming effect on the couple's mood; after a while they spoke, at first haltingly, then with greater animation, about the people streaming past them and what their business in the city might be.

They arrived in Schwabach, their first stop, a little after lunch time. After eating, Felix and Birgit wandered up to the Church of Saint John. It was Lutheran, of course; it was here in Schwabach that the Schwabacher font, used to print Martin Luther's first German bible, had been designed.

Felix pointed out to her the altar carved by Veit Stoss. "You know the story about him?"

Birgit shook her head.

"He was a master of the arts—wood carving, sculpture, painting, and engraving. He was also a forger. He was caught and sentenced to death. The Prince-Bishop of Wurzburg pleaded that his life be spared, and at the last moment the Rath decided that his talents were so great that it would be sacrilegious to execute him. So they branded him on both cheeks, and threw him into prison for a few years. Eventually, the Holy Roman Emperor, Maximilian the First, granted him a full pardon."

"What did he forge?" asked Birgit.

"Some kind of promissory note. Not another artist's painting, if that's what you were thinking."

After looking at a few paintings, they sauntered out, and blinked as their eyes re-adjusted to the bright sunlight. "Okay, now it's my turn," Birgit said. "We have a look at the needle factory."

"Needles?"

"It's for another of my . . . schemes. . . ."

"No problem," he said hurriedly. "Take your time, I'll do some sketching."

They spent some minutes there, and Birgit ended up buying a few needles. Not for sewing or knitting on her own account, however.

"I had a very interesting chat with Sarah Wendell before we left Grantville. The Higgins Sewing Machine Factory would like to find a better source for needles than the one it is using now. Someone read in an encyclopedia that Schwabach was the, what was the phrase?" She wrinkled her eyes. "The 'chief seat of needle manufacture in Bavaria.'"

"When?"

"Well, that was the question no one in Grantville knew the answer to. But when we got to Nurnberg, I asked around, and they told me that a needle factory was established here last year. And HSMC will pay me for the information I collected, thank you very much. Enough so that we can certainly spend the night at the inn."

"I won't fight you on that. Particularly since I made my own inquiries in Nurnberg."

"And?"

"They said that the brewery here is excellent."

* * *

They had only driven the cart for perhaps an hour or two when Felix heard a rider, coming up fast behind them. At least, he hoped it was just one rider.

There was no way that the mule-drawn wagon was going to stay ahead of a horseman all the way to Roth, so Felix pulled over to one side. He sent Birgit into the woods close by, pulled out a pre-cocked crossbow, and loaded a bolt into it. He stood on the far side of the wagon from the road, and used the body of the wagon to conceal the weapon. And he put a souvenir of his stay in the New World—a tomahawk—close at hand.

The rider swept by. He was young, and wore clothes which would have been deemed gentlemanly if they weren't tattered. He gave Felix only a quick glance and then continued.

Felix didn't wave her back. After perhaps a quarter of an hour, Birgit emerged from the woods anyway. "That was a false alarm. . . ."

"Get back in hiding! We don't know who's after him, or why! And I hear riders!"

She scowled, but scurried back into hiding.

A few minutes later, four more riders appeared. . . . Sighting Felix, the leader made a hand motion. Two of the riders kept going, and the leader and his remaining henchman came toward Felix and dismounted.

"Hello, stranger. Have you seen anyone in a hurry this morning, heading south?" As he spoke, his fellow

rider sidled to his left.

"Indeed I have," said Felix. "You're perhaps a half-hour behind him."

"Well, that's good to know. However, I think I would like to look inside this wagon of yours, to make sure that he didn't accidentally sneak under the blankets when you weren't looking."

"And I might let you do that, provided that we take precautions so that you don't accidentally ride off with something which doesn't belong to you. To begin with, tell your friend to halt . . . now." Felix raised the crossbow into view. The flanker halted, but gave the leader a questioning look.

"That's good for only one shot," the leader said coolly.

"I am sure that your widow will find that a great consolation."

"So what do you propose?"

"Your friend rides far enough away that I don't have to worry about him rushing me, but in sight so that he can see that I am playing fair with you." Felix didn't add, *and so I can see that he isn't trying to circle around me*. But the leader no doubt understood.

"You take off your weapons, leave them back a few feet. Then you can pull off the blankets. Look all you please, but keep both hands where I can see them."

"Fine, fine." The leader rummaged around the inside of the wagon, looked underneath, shook his head. "Okay, that's clear. How do I know he's not hiding in the woods?"

"Then what did he do with his horse? These are mules, as I am sure you know. You see where they're standing. Do you see any fresh horse poop elsewhere, but nearby, other than what you brought with you? This whole time, have you heard your horses' neighing answered?

The leader scowled. "I do see foot prints, actually."

"My son's. I sent him into the woods, for obvious reasons."

The leader stood, studying Felix.

Felix returned the compliment. "You think the two men you sent ahead will be enough to get him, before he reaches Roth?"

The leader shrugged. "I suppose that even if you've got him hidden in the woods behind you, it will cost him in the long run if we beat him there." He bowed, collected his weapons, and swung himself back into the saddle. "If we do find out you helped him, and we see you again . . . you'll regret it."

He turned to the other man. "Joseph. On to Roth."

They rode off. Felix waited, until he was sure that they weren't planning a double back, then called Birgit back.

She emerged, somewhat tattered himself. "When I went back in the second time, I had less time to find a decent hiding place, I had to throw myself into a goddamn bramble bush."

"Better a few thorns than a few swords," said Felix. "You can repair yourself when we get to Roth."

* * *

They arrived there shortly before lunch. They passed through the gate, and Felix pointed toward a fountain. "And this is why the chase was so fierce," Felix said.

"What . . . oh." She saw the sign. "An asylum." Here, a fugitive could pay the *Freingsgulden* and stay in Roth for a year, hoping that in the meantime he or she could negotiate a more permanent solution with the pursuers.

"Did he make it?"

"I hope so," Felix said. "I didn't appreciate the interrogation."

"You're just sympathetic because you think he was fleeing creditors."

"That might be part of it. It is, after all, almost the natural state of the aspiring artist."

"But for all you know," said Birgit, "he seduced their sister, or maybe he even murdered someone."

"We won't be here long enough to find out."

Felix had thought they were just passing through Roth, but Birgit had other ideas. "I've heard about this town. Back when we were in Nurnberg. Half a century ago, the Fournier family started a wire goods factory here. Started by Georg Fournier, who fled here from a Nurnberg debtor's prison."

Felix groaned. "Not another factory. Perhaps I'll let that fugitive we met murder *me* ."

Birgit smiled sweetly. "You don't have to go. You can go up to Schloss Ratibor, the hunting lodge built here by the Margrave of Ansbach. Look at the artwork."

"Right. One painting after another of noblemen on horseback, and dogs treeing some critter or another. Fascinating."

* * *

Despite the factory tour, they reached Pleinfeld at dusk, and hurried in before the gates were closed.

"No factories here, I hope," muttered Felix.

"None that I know of. They mine sand here—I think they sell it to glassmakers—but it is too expensive to ship it a long distance. Now, when the railroad comes to Nurnberg, there will be some possibilities."

* * *

The inn at Pleinfeld had been horrible. Felix and Birgit almost wished that they had been locked out of the town. But at least they could look forward to a lunch stop at the Imperial Free City of Weissenburg-am-Sand. Or at least Felix was looking forward to it.

"I'm feeling a little nauseous," said Birgit.

"I am not surprised. I think the eggs were rancid."

As they neared Ellingen, the traffic picked up. At first Felix thought it was because they were getting near to Weissenberg, but that wasn't the answer. Or at least not the whole answer. At Ellingen, the road from Nurnberg to Augsburg crossed the one from Wurzburg to Munich.

"Stop the cart."

"Ho!" Felix shouted, as he pulled gently on the reins.

A moment later, Birgit leaned over the side of the wagon, and threw up.

Felix shook some water out of a water pouch and used it to moisten a rag. He reached around and held it to her forehead. "That help?" She nodded, but stayed by the side of the wagon.

They waited a while, and at last Birgit announced, "I think that's it. Let's get going."

"You sure?"

"If I'm sick, and not just suffering from indigestion, I'd rather be in Weissenberg."

If I were sick, I'd rather be in Grantville, or Jena, than Weissenberg, thought Felix.

They came to the crossroad, and Felix looked both ways. "Well, that's an interesting coincidence. " He pointed in the direction of Wurzburg, at an approaching coach, with cabbalistic symbols marked on the front. "A traveling Paracelsus." By which, he meant, an itinerant peddler of medicines. "Perhaps he has something that can help you."

This Paracelsus wannabee was of the opinion that to pause between sentences was to waste God's Bounty of Breath. "And then I have the new products, out of Grantville. Do you have a headache? I have Gribbleflotz *Sal Vin Betula* . That is, the little blue pills of happiness."

"Not a headache. Nausea."

"Hmm . . . then perhaps you should try a little Gribbleflotz *Sal Aer Fixus* , in water. And add some ginger. Honey, too, perhaps. Let me see what I have."

He found the *Sal Aer Fixus* quickly enough, but had to search for the ginger. He kept chattering as he did so. Finally, he pulled out a jar, and held it out where he could read the label. "Ah, that's it," he muttered. "Sorry it was buried so deep. But the toughest part is over, I have the honey right here."

They dickered a bit. Felix had to do the talking, and Birgit thought that he settled at too high a price, but she didn't have the energy to intervene. At last, the peddler waved good bye, and continued on his way, and Felix administered the remedies to Birgit.. . .After giving it time to take effect, he helped Birgit back on board and took up the reins.

* * *

They came around a bend in the road and Felix brought the team to a halt, and sighed.

"What's wrong, Felix?"

"Nothing's wrong. Under ordinary circumstances, I would draw that vista." The city of Weissenberg was perhaps a mile beyond. But Birgit quickly realized that the city was not the attraction. Rather, it was the fortress of Wulzburg, southeast of Weissenberg. This crowned a hill that rose perhaps two thousand feet above the town.

"You can draw it. I am not nauseous right now."

He paused for a moment, then motioned the mules back into action. "No, we best not wait, your nausea might return. Perhaps I will draw it on our return trip."

* * *

The next morning, Birgit told Felix that she was feeling better, but wanted to go back to sleep.

"So we will spend the day here in Weissenberg?"

"Yes—you could go back and draw the fortress you liked."

"You're sure you won't need me?"

Birgit pulled the covers over her head. Through them she mumbled, "I feel fine, I just want to take it easy today. Now, tell the maid not to disturb me, and go out and let me get some rest." Felix went out, and returned; Birgit passed on lunch. At dinner she just ate some bread.

* * *

From Schwabach to Weissenburg, they had been heading up the valley of the Regnitz, a tributary of the Main. To continue, they now had to head south, and cross into the valley of the Altmuhl. This would take them to Dietfurth, Pappenheim, and at last to Solnhofen. While that was their ultimate destination, the Altmuhl would flow on, eventually reaching the Danube at Kelheim.

Still, some delays were necessary, at least artistically. They had barely left Weissenburg behind them, and Felix already had his sketchbook out, after an apologetic look at Birgit. The mules didn't mind.. . .Birgit didn't either. Now that she had the ginger. And not if Felix was quick about it. It was business, after all—exotic scenes were the artist's stock in trade.

Birgit watched his fingers as he drew, then followed his gaze. "So that is the *Teufelsmauer* —the 'Devil's Wall.' You have to wonder why the Devil bothered to build a wall out here in the middle of nowhere."

"Very funny, Birgit," he replied, his pencil continuing to fly across the page, and his eyes flicking back and forth between the vista and the paper. "You heard what the minister in Weissenburg said, before I drank him under the table—the Romans built this wall. You have to visualize what it was like when it was new. A stone wall eight feet high, made, I suppose, of rock from local quarries.. . .With a road behind, and stone watchtowers, three times the height of the wall, every few miles. With legionaries on the lookout for the Hunnish hordes to the north."

"I'm a Hun, I suppose."

"I am sure they would have been happy to let *you* across. But not your brothers and boy-cousins."

Birgit was feeling back to normal. While Felix drew, she looked around for Roman artifacts that might be sold as curiosities. Just before her enthusiasm dwindled to the point of nothingness, she found the cheekpiece of a legionnaire's helmet. It was embossed with the image of a woman.

"She's carrying a bow, so she's probably the Goddess Diana. Should fetch a decent price for some collector's *Wunderkammer* ." A wunderkammer was a curiosity cabinet, a private museum. Throughout Europe, many noblemen had them, and in the Netherlands, merchants were also collectors. Since Felix was a landscape artist, he had found it to be a profitable sideline to also keep his eyes open for artifacts, historical and natural, that he might sell to curiosity seekers. He had been off prospecting at the time of the Battle of Dunkirk. Otherwise, he would probably have been in Amsterdam when the siege began. "Unless you would rather keep it. Being a goddess on earth, yourself."

Birgit shook her head, but smiled.

The minister had also told them about the *Fossa Carolina*— Charlemagne's Ditch—which was five miles southwest of Weissenburg. In 792, the Emperor ordered that a canal be dug to connect the Rhine to the Danube. Or, more precisely, the Altmuhl to the Rezat. The effort petered out, even though the two tributaries were only a mile apart, because canal locks had not yet been invented, and the two streams were at levels many feet apart.

The minister had a somewhat more spiritual explanation for the failure: "God would not allow his own Design to be frustrated." Which was another way of saying, if the Lord had wanted the Rhine and the Danube to be connected, he would have formed them that way to begin with. Birgit was unimpressed—she knew that a Rhine-Danube canal was shown on the up-timer's maps of Germany—but kept her skepticism to herself.

* * *

Felix had thought, based on the up-time maps, that they could stay on the north bank of the Altmuhl all the way to Solnhofen. That wasn't possible, after all. Just past Dietfurt, the river turned sharply south, skirting a tall plateau.

Yes, a local told them, they had to cross the river at Dietfurt, Felix should have guessed; the name of the town did mean, "People's Ford."

By the time they completed the crossing, both Felix and Birgit were exhausted. Still, the Lutheran Birgit made the time to seek out the former home of the famous female champion of the Reformation, Argula

von Grumbach. When Arsacius was arrested in 1522, she had lobbied the Rector and Council of Ingolstadt University. Her Scripture-rich letter found its way into print, and went through fourteen editions in two months. The Catholics called for Duke Wilhelm to tame "the silly bag," but the Lutheran preacher Balthasar Hubmaier said that she knew more of the Divine Word than all the red hats in the world put together.

Her principles were pursued at some cost; her husband Friedrich remained a Catholic, yet lost his job at Dietfurt as a punishment for her activities. Argula had once written, "May God teach me to understand how I should act towards my man." Birgit had sometimes wondered that herself, even though Felix's Calvinism was not especially problematic for her.

* * *

The Altmuhl, heading east, had to force its way across the Franconian Jura, like a corkscrew threading into a wine cork. It was narrow and windy, with cliffs several hundred feet high framing the river. Willows shaded the green water, and oak trees dotted the ground between the river and the cliffs. Beech trees clutched the slopes, and, craning his neck and shielding his eyes against the sun, Felix could make out the familiar silhouettes of spruce, pine and larch at the top of the gorge.

It was by the circuitous path of the Altmuhl that they came at last to the village of Pappenheim, the boyhood home of the famous commander of the Black Cuirassiers. Who was now far away, in the service of His Recently-crowned Majesty, King Wenceslas V Adalbertus, sovereign of Bohemia and all its dominions. Formerly known in these Protestant parts as Wallenstein the Devil.

The next morning, the sky was dark and threatening, and before they broke their fast, it began to rain. So heavily, in fact, that Felix joked that he wasn't sure whether the river Altmuhl was at their feet or above their heads.

Two hours later, the rain hadn't slackened a bit, and they decided to have lunch in Pappenheim. Felix took out a piece of charcoal, and drew an eight by eight grid on the table. They improvised chess pieces from pieces of wood and rock, and played chess the rest of the dreary afternoon.

The next morning, they were surprised to receive an invitation to the graf's castle. Actually, the summons was from the grafin, Anna Elisabeth, Pappenheim's second wife. Thanks to Pappenheim riding Wallenstein's coattails, she would now be "Her Serene Highness, the Duchess of Moravia."

She had heard, from a somewhat drenched servant, of Felix and Birgit's presence in the village, and was anxious for news of fabled Grantville. And, of course, of her husband. They enlightened her as best they could.

They were surprised to discover that, like Birgit, the duchess was of the Lutheran faith. Pappenheim, after all, was one of the leading lights of the Catholic League until he was forced to choose between Maximilian and Wallenstein. But it turned out that when Pappenheim married Anna Elisabeth in 1629, he guaranteed her freedom of worship, and ceased the persecution of Protestants in his lands. Even Calvinists like Felix.

Birgit and Felix each played a game of chess with her, this time using a real chess set, with silver pieces and a marble board. They then did their best to entertain their noble hostess in other ways. Birgit sang a show tune from the new musical, *Franconia!* , and Felix drew a sketch of the noble lady.

Much to the amazement of her maid, Anna Elizabeth then condescended to give them the "castle tour"

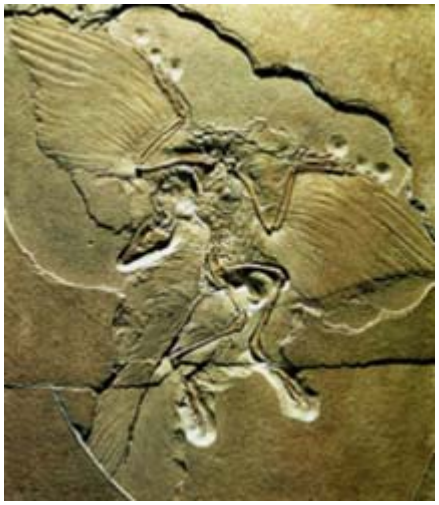
herself. In the process, they discovered that Pappenheim wasn't, exactly, *her* castle. She normally lived at Schloss Treuchtlingen, further up the Altmuhl. But her husband's elder cousin, the real Graf zu Pappenheim, had fled the region, and so she spent part of her year in Pappenheim to make sure the place didn't—what was the American expression?—"go to pot." Whatever that meant.

Before they left, she gave them a letter of introduction to the village headman in Solnhofen. "Perhaps it will help you get what you are looking for. It is the least I can do for someone who has helped me wile away what would otherwise have been a boring day."

* * *

It was evident from their first look at the village of Solnhofen that they had come to the right place. All of the rooftops were covered with *Legschieferdächer* , flat stone shingles, probably cut from the very quarries they were seeking. They were larger and thicker than the slate shingles that Felix had seen elsewhere, and they varied in thickness, giving the shallow-pitched roofs an odd appearance. Felix fancied that it was as though some of the limestone outcrops, tired of roughing it in the mountains, had slid or rolled down to the river's edge. And then grown windows so they could keep an eye on things.

Since Roman times, perhaps earlier, the rock had been collected for use as a building material, and rafted downriver to Kelheim and the Danube. In fact, in the towns on the Danube, it was known as *Kellheimer-platten* , rather than by its town of origin. Outside the Solnhofen area, it was used as a floor tile or wall covering. In fact, in Pappenheim, Felix and Birgit heard that that it had been used in the old Roman bath at Weissenberg, and even in the Haghia Sofia in faraway Constantinople.



Now, Felix and Birgit had a new use for it. Actually, uses. Birgit didn't know if the lure of a new printing technique alone would have been enough to persuade Felix to make the long journey. Fortunately, there had been an unexpected twist. Some months earlier, while Birgit was still in Stroebeck, Felix had illustrated a new geology pamphlet for the SoTF. As soon as he mentioned Solnhofen to his mentor, Lolly Aossey, she started jumping up and down, shouting "Archaeopteryx!" Once she had calmed down, she explained that Solnhofen was one of the most famous geological sites in the world. Its limestone had once been the carbonate-rich mud of a Jurassic lagoon, and it preserved fossils of dragonflies, beetles, sea lilies, pterosaurs and, most remarkable of all, the *Archaeopteryx lithographica* , the earliest known bird.

If the limestone had fossils, he could sell it to collectors, and if it didn't, he could use it for printing.

Just how valuable was an Archaeopteryx, Felix had asked.

The British Museum paid two years of its Geology Department budget for a single Archaeopteryx, Lolly told him. That got Felix' attention, all right. It sounded like, if luck was with him, he might find something which would command a truly royal price. One of Lolly's books had an Archaeopteryx illustration, which he copied into his sketchbook so he would know exactly what it would look like.

* * *

Felix was not looking forward to the bargaining process. If he were dealing with art, or with "curiosities," he would be more comfortable; through long experience, he knew what was in demand, where, and the going prices. He didn't necessarily do what the market forces dictated, especially when it came to producing art, but he did know the market.

But building stone? That was a bit outside his purview. Felix repressed the sudden urge to just wait until nightfall and then de-shingle a few houses.

* * *

"Remember the signals, Felix."

"I remember."

Felix knew very well that Birgit had much more business sense than he did. Ideally, he would just let her do the negotiating. But this wasn't Amsterdam, where a woman could be a "she-merchant" without raising male hackles. . . . They feared that here, in rural Franconia, if Birgit took too prominent a role, that it might do more harm then good.

Hence, they had worked out signals by which Birgit could tell Felix when to stand firm and when to make a concession.

"And if I kick you, what does that mean, Felix?"

"I don't remember that one."

"It means that you aren't paying attention to my signals!"

* * *

"I'm Johannes Bergmann, and I'm the foreman here. Looking for *Plattenkalk* ?"

"Yes, we are."

"How much?"

"It depends on the price. A wagon load, if the price is right."

Johannes wrinkled his nose. "Don't expect buying a wagon load to get you a price break, we sell by the raft load hereabouts. Roofs or floors?"

"Huh?"

Johannes gave Felix a pitying look. Speaking slowly, he said, "Are you going to put the plates on the rooftop, or use them as flooring?"

Felix didn't want to reveal that he had a new use for the stones. It might prompt a price increase. "Uh . . . on the floor." Felix hoped that he wasn't coming across as a simpleton.

"Then this be what you're wanting." He held out a piece to them.

Felix picked it up, looked at both faces, and shook his head. "No, this is wedged."

It was Johannes' turn to be puzzled. "What do you mean?"

"The faces need to be flat, and parallel, like the front and back covers of a book."

"Gah, you set the pretty face upward in the floor, it doesn't matter how rough the back be, or where it faces. The good earth holds it."

"It matters to me."

"Oh, please, good sir," Birgit added.

"Well, then." Johannes pulled out another piece. "Is this what you want?"

"Well, the shape's right. But it's too thin." Felix knew that it were too thin, it would break under the weight of the printing press.

"How about this one?"

"Sorry, too thick, not easy to handle. What I want is, oh, the thickness of between four and seven of my fingers, held together." That worked out, in up-timer measurements, to three to five inches. That was the value recommended by the 1911 Encyclopedia.

"I suppose that can be done. Although it isn't easy to get just the right thickness, mind you. The stones don't always split as you want them to. You'll have to pay for the wastage."

"Really? I thought they split as well as slate. That's what puts the *Platten* in the *Plattenkalk* , right?"

The quarryman grumbled. "It depends on the layer. Some split better than others."

"But you can give me the ones that split well. The ones that don't, you can sell to the fellows who want thick slabs anyway."

"Fine, fine. Let's get you your stones, and tally them up. Then I can quote you a price."

"Forgive me, but I'm concerned about more than just the dimensions." Felix pulled out the magnifying glass he had been assigned when he started working part-time for the Geological Survey. The quarryman stared at Felix as though he had just pulled a rhinoceros out of his pocket.

Next to the quarryman, there were several open wooden crates, each holding perhaps forty pieces, standing on edge. They varied somewhat in color. Through his magnifying glass, Felix studied their exposed faces, trying to judge how fine- or coarse-grained they were, and thus their porosity. Another of the workers wandered over to see what Felix was up to.

"This is my younger brother, Simon," said Johannes.

"Want to take a peek?" Felix asked.

Johannes shook his head, but Simon looked through the magnifier. He shrugged. "Not very interesting. Sometimes we find fish in the stones. Washed up here by Noah's Flood."

Felix tried to stay calm. "Do you have any for me to look at?"

"Not now," said Simon. "We don't find them every day. So what are you using that seeing-glass to look for?" Johannes, in the meantime, had noticed a worker slacking off and was now haranguing him.

"Just as cloth has its weave, which may be coarse or fine, so, too, do stones have their grain, for they are made up of much tinier stones which you can see clearly in my magnifying glass," he told Simon.

Felix would be drawing on the stone with a greasy crayon or the like. The stone had to be porous enough so that the grease would penetrate a reasonable distance. But it had to be fine-grained enough so that one would get a continuous-tone.

"Well, you know more about rock than most of our customers. Are you a mason?"

"An artist.". . .He said this, figuring that Simon would assume Felix was some sort of stone carver.

Felix mulled over what he had learned from the inspection. There was a good correlation between color and grain size. That was good, because it would be a lot easier to specify the color. The white stones were the coarsest, so he figured that they were unsuitable. Especially since the encyclopedia article had mentioned yellow and grey stones, but not whites. The yellows were a medium-grain, the greys finer still, and the blues finest of all.

Then Johannes returned. "Sorry about that. So, have you decided on which stones to take? Should I have Simon here lift up the mountain, so you can have a peek at its roots?" He laughed at his own joke.

"This is the color I want, just this," said Felix, pointing to a grey.

"Hey, now, this isn't a jeweler's shop, where you can pick out just the right color and shape of gem," Johannes shouted, his face reddening. " This is a quarry, you need take what we're digging out, when we're digging it out."

"But you can see the color of the layer when it's still in the earth, and dig out the color I want."

Johannes gestured in the general direction of the diggers. "If we have to go hunting for a particular color for you, then we waste time. And if you only take the grey stone, then the rest goes to waste."

"It's not waste, you'll just sell it to someone who isn't looking for grey."

"There's not enough grey. If you want that, you must take some of the other rock as well."

Birgit had been eyeing the slates in the cart. "Oh, Felix, I do think the yellow is nice. Doesn't it complement my hair? Do you think the yellow might do? There is so much of it."

Felix knew that Birgit was gently reminding him that the encyclopedia considered the yellow stones to be acceptable. For Johannes' benefit, he harrumphed. "I . . . suppose . . . we could take some yellow . . . If we got all the grey. And if the thickness were right."

Then they talked price. As Felix and Johannes argued, Birgit sat primly on a nearby rock, her hands in her lap. Johannes didn't notice how her left hand, initially covering her right, would move up the right arm now and again, signaling how much of a price increment Felix should agree to.

Then Birgit brushed her hair.

Felix recognized the cue. "We could go to Langenaltheim. Perhaps their prices will be more reasonable. They have *Plattenkalk* there, too, don't they?"

"Langenaltheim. You don't want to go there. It's a good five miles from the river, the cartage costs would ruin you." Johannes looked at his brother. "Isn't that right, Simon?" Simon nodded.

Felix disagreed. "More like half that. But if all we are paying for are the choice pieces we want, then that will keep our cartage costs down, too.

"Besides . . . there's Moernsheim, too. Just a few miles downstream from Solnhofen. No cartage costs

to get it to the Donau, none at all, right?"

Birgit pitched in with some delicately phrased prattle. "And Moernsheim is on the way to Eichstatt, dear Felix. Her Grace, the Duchess, the lady of Pappenheim castle, told me to be sure to visit the Prince-Bishop's garden, the *Hortus Eystettensis* . The one founded by the late Bishop Konrad."

Johannes blinked rapidly. "You know Her Grace?"

"Oh, yes. Show him the letter she wrote for us, Felix." Felix whisked it out. As Johannes studied it, Felix watched his eyes and lips closely. Johannes didn't move his lips at all, so it was very doubtful that he could read a word of it. On the other hand, he was probably perfectly capable of recognizing the lady's seal. Or at least of recognizing that it was the seal of some member of the nobility.

Johannes folded it up and handed it back. "I am sure we can work something out. For associates of Her Grace."

* * *

Okay. Now the hard part, thought Felix. Getting the stones on the wagon, and keeping them there all the way back to Grantville. He was thankful that it was no mere farmer's cart, but a full-fledged light freight wagon, made according to the new design that the up-timers had introduced. A "double box" wagon, it was called.

They ordinarily couldn't have afforded it. But Birgit had spoken to the craftsman who made it, and pointed out that his business would be so much better if he sold it through the *Wish Book*. And wouldn't he like the catalog to include a picture of the wagon, drawn by Felix? And Felix could also paint a little advertisement on the side of the wagon, which was being driven all the way to Nurnberg. And when Felix returned, he could give a little testimonial to add to the *Wish Book*copy, which would be most impressive since Felix was a world traveler.

He and Birgit wrapped the stones in burlap. It was nice for the quarrymen that the Solnhofen limestone split so easily, but that also meant that the bumps of the trip home could reduce his fine specimens to little shards if they weren't protected. Then they racked them in wood crates like the ones that the quarrymen used.

The average stone weighed perhaps eighty pounds, but there was a lot of variation. One stone, however, was both heavier and bulkier than he liked. It was one of the stones that the Johanneshad insisted he take, and Felix had agreed since it had some grey sections. Belatedly, Felix decided to try to split it into more manageable pieces.

One of the perks of working part-time for the Geological Survey was that he was issued a decent rock hammer and chisel. Bureaucracies being what they were, regardless of place and time, the Geological Survey had forgotten to ask for it back. And Felix had no intent of reminding them, they came in very handy when he was out looking for curiosities.

He found a likely crack, inserted the chisel edge, and gave the other end a controlled whack. A big chunk split off. He gave a grunt of satisfaction. Which changed into something more.

"Birgit! Look at this!"

He turned the piece so she could see it. The freshly exposed face held the clearly delineated fossil of a

fish. Its body was almost triangular, and it had a long spearlike beak.

"What about the other piece? The part you split off?"

He flipped that over, and found that it bore an impression of the body of the same fish.

"Matching pieces!" he announced with glee, and gave her a celebratory kiss. "For the right collector, that would probably pay for our entire trip."

"That's wonderful news. I suppose that you should try splitting any stone you decide isn't quite usable for lithography."

Yep. Perhaps I'll even find an archeopteryx."

"Don't be disappointed if you don't. What did Lolly tell you? Less than a dozen found after a century and a half of hunting for them."

"The Bible places great emphasis on the importance of faith."

* * *

"Felix, it isn't as though it isn't a beautiful day, but can you stop gloating over the fossil fish, and get back to packing? I'd rather not sleep in Solnhofen tonight."

"Oh. Right."

* * *

Felix didn't think the trip back to Nurnberg would be too bad. They didn't have to ascend or descend any mountains, and the only ford was the one at Dietfurt. And this was fall, when the water levels were usually at their lowest. Past Dietfurt, it was open country, and when they reached the Rezat and the Regnitz, they would keep to their east banks all the way to Nurnberg.

The wagon, of course, was heavier than on the trip out. Perhaps two tons. But six mules could pull such a load, even on the crude roads of the Altmuhl valley. Once they reached Nurnberg, they could make do with four.

Their progress was slower, of course. It took two days to traverse the seven miles back to Dietfurt, because they sometimes had to weave their way between the trees dotting the ribbon of flat land between the river and the cliffs, or dare the soft ground of the river bank.

By the time they reached Dietfurt, it was getting dark, and they decided to spend the night in the village and make the river crossing in the morning.

* * *

Birgit motioned Felix over. "The innkeeper says it rained last night. Quite hard."

"I'm surprised. We were by Pappenheim then, they didn't get any rain."

Birgit shrugged. "This is mountain country, like the Harz near Stroebeck. Local showers are common

enough."

"I suppose. I grew up amidst the mountains of Holland." He paused for effect. "Some rise as high as three feet."

Birgit waved the barmaid over, got her mug refilled. "So, are we going to have to wait in Dietfurt for the river to go down?"

"I'll make a judgment tomorrow morning. In the meantime, the levels in the Altmuhl may rise, but that in our mugs shall decline. In the interest of natural equilibrium, of course."

* * *

The waters of the Altmuhl gurgled at Felix' feet. He held a long stick up in the air and drove its sharpened end into the riverbed. He gave it a shake, then pulled it out again and repeated the procedure a yard away.

"Well?" asked Birgit.

Felix made an unhappy noise. "It's softer than I like. If we try, the mules might get skittish, and stop, and then the wheels will sink in fast and we'll be in big trouble. Just to add to the fun, the mules might decide to lie down, and then they have to be dragged out."

"Can we go around the headwaters of the Altmuhl?"

"Let's look at the map."

Birgit fetched it, and they rolled it out over a slab of *Plattenkalk* . Felix put an arm around Birgit, and she leaned into him.

They studied the map for longer than was perhaps strictly necessary.

Birgit summed it up. "Ugh."

"Yes. It's a good forty or so miles to the end, near Rothenberg, and then almost the same distance east to Nurnberg. And we have no idea whether we can take a wagon along the upper Altmuhl and then cut over, either."

It rained that afternoon, and in the evening, too.

* * *

Felix watched the raindrops pockmark the surface of the Altmuhl. "This delay isn't doing our purse any good." It hadn't helped that the innkeeper had decided to jack up the price of room and board, for both people and mules. Felix and Birgit weren't the only northbound travelers who were unexpectedly enjoying his hospitality, and the elevated demand was much to his liking.

"I know. Can you, I don't know, sell any drawings here?"

"In Dietfurt? The art capital of Europe?" He laughed to remove the sting.

"It's too bad there are no barges here," Birgit muttered. "That we could load the wagon onto, I mean."

A few moments later, Felix turned abruptly. "You know, there is an option. "Water casks. Empty ones. We lay the wagon bed on top of couple of kegs, lash them together, and float the wagon across. We'll need ropes to haul it from the far side. Don't worry, I can get the rope there."

"So we need rope and water casks. We have some rope, is it enough?"

"Yes, but we still need the casks. And I can't imagine what the innkeeper would charge for them."

"We don't need to buy them, just find some peasants to borrow or rent them from. If they can be floated across, they can be floated back."

"That might still cost too much."

"Give me a moment." Birgit went over to talk to some of the other travelers, then returned.

"They're as tired of Dietfurt as we are. I told them that you're an expert riverman. If you know more than your client, you're an expert, right? I promised that if they get the casks, then you'll guide them how to get their wagons and ours across. You can do that, I hope? And then we'll have more people to push and pull, too."

Felix agreed. The travelers assembled at the ford.

"Don't peek," Felix told Birgit. She closed her eyes, and he stripped. He tied a borrowed fishing line to a nearby tree, put the other end in his mouth, and, holding it with his teeth, swam across.

Birgit peeked anyway.

He signaled, and one of the other travelers took the tree end of the line and tied a heavier rope to it. Felix pulled it over, and tied the rope to a tree on the far side. The rope was now fastened to a tree on either bank, and hung low over the surface of the Altmuhl. Felix had chosen his tree so the rope went diagonally across, in a downstream direction.

Felix signaled again, and a couple of their fellow travelers stepped out into the water, holding the rope and guiding all of their mules across, tied together in single file. Since they weren't pulling a load, the mules weren't likely to be fazed by the water.

Birgit untied the rope from the tree on the south bank, and retied it to the tongue of their wagon. On the far bank, Felix set up their mules to haul the wagon across. She hopped on, and the remaining travelers pushed it into the water. Soon, she and their precious cargo were on the other side. Felix waded back, an arm on each cask, and returned them to the south bank.

The process was repeated until everyone was across. The last men, of course, had to wade. Or swim.

* * *

*"Come to the bath house, rich and poor,*
*"The water is hot, you may be sure"*

Felix was thinking about one of the entries in Jost Amman's *Das Standebuch* , a collection of woodcuts which depicted various trades, from *Apothekers* to *Zirkelschmidt* s . . . tool makers.

Amman was from Nurnberg, and there even the poor were given money and an hour off for their weekly bath. After the arduous wagon trip all the way from Solnhofen to Nurnberg, Felix was looking forward to a good soak. A tip from a rich merchant that Felix had assisted over the Altmuhl was paying for the bath.

Felix paid his fee, and waited for the trumpet to sound, the signal that the water was hot and the bath was ready to receive guests.

*"With fragrant soap we wash your skin,*
*"Then put you in the sweating bin;"*

Felix had been in Grantville long enough to have his doubts as to the efficacy of sweating as a plague preventative. But he figured it couldn't do any harm, since the up-timers admitted that twentieth century Scandinavians still took saunas.

*"And when you've had a healthful sweat,*
*"Your hair is cut, your blood is let,"*

But Felix decided to draw the line at blood-letting.

*"And then, to finish, a good rub*
*"And a pleasant soak in a soothing tub."*

Felix fought back a yawn as he left the bath. As he headed back to their lodging, he wondered how Birgit had fared with her mysterious errands.

* * *

"Felix!"

"What's wrong, Birgit?"

"The question isn't what's wrong, but what's right. Now is the right time for you to make a lithograph."

"Wait, Birgit. I was going to take the stones back to Grantville, experiment with different media and etchings, make a few trial runs . . . That was our plan when we left Grantville, right?"

"Yes, yes, that was a good plan then, but this is a cusp, a turning point in history, and you must take advantage of its artistic possibilities. And financial possibilities."

"What are you talking about?"

Birgit shoved a newspaper in his direction.

"Hmm . . . So Don Fernando, the self-proclaimed King in the Low Countries, has rescued his cousin, the Archduchess Maria Anna, from the clutches of Bernhard of Saxe-Weimar. By airplane, no less. It is

certainly a great moment in history. Don Fernando will no doubt commission Pieter Paul Rubens to paint it. Lesser artists will copy the Rubens. None of which will matter to me, back in Grantville."

"Don't you see? Those paintings will take months to complete. And they will be seen only by a few members of the nobility. But with lithography, you can create hundreds, perhaps thousands of posters quickly, so that everyone who reads the newspaper—and even people who can't read—can picture what the, the Aerial Rescue, was like. What's the proverb? Strike while the iron is hot."

"I can quote proverbs, too. 'Look before you leap.'"

"'He who hesitates is lost.'"

"'Fools rush in where angels fear to tread.'"

"'The early bird catches the worm.'"

"'Haste makes waste.'"

"'A stitch in time—'" Birgit cut herself off. "Enough of the dueling proverbs! The point is, we have a chance to make a killing. You can do your experimenting here, and when you're satisfied with the results, well, there are plenty of printers in Nurnberg." She paused, then added slyly. "How would you depict the event, if you were drawing it?"

Felix leaned back in his chair, eyelids half-shuttered. "Well, there are many possibilities. You could show the prince helping the archduchess into the cockpit. But that's a little, um, passive?

"Or the plane coming in for a landing on one side, and Bernhard's cavalry charging in from the other. With the archduchess waiting in the middle." He paused. "Perhaps with one angel in the air, helping the plane along, and another rising out of the ground, causing Bernhard's horses to topple.

"Or perhaps we should have them already in the air, flying on to the Netherlands. Into the sunset."

Birgit gave him a quick kiss on the cheek. "You could do all three, see which sells best. People can buy any of the three, or the set at a special price."

"All right. I'll do it. Fortunately, I have seen a plane. A Gustav flying over Grantville. So I know what it looks like from below. I'll have to guess what it looks like from above, if I decide to show that view. But, hey, only a handful of up-timers will know if I get that wrong.

"I'll need pictures of Don Fernando. And the Archduchess. Duke Bernhard, if I can find his likeness, but I can always recycle a stock villain if I have to." Birgit promised to see what she could come up with; she already knew a printer who she thought likely to try a new printing method. He already had two "Vignelli-graphs," the down-time recreations of a mimeograph machine.

Felix would get the artist's materials. And do preliminary sketches to show the printer, and pick out the stone to use for making the first lithograph in history.

* * *

He could draw on the stone with a wax crayon, like the "Crayola" crayons which the up-time children hoarded. Or with a pastel, the newfangled chalk-like drawing stick in which pigment was bound by gum.

Or with an oil-based ink. All had the fundamental attribute that the binder was a water-repellent grease of some sort.

He didn't have the special grained transfer paper which was mentioned in the encyclopedia article. That meant that he would have to do the drawing in reverse. Well, that wasn't a problem. Birgit had a hand mirror; he would do an initial sketch in charcoal, view it in the mirror, and then draw the reverse image on the stone.

Picking the right stone wasn't easy. Yellow or grey? He decided to try a yellow first. He had more of them, so if he spoiled the stone on his first attempt, it would be less of a loss. He picked out a likely prospect, and used calipers to check for parallelism. Hmm, not so good as it had seemed when he was at the quarry. Well, when they got back to Grantville, he could see if someone at the machine shop could sand it down for him. In the meantime, he needed a different stone.

His second choice was more of a greyish-yellow. It passed the caliper test. He now drew a big X of water on it, sprinkled some sand, and rotated a second stone on top of it. He stopped when the X was completely gone. "I hope that's good enough," he thought.

He drew the simplest of the three images on the stone; it took a full day to complete. So far so good.

Felix had bought both aqua fortis—what the up-timers called nitric acid—and gum arabic at a nearby apothecary. The next morning, he made a trial mixture of a small amount of each, and tested it on an unused part of the stone. Hmm, not strong enough. He added another drop of the aqua fortis, and decided this was satisfactory. So he made up a larger batch, with the new proportions, and retested.

He took a deep breath and brushed the mixture over the stone, starting at the margins and then, not without some trepidation, over the drawing proper.

The purpose of the etch was not to remove material, but to make sure that the undrawn portions of the stone would, when wet with water, repel the printer's ink. Whereas the drawn portions, thanks to the grease, would attract it. He was pleased—relieved to be more accurate—to see that the etchant hadn't defaced the drawing.

Felix hesitated at this point. The Encyclopedia Americana had said to wash the etched stone with a mixture of ink and turpentine, replacing the original image. That didn't make a lot of sense to Felix. And the 1911 Encyclopedia hadn't said anything about turpentine. Felix decided to go ahead with the turpentine wash, and then do a second etching.

He carefully picked up the prepared stone and headed to the printer. Felix got into a big argument with the fellow. The printer wanted to use some cheap paper that he was overstocked with; Felix insisted that he use a high-quality rag paper, as suggested by the encyclopedia. Felix also warned him to use an oily ink. By the time Felix wore the printer down, it was closing time. The printer promised to run off a proof

the next morning.

Felix and Birgit came by the print shop at daybreak. They entered, uncertain of their reception, but the printer was all smiles. The proof looked good, very good indeed. The printer told them to come back in the afternoon. They did so, and the printer was even more cheerful. It had taken only a few hours to pull the hundred lithographs off the press; they were still drying, but they looked exquisite. All three went out to celebrate.

Felix spent several days drawing the second, more detailed image, and rushed it over to the printer. The results were . . . not so good. Felix blamed the printer, the printer blamed Felix. There was no celebrating that night.

The following morning, Birgit suggested that perhaps what was lacking was . . . time. The original argument had resulted in the prepared stone sitting overnight before being used. Perhaps the chemicals needed to settle in, somehow? Felix talked it over with the printer, and he grudgingly agreed to an experiment. Felix would break a stone in half, and prepare each half the same way, but one would be used immediately after etching, and the other after an overnight delay.

The printer sponged each trial stone with water, rolled oily ink over it, and printed a few specimens. Sure enough, the delay was critical. For whatever esoteric reason, the image needed to be allowed to rest, after etching, to be stable. With confidence restored, Felix redid the second drawing and then moved on to the third.

* * *

"So, have we sold any yet?"

"Not yet, Felix. We finished the print run too late in the day. We'll have a better idea in the morning."

Felix tossed and turned that night. Birgit tried to ignore his agitated movements, but couldn't. She finally kicked him out of a bed. Apologetically, but firmly.

* * *

They walked down to the print shop.

"How're they selling?" Felix asked.

The printer stared at them lugubriously. Felix started to turn away.

"Like *Lebkuchen* !" the printer shouted, and laughed. He took Felix into a bear hug.

* * *

The trilogy of lithographs celebrating "The Aerial Rescue" was a great commercial and artistic success. The printer was besieged with requests for reprints and new works. Birgit negotiated an arrangement under which he would obtain the stones for them, and he would have the first dibs for printing lithographs from those stones in Franconia.

And if anyone noticed that the archduchess in the poster had a surprising resemblance to one Birgit Wegenerin, artist's wife and entrepreneur, who was equally tall and buxom, well . . . they didn't mention it

in public.

* * *

# A Gentile in the Family?

## Written by Terry Howard


## *Late winter 1635*

"Sarah? Just what do you think is going to happen when your father finds out?" Rivka asked as they left the grade school. She was one of those precocious little girls who behave like they were born twenty years old and started aging from there.

"Finds out what?" Sarah replied. Snow was falling in large wet flakes all around them.

"You know what! I saw you kissing that boy. It wasn't the first time you kissed him either. If I saw you, others have too. Someone will tell and it will get talked about down at the *shul* . What do you think your father will do when he finds out?"

Rivka was not allowed to walk the two blocks home from school without an escort; which was usually her brother Chaim and their cousin Yudl. When Chaim sat detention, Rivka waited in the library with Yudl until they could walk her home. On those detention days her brother and Yudl needed to go to the *shul* after school for Hebrew lessons; Yudl could not wait without being late. So Rivka waited until Sarah came after the high school let out to walk with her.

Sarah traveled to and from school without a chaperone. At first she left for school with other children in the family on the trolley, which was contracted to move school children so the buses could handle the areas not yet serviced by a rail line.

When she landed a before school job at a bakery, an escort for form's sake was discussed, even though she had to leave the house at four in the morning. It was agreed Grantville was safe, so the escort was foregone. When there is not a Jewish quarter where the boundary is set and behavior changes, a family must decide what is and is not allowable.

Sarah's boyfriend Hans accompanied Sarah as far as the grade school and said goodbye there. Eventually Rivka saw them saying good bye.

"I'm going to marry Hans!" Sarah told her young cousin.

"No, you're not. You tried to bring it up with your father and he wouldn't even hear you out. There's no way you're *ever* going to get him to give his consent."

"I don't need his consent. This is Grantville. He does not own me. I do not have to have a dowry. I do not have to have his permission. When we've graduated Hans will get a job, we will get a place of our own and get married, and there is nothing my family can do to stop us."

"Until you're eighteen you can't get married without parental consent." The age of consent had been hashed out by the government. It used to be even lower in some places back up-time. Some down-timers wanted it higher still and others thought no girl or women should be allowed to marry without the consent of a guardian, for their own protection.

"We might not have to wait that long!" Sarah said in a dreamy voice.

"What do you have planned, little bird?" Rivka asked, translating a family endearment into English.

"Oh, nothing really."

"'Fess up, Faygeleh." Rivka saw nothing odd about the hash of languages.

"Hans is checking on something. He knows a boy who was fighting with his parents over how much of his paycheck they got and how much he could keep. The father wanted the whole thing. Well, they yelled at each other so loud and so often the neighbors called the police. The police told the boy if he had an income and a place to stay he could get the court to declare him an emancipated minor and he could move out. So he did.

"I've got an income from the bakery. All I need is a place to stay and then I can do what I want and I don't have to wait to get married."

Sarah!" Rivka was truly shocked. "Do you want them to sit *shiva* for a dummy and declare you dead to the family? I'd never be allowed to speak to you again!"

"They won't do it unless I convert."

"You're getting married by a priest. You will have to convert."

"Rebecca didn't."

The conversation ended right there for the time being. Chaim, out of ear shot, was heading straight and fast for three boys who were waiting on the corner, snowballs in hand. They would get off one shot and then they would have to run or Chaim would be all over them.

"It was a fair fight," Chaim said once, "there were four of them." When it became clear that as long as he was not the one starting the fight, all that would happen was a few hours of detention, fighting became Chaim's passion. At first his family was proud; after a bit they became annoyed. When the rabbi complained he was late to Hebrew classes because of detention for fighting, it became a serious topic of concern, almost as troublesome as Chaim wanting to cut his ear locks or Daniel taking a second shift job in the munitions plant and missing Hebrew classes because of it.

Chaim just plain liked to fight.

"Chaim Bookbindern," Sarah called out loud and clear, "don't you dare. If you are one minute later getting to the *shul* than you need to be you will be in serious trouble, young man."

So Chaim was plastered with three snowballs and then three more as he hurried past with a promise of "later," being his only response. He would have gotten hit a third time but Sarah's stern "Drop them!" put a stop to it.

Then Sarah and Rivka were home so the conversation was put on hold.

* * *

Two weeks later Sarah's trouble with her parents came to a head.

Yankel, his brother Avram and Moshe, who was married to Cousin Leah, trudged home against the icy wind to the house shared by all three families, after a long day at the shop. They entered the kitchen off the back porch. The very word "kitchen" was warm. In their minds it meant: hot soup, hot oven, good food, and happy wives. But most of all it meant: a rich man's house with a room just for cooking and eating. What awaited them ended any warm thoughts. They stopped in the middle of taking off their cold weather trappings.

Rachael, Ruth and Leah were waiting. They could have been sitting *shiva* for the dead from their solemn faces and quiet ways. It was a heavy, sour quiet, like an over-filled balloon on the edge of popping.

Avram voiced his worse fear. "Is Daniel . . . ?" He worried every day about his eldest son working at the munitions plant.

"Daniel is well," Ruth answered. There was more to tell, yet she was a dry pump.

Avram primed. "What has happened?"

"Sarah has moved out."

"What? She can't. She's not married. Where would she go? Why?"

"She's moving in with a girl she works with who lives at the bakery," Ruth replied.

"Why?"

Ruth closed her mouth and her eyes. The former was leaking pain, the latter tears. She rocked back and forth in her chair as if she were *davening* , her arms wrapped tightly around herself.

Rachael spoke. "She is going to marry a boy from school. A Baptist."

"She can't. I forbid it!" Avram shouted.

"It is against the law," Moshe added.

"No, it isn't," Yankel said.

"Yes, it is! She is under age," Avram answered.

"We tried that argument," Rachael said. "She said she is seventeen; she has an income and an address. She can get the court to declare her—what was the word—an emancipated minor. Their laws will not stop her for us."

"The marriage is against the law!" Moshe said.

"No, it is not!" Yankel said.

Moshe looked at him as if he had lost his mind.

"Rebecca?" Yankel paused. "She married Mike?"

Moshe paled. "So we will get no help from the Abrabanels in this. Sephardim!" He used the word for Spanish Jews as an obscene curse. "They approve! Why did we ever *comen* here?"

Leah spoke. "For a good living, to be safe."

"At what price? Is this any better than a pogrom? If she were killed at least we would have a body to bury," Yankel said.

"We do not have to treat her as one who is dead. She is not converting. She is just getting married without permission, unless you decide to give your consent," Rachael said. She looked at Avram, while Sarah's mother continued to sob quietly.

"How can she get married without converting? The priest will not allow it," Moshe said.

"The Baptists do not have priests. They have a minister. They are different. Rebecca did not convert," Rachael countered.

"I never thought this could happen to us," Avram said.

Chaim came in from after school Hebrew class with a blast of cold air. He was late getting home because he was late getting to the *shul* . With the number of detentions he was sitting for fighting it almost seemed normal. The fathers were home. Dinner would be ready. He too stopped with only the first button of his coat undone. The table was not set. Dinner was not ready. His father and uncle were pale, his aunt was weeping. His mother was stern faced. Everyone looked at him.

"I haven't been fighting!" Chaim said.

"Go to your room."

"I haven't done anything!"

His father said, "Do as your mother told you!"

"You're fine," his mother said. "It is nothing you have done. I will call you when dinner is ready."

In the room Chaim asked, "What is going on?"

"Shhhh," he was told in a whisper by a cousin with his ear to the heat run.

"Ruth told them Sarah is marrying her goy boyfriend," another cousin whispered. Chaim swallowed his questions. He knew it wasn't easy to hear through the duct. If the furnace kicked in there would be an end to it, so the thermostat was turned down even farther than its normal frugal setting.

"Avram wants to kidnap her and go back home," the boy at the listening post reported. "Moshe says we'd get caught." He paused to listen. "Leah says would it be so bad if she does? Rebecca is doing well."

"My daughter will not marry a *grauber jung* !" This did not need repeating. All the boys heard it through the walls. They also heard the door slam as Avram stormed out.

"Rachael says you had better go after him," the listener said. "Leah says they had better have dinner ready when they get back." Then he said, "Turn the heat back up." If they were making dinner there would be too much noise to hear what was said. No one wanted an adult asking why the heat was turned so low.

Sarah was not at the bakery. The girl who lived there checked a phone book and gave them an address for Sarah's boyfriend.

Avram knocked on the door of a neatly-kept house in a good neighborhood, forgetting, in his grim mood, about door bell buttons.

The pre-teenaged girl who answered the door got a look at who was there and stopped with a word not half out of her mouth.

"I am looking for Sarah!" Avram said.

Avram spoke loudly enough to be clearly heard through the front of the house. "Ask Mister Bookbinder to come to the kitchen, Clara."

The three bearded men followed the girl through the living room. In the kitchen Janice had just put two cups on the table, when she saw her quests she took two more from the cupboard.

"I am looking for my daughter!" Avram declared.

"Please be seated. Clara, would you check the tea, please?" Real tea was now available in Grantville, though mints and herbs were still what most people were calling tea. "Mister Bookbinder, I am Janice Shaver." She held out her hand.

Avram realized she was waiting for him to shake. Would it be rude of him not to? He was put in a quandary.

No Jewish woman would ask him to shake hands unless she was being rude, in which case it would be all right to be rude back. No self-respecting down-time female gentile would allow a Jew to touch her. Those without self respect could be ignored without being thought rude. But up-timers had a lot of strange ideas about equality and politeness. Some were a great pleasure and benefit. Others were a great puzzlement. Just look at the way the girls and many grown women dressed in what were clearly men's

garments. Was this woman being intentionally ill-mannered? If not, then what?

There were so many things in Grantville where the old rules did not seem to apply, so many things that simply were not clearly defined. After a half second eternity Avram shook it with the lightest grip he could find and for the briefest of shakes.

"Please, be seated," Janice repeated. Moshe took a seat and the others followed suit.

The hot drinks were poured. Janice sipped hers and set it down. Neither Avram nor either of his companions so much as touched the cup in front of them. The kitchen was not kosher. They would not eat or drink anything prepared there. Politeness only goes so far.

She looked up from her cup and said, "Sarah is not here. I sent her home."

"We go, back to bakery!" Avram said, beginning to rise from the chair. His English was slipping, a sure sign he was losing his temper.

"Sarah is not there! I sent her home!" The calm certainty Sarah would do as she was told, the clear assumption she had the right to tell Sarah what to do was not half as astonishing as her next statement. "Sit down, Mister Bookbinder. We need to talk." Avram found his bottom firmly interfacing with the cushion on the chair.

"When Hans told me he was getting married, I asked if he had gotten the girl in trouble. Hans speaks English so well sometimes I forget it is a second language for him. My husband and I took Hans and Clara in back in '31. It seems like they've always been part of the family, so sometimes I slip up.

"When I asked was she in trouble I meant: was she pregnant? Hans said yes. He meant she was in trouble for wanting to marry without permission. Well, if she was in a family way then she and the baby were his obligation and if we are his family, then it is our obligation. So I agreed they could get married and she could move in until they got on their feet and settled.

"When I finally got my facts straight, I sent her home.

"My husband and Hans have her things in the car." They had one which had been converted to natural gas. "They've been gone for awhile and I'm surprised they're not back yet. Sarah will be home when you get there.

"Hans will be calling on you in the near future asking for permission to court your daughter. I realize your

family is observant. I suggest you tell Hans he may only court her if he undertakes to study for conversion. It will take a year or more to learn Hebrew and then he needs to study the law. That will give them at least two years to finish growing up. They will probably be over this by then.

"I've just met Sarah, but I know Hans. If you tell him he can't, you've waved a red flag at a bull. I would hate to see them do something impulsive."

Moshe broke the silence. "Is it not unlawful for a Christian to convert to Judaism?"

"No, it is not," Janice replied. "Besides, I am not sure Hans is a Christian. My husband tells me the boy is circumcised. We asked him about it. He said he had always been that way." Janice chuckled. "He was half grown when we took him in and he couldn't tell us anything solid about where he was from or who he was. He was sure the people he was with weren't his family but beyond that it was 'a camp by a river, a sacked town with a castle, a long walk here, a long walk there. He called places by names we can't find on a map anywhere. He talked about people being killed, places being burned. He thinks he's eighteen; I think he's sixteen or younger.

"We explained that other than up-timers, only Jews and Muslims are circumcised. That is when he started asking Sarah about what it means to be Jewish. They talked a lot and now they think they're in love.

"As I said, I forgot he doesn't know English as a first language. I created this confusion. I am sorry about that."

Yankel was puzzled to the point of distraction by one thing. "Up-timers are circumcised? Even Christians?"

"My husband is a Christian. We don't attend but he was raised Baptist. We've sent Hans and Clara to Bible school in the summer and to Sunday School even if we don't go very often ourselves." In truth, if it were not for the occasional children's program, like the Christmas pageant, they wouldn't go at all.

"A lot of up-timers are circumcised. It is a sanitary practice."

Avram was much calmer than when he arrived. "Thank you for sending Sarah home. We will wait for Hans to ask to court Sarah. We need to be going now."

As they trudged homeward with the wind to their back Moshe asked, "What will we do?"

Avram replied, "We will take her wise advice. If Hans is a lost Jew then we should teach him how to be Jewish."

"Not just that, Avram. Chaim wants to cut his *peyot* . He is in a fight every other week. Sarah would marry without asking? Daniel is missing prayers because he works second shift and . . . " The word dwindled into the future and disappeared. "What will we do? How do we keep them safe?"

"I don't know, Moshe." Avram let out a deep sigh. "I just don't know."

* * *

# The Royal and Ancient Game

## Written by Mark H. Huston


### *St Andrews Scotland, Winter 1634*

James O'Fehl, the butler of Ramsay Manor, wearily tugged open the heavy wooden door to Andrew's bedchamber. He could see faint streaks of morning light through gaps in the drawn draperies. Andrew was sleeping soundly in the center of his large bed. James shuffled across the room, and briefly paused to steel himself against what he knew must be done. He took a deep breath, shook Andrew's shoulder, and quietly announced, "The package ha' arrived, milord."

Andrew, the son of Lord Ramsay, sat upright, instantly awake "Here? In the castle?"

"Aye, milord."

Andrew tossed back the covers, peeled his nightshirt off in one swift motion and began to pull on his clothing. The cold January air chilled the bed chamber, and he shivered with cold. *Or maybe excitement* , James thought dryly.

"Just in time for today! Perfect, James! Have you told my father?"

James lit more candles in the room. "No, milord. You wanted me to wake you first, if they arrived tonight. The messenger brought them out in darkness, sir. It was quite expensive to have them delivered at this hour. They got to the village last night, I'm told."

"Does anyone in the village know of this?" Andrew hopped on one foot as he pulled on a stocking, finally steadying himself on the bedpost.

"No, sir. Other than it was a very special package, and had to be delivered to you as soon as possible." James picked up a doublet, and held it so Andrew could put his arms into it. "That has happened before, with other packets and letters for your father. While this is somewhat larger, we aroused no undue suspicion."

Andrew ignored the doublet, threw a splash of water on his face, and turned to James. "Did anyone know they were from Germany, specifically Grantville?"

"The writing on the package was somewhat strange, but it is unlikely anyone noticed, or could deduce the contents."

Andrew smiled and clapped James on the back. "This is going to be one of the best days of my life. I cannot wait to see the look on Foreman's face. He's Spottiswoode's man, you know. Nobody has beaten him in a year and a half. But today. Hah! Today will be different. We must wake my father."

* * *

Laird Ramsay dashed down the stairs and joined his son and James in the main hall. Laird Ramsey hadn't bothered to dress; he was still in his nightclothes. The crate was half opened by the time he arrived. It was not yet fully light, and flickering candles in the great hall created twisted and dancing shadows as the men worked. Laird Ramsey dashed to the fireplace, snatched the massive family claymore from over the mantle, and used it to hack away some of the last bindings.

At last. They had them. From Grantville, the future. They lay exposed, in their bag.

Laird Ramsey handed the heavy sword to his son, and knelt in front of the open crate. He carefully lifted out a long bag. It rattled mysteriously. Father and son looked at each other with a mix of anticipation, joy and disbelief. Andrew was clenching the massive claymore in both hands, breathless with anticipation.

The two men grinned at each other, a wide silly grin.

Laird Ramsey reached inside the bag and grasped a shiny metal shaft. He pulled it out of the bag, and looked at it in wonder. "Look how long this is!". He held it up to a candle, and looked at it closely. There were cushioned grips! At the opposite end, where the gleaming metal shaft blossomed out to a bulbous shape, were the deeply embossed words *Titanium* and *Wilson Pro Golf* . It was a three wood. Made of metal. The rarest metal in the world. "They mus' be strong, named afta' the Titans," he muttered

Andrew nodded, and then hastily looked at the other clubs in the bag: the massive driver, the irons, and the curious short and flat-faced putter, all purpose-built for the greatest game in the universe.

"This," said Laird Ramsay, his voice quavering with excitement, "this is what we will use to finally defeat that dammed Spottiswoode." He looked as his son a little guiltily. "S'pose I shouldn't call him dammed. He is the archbishop of St Andrews *and* Lord Chancellor, after all. But his men Forman and Hannay have beaten us for the last time."

This was a rivalry that went far, wide and deep. The noblemen had their pride. The men of the kirk had the same. Both groups struggled against the sin, and in most other areas of their lives all were successful at being good, modest, and solid Christians.

However . . .

This was golf, and their struggles against the sin of pride were less successful here.

The kirk/noble game had been going on every Monday morning, weather and course allowing, for the last three years. It had been two years since Lord Ramsay had carried the day. Two years of itchy, scratchy, rubbed-raw-with-dirty-burlap humility. It was time. Past time. A man can only take so much humility.

Andrew was still clutching a putter. "We should challenge them to a wager. Something significant, something the preacher and his kirk golfers will have to live down. Something embarrassing." He handed the putter to James and tuned to his father conspiratorially. "What should it be, Father?"

Laird Ramsay held up his hand and got far off look in his eyes. "I have just the thing. Something no bishop's man should ever do. Aye." He nodded his head slowly. "Aye, 'tis perfect."

"I've seen that smile on your face before, Father. Whatever it is, you are scheming. That much I know for sure."

"Aye, lad. And we must make the wager before they see the clubs, or hear of their existence. It must be today." He held the club in his grip, wiggling it. "See how it flexes, boy, so much more than the old ash? We will be able to hit the ball so much further. We will have one shot for two of theirs. 'Twill be a slaughter, it will."

Andrew had been digging in the crate and the golf bag, going through the zippered pockets. "Look, Father. Balls! They sent us up-time balls too. These will work better than the feather stuffed balls we use."

The father lifted his son's face to his, each man holding a club, and solemnly said, "Lad. We both know it takes balls to play this game of golf."

James O'Fehl almost stifled his laugh, but wasn't quite successful.

The laird and his son glared at him.

* * *

Later, the sun was shining brightly for a Monday morning in January. Cold but unusually clear. Brisk. Perfect weather for golf. Just a touch of wind from the sea.

Spottiswoode and his men Forman and Hannay were already waiting on the first tee at St. Andrews. At sixty-eight years of age, Spottiswoode had withdrawn from active competition in the last year, although he still played occasionally. He nearly always came out to walk a few holes, and offer encouragement to his two associates.

Laird Ramsay and his son strode confidently to the tee, carrying their same old clubs. They bowed slightly to Spottiswoode. "Good morning, Archbishop and Lord Chancellor. It is a pleasure to see you in fine form this morning." Laird Ramsay turned to Foreman and Hannay, and nodded to them. "Gentlemen, you too are looking fine this morning. Beautiful day, no?" The nobleman smiled beatifically.

Hannay looked suspiciously at Laird Ramsay. "You are in quite a mood today, milord. 'Tis been a while since I have seen you this chipper for our weekly match." He turned to his partner Foreman. "What d'ye think?"

Foreman smiled. "I think it will be different at the end of the day, after we finish, and he pays us the wagers he has lost. Like every other day."

Hannay piped up. "'Tis for a good cause tho, lads. Ye be supporting the kirk." The two churchmen laughed. Spottiswoode frowned slightly at his subordinates. They were rubbing it in too hard.

The silly smile did not leave Laird Ramsay's face. "I feel lucky today, lads. Very lucky. So does Andrew, don't ye, son?"

"Aye, Father."

Laird Ramsay continued, "So lucky I want to raise the wager, gentlemen. Today, we have decided to go 'all or nothing' as it were."

Archbishop Spottiswoode wondered what they were up to. He raised both hands in front of him, as if to give a blessing. "Gentlemen, I must maintain my—let us call it *distance* . I am, after all, the king's hands, eyes and ears for Scotland, and the head of her church. It might appear unseemly of me if I should be partaking, or supporting the partaking, of wagering on the golf course." He looked at the carriages a few yards away, and pointed. "I am going to walk over there, so I do not witness these untoward actions between my senior church men and members of a noble family. It might be too much for me to bear. Let me know when it is time to return, I will be waiting." As he walked away, he turned and looked over his shoulder with a twinkle in his eye.

He waited a few minutes more than he thought he might. There was some discussion of the wager between the men, and Laird Ramsay looked to be raising the stakes even more, sweetening the deal. Finally an agreement was reached, and all shook hands. Spottiswoode then returned to the four men, while the caddy for the Ramsays trotted off. "Are you finished with your discussions of the game, gentlemen? It does grow late, and I want to walk all twenty-two holes today."

Foreman leaned toward him and said, "These two are up to something today, Your Grace. I don't know what, but there is some sort of nonsense. The wager they made is—"

"Tut-tut, Foreman. I will hear nothing of any wagers."

"But—"

"Nothing, Foreman."

"Yes, Your Grace."

Spottiswoode squinted off in the distance. "What is it your caddy is carrying there, Ramsay? What a large bag!"

Ramsay smiled his silly smile again. "Oh, nothing. Just some new clubs and balls we are trying out today."

Foreman snorted a laugh. "Hah. If this is anything like the time you soaked your golf balls in fish oil to get additional yardage off of the tee, you *are* going to owe us, Ramsay." He turned to Hannay. "That only caused the ball to explode after he hit it the third time. Quite a mess with feathers and stink all over."

Laird Ramsay continued to smile. "Say what you will, Foreman. Take a look at what we have obtained." The caddy stood the golf bag up in front of Laird Ramsay. "Up-time golf clubs. And balls. Regulation equipment, from the future." Laird Ramsay got just a touch of gloating in his voice. "I don't think you lads are going to stand a chance against us today. Not a chance." Laird Ramsay then took out the driver and danced around a little bit, humming a tune, and occasionally stopping to take a joyous practice swing.

Andrew looked a little sheepish, and just shrugged at the churchmen. "We got them last night, we did."

While his opponents stood shocked and looking worried, Andrew explained to Spottiswoode how he had acquired the club set. An old lady had bought them, right after the Ring of Fire as an investment, and kept them unused in her home until they were discovered by a Scotsman, who told his captain, who immediately wrote to Ramsey. The amount of money exchanged was—well, Laird Ramsey could afford it.

Spottiswoode and his two men admired the clubs, oohed and ahhed at the balls, and flexed the shafts. They tried a couple of swings. They looked even more worried.

"You say you got these last night?" Spottiswoode asked as he carefully examined the balls and the curious titanium driver.

"Aye, that's true," replied Andrew.

"This says it is made of metal named after the Titans."

Andrew nodded his head. "Very strong, ye know, the Titans."

Spottiswoode felt a bit happier. "Aye, lad. Very strong. Primitive. Clumsy, some would say." He turned to his two assistants, who were looking on with elevated concern. "I don't think you have much to worry about today, lads."

The two churchmen looked at their leader with surprise, their expressions clearly indicating that the good archbishop had lost his ability to observe and reason. Foreman swallowed and bravely went first. "Begging Your Grace's pardon, but I think we are going to be spanked by this new kit."

"Spanked good," added Hannay.

"Patience, my sons, patience. Play your own game; let them play their own game." Spottiswoode smiled broadly at his two charges.

Hannay and Foreman teed off first. The first hole was a short one, a little over one hundred yards. Both hit good shots, and then waited for the Ramsays.

Spottiswoode got the feeling that Laird Ramsay was not about to let this opportunity get away. Ramsay used one of the new balls, one of the golf tees that were sent to be used in place of the small piles of sand usually pulled from the hole, but most interestingly, he grabbed the largest club in the bag to hit his first shot. Spottiswoode smiled as Andrew, seeing the club, tried to stop his father. Andrew must have read these clubs could hit a ball well over three hundred yards, and the first hole was only a little over one hundred, and the second was only another hundred yards beyond the first. But Spottiswoode had seen this look in Lord Ramsay's eyes before. The look of certainty bordering on rapture. A glorious certainty, wrapped in layers of three years of chaffing rough burlap. The protest died on Andrew's lips. The boy

must know that it was hopeless.

Laird Ramsay took a couple of practice swings, stepped up to the ball after glancing over his shoulder at his opponents, and swung at it with all of his might.

The laird was a fine athlete, powerful, and had a good swing. When he connected, the club hitting the ball made a fascinating metallic and musical *ping* , and it took off like some sort of holiday firework, rocketing down the fairway. It passed over the hole where it had been aimed, and continued to rise. But then it did a most curious thing.

The ball turned right. Toward the sea. One moment it was climbing, well on its way to—well, the *third* hole and then, slowly at first, it turned off target. The further right it turned, the faster it seemed to go. The five men watched it rocket at what was now a ninety degree angle to the original path. They watched in amazement as the ball finally lost momentum, dropped down near the shore, disappeared for a heartbeat, and then bounced high into the air with a solid thwack as it rebounded off of a rock, and finally finished with a quiet *plop* , a good twenty yards into the sea.

They could all see the concentric rings radiating outward from where the little white ball disappeared beneath the sea. It was a few moments before anyone spoke.

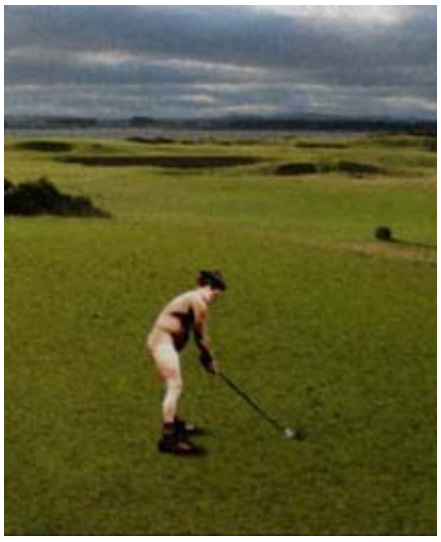
Finally, Spottiswoode broke the reverie. "That is the singularly most impressive out of bounds shot I have ever seen."

Laird Ramsay looked at the golf club in his hands as if it were some bewitched stick. He then looked at the archbishop. Then to his son. "Wa' hae I done, lad?"

"Wee bit too much club, Da."

The rest of the round wasn't much better, and the Laird and his son were soundly defeated. They couldn't adjust to the new technology and sliced and hooked and overshot their way to the worst defeat ever. It was not pretty.

* * *



They were honorable men, the Ramsays. They paid their debt the next week. Half of the village turned out to watch the match. Bravely, father and son doffed their clothing and began to play in the nude. Since

it was so very cold that day, Spotswoodie took pity on them, and only made them play the first two holes in the buff. They refused his suggestion, and played an additional hole to prove their resolve.

From the day of the fateful match forward, when the Ramsays played their three holes in the buff, the putter, which is the shortest club in a set, was henceforth known as the "Naked Ramsay."

* * *

# High Road to Venice

## Written by Gorg Huff and Paula Goodlett


Merton Smith rolled his wheel chair over to the phone and called up the weather service. "Hi, Dan. How's it look for a flight to Venice?"

"Not horrible. The reports from the weather stations are mostly in. There is a warm front that was moving in from the west but it seems to have stalled. We don't know why, but we suspect that something is going on in the east. I wish we still had the stations in Saxony and Brandenburg."

"Politics." Merton snorted. "They screw up everything. So what do you figure is out east that Saxony and Brandenburg aren't reporting?"

"It's a cold front, Merton. We just don't know how big it is."

"Okay. How's it look on the south side of the Alps?"

"That's the good news. Clear and sunny all the way to Rome. Bolzano is reporting light winds through the pass and wants to know when you guys are coming."

"Looks like today's a go," Merton told him.

* * *

Johan did the walkaround. He was the pilot, Merton the co. Besides, Merton couldn't walk, at least not all that well. Merton had gotten new fiberglass prosthetics but wasn't all that used to them yet. Honestly, Johan wasn't all that comfortable with Merton. A man who was missing both legs to above the knee shouldn't be piloting an airplane even if he was an up-timer and familiar with the engines. Johan checked the bag for leaks. It was double thick canvas with tar between the layers and oiled leather at the bottom where it contacted the ground, where the greatest wear would occur. He wiggled the flaps and the rudders. Checked for dings in the wings body and tail. Checked the bag fan, then climbed the step ladder

and went aboard the plane where Merton was already in the right seat. By tradition, the left seat in a fixed wing was the pilot's seat. Johan headed back and checked the cargo. "So what do we have?"

Merton turned in his seat and read off the passenger list. "Eight passengers plus the cargo has us traveling a bit heavy, Captain. We have two Venetian bigwigs that were in Grantville for shopping and business. Lucco Ricci and Alberto DeLuca. DeLuca is the redhead. There's a little boy that was sent here for surgery on a deviated septum. His dad is some sort of muckety-muck or something in France, so they sent him to Grantville by way of Venice. He's five, and I've been calling him Frankie. His nanny, Mademoiselle Babin, isn't crazy about that, lemme tell you."

Johan caught sight of a really differently dressed stranger. "Who's the guy in the robes?"

"Magdalena said he's a sultan or something from Algiers, or North Africa anyway, who wanted a look at the library in Grantville. Can't pronounce it right. Hafsid Bey Sidi Uthman, that's it. Peter back there is a certified electrician the sultan hired to wire his palace. The blond guy is Matthew Howard, English kid on his grand tour."

"I heard about him," Johan said. "He cut quite a swath through the young women in Grantville. Good thing he didn't stay more than a month."

"Yeah, he's headed to Rome, he said. And the last is David Bartley, who's going to Venice for a week on some business."

"About standard," Johan said. "Half a million in cargo and five million in ransoms." Then he waved to Magdalena that they were ready and the passengers started to board.

* * *

"Welcome aboard, sir, ma'am." Johan got the passengers settled in then headed up front for the usual speech. "Folks, we're not having box lunches this trip. Nürnberg is only eighty-five miles away and we have to stop to refuel, since the trip is about four hundred miles. TransEuropean Airlines will have a catered lunch waiting for us when we get there. There will be snacks and drinks for the long leg of the trip, which is the one to Bolzano, where we refuel again. Then it's just a hop, skip and jump to Venice. We should be there before sundown."

Sidi Uthman asked, "This lunch? I did explain my dietary requirements . . ."

"I'm sure our office sent word ahead, sir." Johan made his way back up front, resenting a bit that it was him acting as greeter. He wished again that they could afford the weight of a stewardess. But these weren't up-time passenger planes. They were more like an air-going stagecoach in the amount they could carry. They were roomier per pound or passenger they could carry than an up-time aircraft would be, which made them pretty luxurious stage coaches. But that was because they had less lift for their size.

About a quarter hour later, they were in the air and headed south.

* * *

"Stop that squirming, Francois!" Mme. Badin snapped. "Can't you just look out the window?"

Francois tried but he really had to go. He'd been too excited to visit the restroom before they took off. Then Mr. David Bartley leaned over the seat in front of him and said, "I need to go use the facilities. I'll

take him, if you like."

Mme. Badin gave Mr. Bartley a measuring look. Francois knew that she was uncomfortable with airplanes, and the idea of getting up and walking around in them made her even more nervous. He squirmed some more. "I really need to go."

"Very well. But be careful."


The young Englishman stood up and headed to the can, just beating Mr. Bartley and Francois. " *Don't* push the red button!" Mr. Bartley said and Francois looked up in time to see that Mr. Bartley was grinning.

"No fear," Matthew said. "I've been told all about the red button."

Francois looked up at the two men. He hadn't been told about the red button. He wondered what it did. He knew enough to know that red buttons did bad things.

"Just not till we get out of range of Grantville," Mr. Bartley explained. "You don't want your poop landing on the head of someone who'll complain to the mayor, do you?"

Francois felt his eyes get even wider. Then Matthew came out and agreed. "Yes. The red button opens a hole in the bottom of the plane. Then poof! Everything that's, ah, collected during a flight will fall down out of the sky. Best to do that over a forest or something, so you don't drop it on someone's head."

Francois went in and spent some time looking for the red button but didn't find it. He became convinced that Mr. Bartley and the Englishman were playing with him. Then he spent some time giggling about how it would work. He was still giggling when he got back to his seat. His nanny, after he told her the story, turned around and gave Matthew and David a very stern look. They glanced at each other, trying to hold back the laughs. It wasn't true, of course. The toilet in the *Monster* was emptied on the ground by much more conventional means. But it made a fun story for Francois.

Shortly after that Francois got to visit the cockpit where they steered the plane. It was big, almost as big as the cabin. There were cabinets and things where they stored stuff for the plane. There were two chairs. At first Francois thought they weren't locked to the floor like the seats in the cabin were. But they showed him the little rails that let the seats be moved then be locked down again. So that the copilot could be navigating when he wasn't copiloting and the pilot could handle the radio and stuff. But the chairs were still attached to the floor.

It was while Francois was down on the floor looking at the rails that he saw the copilot's feet. Now

Francois was greatly impressed with the medical know-how of the doctors in Grantville. They had fixed his deviated septum. The idea that they could make legs that were real legs seemed to him quite likely. Besides, these didn't look at all like the peg legs he had seen. They had feet. It also seemed quite a neat thing to have. "Did the doctors fix your legs like they fixed my seppum? Did they hurt after they sewed them on?"

"No, I'm afraid not. The guy who designed the *Monster* had more to do with my legs than the doctors did. They aren't sewn on; I take them off at night like shoes," the copilot explained. "They are made of a composite, the same as the airplane."

"Why not just use wood?"

"Wood is heavy and artificial legs don't have muscles in them. Well, these have springs in them which help, but they aren't really the same as muscles. So Georg used composites to keep the weight down. I'm still getting used to them but they are better than sitting in a chair all the time." They didn't explain to him that Merton the copilot had been in an accident at a machine shop a couple of years ago and had lost both legs above the knee. The loss of his legs had been especially hard on Merton and the Ring of Fire had made it harder still, because it had turned back the clock in the field of prosthetics. It had never occurred to Merton before the accident that the switch from "disabled" to "physically-challenged" had been anything but political correctness. The difference between a peg leg and an up-time prosthetic limb was the difference between a disability and a challenge. At least in Merton's case. It was, for all practical purposes, impossible to walk on a couple of peg legs that started above the knee. That was not true with up-time prosthetics.

The composite legs that Georg had made for Merton at Farrell's request fell somewhere in between an up-time prosthetic and a peg leg but rather closer to the up-time product. They allowed Merton to walk with the aid of something to hold on to. He'd been told that once he got a bit more used to them he might even be able to get by with a couple of canes instead of a walker.

Francois spent the rest of the hour and a half flight to Nürnberg looking out the window, mostly at clouds. When that got old he looked at the passengers. Francois was a child of nobility. But for most of his life he had been a hidden-away child. Not that his parents didn't love him. They did. Still, he had been sick most of his life, so he hadn't been able to play much. He had met more people in the hospital than in France. All he really knew of France was Mama, Papa and Mme. Badin . . . well, and a few doctors that Papa had had look at him. Not being sick was quite a novelty in itself. So was being able to breath through his nose. During his recovery from the surgery he had gone from shy to curious, perhaps even overly curious.

* * *

"Ah." Sidi Uthman pushed his chair back and burped delicately. "Most interesting, indeed."

The meal had been leg of lamb with mint jelly, not something Merton much cared for at the best of times. But, he figured, whatever it took to make a passenger happy. Gods knew, they paid enough for this treatment. For him there was a large pot of coffee, which he appreciated.

"More please," Frankie said. David Bartley poured himself and the kid another cup of cocoa, while his nanny enjoyed a glass of wine with the Italian merchants. Peter Hartz stuck to beer.

"Merton," Johan called, "time to preflight."

* * *

Back in the air, Johan pointed the nose a bit west of south. "That cold front must be weaker than they predicted," he said. "We came in a bit farther east than I thought we would."

* * *

"What is taking you to Venice, Herr Bartley?" Alberto DeLuca asked. He was a portly man in his late thirties or early forties.

David looked at him then smiled. "Ships. OPM has been asked to invest in a shipping concern, so I'll be looking at ships. And talking to people about what it should cost to refit them with some up-time devices which should allow smaller crews."

"What sort of devices?" asked Lucco Ricci.

"Electric winches, batteries and a drag generator."

"What is a drag generator?"

"It's what Brent Partow calls a small generator that you drag behind a sailing ship. It uses the motion of the ship through the water to charge the batteries. The idea is that a ship rigged with the system would be able to use the wind indirectly to raise the sails and a few other things, decreasing the crew size from a third to half. We're not entirely sure it will work or how big the units would be. I'll also be pricing glass and silks."

The conversation went from there. With David talking about silk and glass while DeLuca and Ricci tried in vain to move the discussion back to the availability of the shipboard power system. Every once in a while David would let slip some tidbit about how the initial investment would be significant but the savings in crew cost would probably pay for it in the course of a single journey, then go back to talking about the price of silk. All in all David thought it was going very well.

* * *

About an hour and a half later, Merton started getting worried. "Shouldn't we have seen Munich by now, Johan?"

"It's the damned clouds," Johan muttered. "Can't see properly half the time."

"Point it a bit further east," Merton said. "It can't be that far."

* * *

"Still no Munich," Johan whispered.

"Maybe we better land and ask?" Merton suggested.

"Not in Bavaria." Johan shuddered. "You *don't* want to set down in Bavaria. Not ever."

* * *

"We can't be that far off course," Merton said.

"Far enough that we don't know exactly where we are," Johan said. "Keep looking."

Merton suppressed the urge to stick his tongue out at Johan, and kept looking. They were passing over the foothills of the Italian Alps. That was clear enough, but where? "Turn right and follow the valley?" Johan had made this trip a lot more often than Merton had.

"Might as well. I don't have a clue where we are, but I wonder where it leads."

"Bolzano, I hope. But at the very least, I hope it's within Duchess Claudia's lands. We should be safe as long as we land in the Tyrol somewhere."

"There's an outpost," Johan said, pointing to a building below. "Might be a customs station."

"And you'd better turn north and follow that pass," Merton grunted. "I'm really not liking this at all. Much more of this and we'll have to land, no matter where we are."

* * *

"Well, do we take the chance?" Johan's voice was worried.

"It's a lake. We know we can land there," Merton pointed out. "All we have to do is find out where we are, then we can plot a course to Bolzano. We're not hurting for fuel yet, but if we keep flying around like this we will be."

There wasn't much help for it. They had to know where they were. As it was, the passengers were getting restless, probably catching their own tension.

"Going down," Johan said. The clouds were low and spotty over the lakes, more mist than anything else, but they could see enough of the lakes to be sure of their outline and one thing about water landings, the water was flat. "Give me twenty percent flaps. I want time to look around a bit as we come down. We'll turn at the end of the lake and come back for landing."

Merton set the flaps and the *Monster* slowed.

* * *

"Folks, make sure your seat belts are fastened," Merton announced. "We're going to land for a bit. Just as soon as we clear up the problem we're having, we'll be on our way again."

"What's the problem?" Matthew said.

"Probably something electrical." Peter grinned. "Luckily, I can help with that."

"Are we lost?" Frankie's face was aflame with curiosity. "Are we stopping to ask directions?"

David Bartley and Sidi Uthman shared a look. "Certainly not."

Nanny snorted. "Men never ask for directions. They'd rather ride—or fly—around in circles all day." Then, as the implications of what she had said occurred to her the joke seemed to lose its humor. If they

weren't stopping to ask for directions, what was wrong?

Matthew looked over at their only female companion, who'd gone white around the lips. "It'll be fine, Miss. The engines are running steady. It's probably just a an odd reading on an indicator or something." He started trying to distract her with stories while the rest of the passengers looked out the windows.

Hearing the conversation through the open cockpit door, Johan said, "Time to 'fess up. Hold her steady for a minute." Then he got up and went back to face the music. "Ladies and gentlemen, I'm afraid Frankie is right. We've missed a couple of our check points, probably because of the spotty visibility we've had today. So we're going to land at a small village on the edge of the lake and ask for directions. It should be no more than a chance to stretch your legs for a few minutes. Then we'll be on our way."

Frankie crowed. "I was right!" And started giggling.

"Amazing!" Nanny laughed.

"Captain!" Mr. Bartley protested. "You're letting down all mankind," though to Frankie he didn't really sound displeased.

Slightly red-faced because it was always embarrassing to admit they were lost, Johan said, "Our director, Magdalena Van de Passe, made stopping to ask directions airline policy."

"Ah, that explains it," Alberto DeLuca proclaimed jovially. "Our pilot and copilot are true men, self-sufficient in all ways, but like all gentlemen they must yield to the quirks of the ladies." He gave a florid bow to Nanny.

* * *

Blushing harder, Johan retreated to the cockpit and went back to the controls. By now they had now flown over the village and he turned around to take up their landing approach. By they time they had finished the turn they were five hundred feet above the ground and losing about fifty feet a minute.

"Forty percent flaps," Johan told Merton and he throttled back the engines. The *Monster* slowed as they came back into the mist over the water. It was the wrong order. A mistake no bush pilot would make, nor any pilot with experience landing pontoon planes, but neither Johan or Merton had that sort of experience. Compared to just about any up-time multi-engine pilot they were rank amateurs. What they had seen was the Air Cushion Landing Gear go over bumps and ditches on land and logs floating in water without missing a beat. They had over flown the lake just like they were supposed to and it looked clear. With the patchy mist, shadows from the mountains, and the altitude of their flyover, it wasn't what a bush pilot would consider a proper examination. In fact, for half the flyover Johan had been calming the passengers rather than looking out the windows for debris or boats on the lake.

"Inflate the bag," Johan said and Merton started the motor that would fill the ACLG.

A few seconds later Merton reported, "Bag deployed." They were now a hover craft—or would be in a few seconds. They were almost half a mile from land, down to ten or so feet over the water and sinking slowly on flare effect. "Jesus! Pull up. Pull up! There's a boat!"

Johan jerked the stick back.

* * *

The last thing Thoman Klein expected was for a monster of any sort to drop on his head. Much less a monster that made those hideous growling noises.

It was the noise that drew his attention. Normally Lake Heiterwanger, especially this far from shore, was dead quiet. All the better for "not really fishing" as far as Thoman was concerned. He just had to get away from his wife, his mother and their constant chatter now and then.

When he turned to see what was making the noise, all the blood drained from the upper part of his body. A massive, rawhide-colored . . . thing was coming right at him. And above the thing, which looked like a lobed bag of some sort, was a bright blue . . . other thing. With wings. Four wings.

Thoman grabbed his oars, but it was too late. He jumped.

* * *

The *Monster* did miss Thoman, but just barely. The landing gear, made only of leather and canvas, caught the bow of his boat. The plane was traveling at over thirty miles per hour; the leather balloon—or at least a portion of it—wrapped around the bow of the skiff and flipped it neat as you please, lifting the starboard side up into the undercarriage of the plane. There was a loud bump followed by shouts from the passengers but the air cushion had cushioned the blow. Not without damage. A rip over ten feet long was torn in the bottom of the bag. Then they were down, trailing strips of leather and a shattered skiff. Now the water itself made up the bottom of the bag, plugging the major leak and leaving only the minor ones. The largest of which was a tear about a foot wide in the rear wall of the bag. They weren't going to

sink. Heck, they wouldn't sink even if the bag were removed entirely. They would become, in essence, a flat-bottomed boat. With most of the bag still in place and the bag motor running they were still a hovercraft, just not a very efficient one. The skirt on a hovercraft is supposed to leak; that's what makes it slip over the surface with very little drag. It just wasn't supposed to leak quite as much as it was at the moment.

Johan made a wide circle on the water and headed back to look for survivors. He saw a head bobbing in the water. "Take the stick, Merton, and get us up beside that guy. I'll go out and throw him a rope."

"I have the stick."

Johan got up, opened the emergency locker and grabbed a rope, then went through the opened door into the passenger compartment. "Keep your seats, folks. We had a problem on landing." The door to the cockpit was generally left open in flight. It was there primarily as an extra security measure when the plane was on the ground, making it a bit harder for someone to steal it by climbing aboard and flying off. "Folks, we hit a boat. Apparently someone was doing a bit of fishing. We're going back now to pick up the survivor." Then he opened the door and stepped out onto the bottom wing.

He watched as the plane approached the man in the water. Who was swimming like hell in the other direction. "Hold up there. I'll throw you a rope," Johan shouted over the noise of the engines.

* * *

Thoman looked over his shoulder to see the thing approaching him and a man standing on it with a rope in his hand. In the blink of an eye he went from being more scared than he had ever been in his life to more angry. They had almost killed him. Thoman didn't have the words for what these up-timers were and he could cuss for half an hour without repeating himself. He was so mad he almost didn't grab the rope that was thrown to him. The man on the machine pulled him toward it and he almost let go. The water around it bubbled and foamed like a witches' brew. But he was a quarter mile out from shore and the water was cold. He wasn't at all sure he could make it back to shore. The man who pulled him up was well-dressed, if in a strange style.

Damned up-timers and their flying machines. "You wrecked my boat," he yelled as soon as he was out of the water. "You lost me my trolling rig and my lunch. You soaked my clothes and almost killed me. I want restitution." There were faces in the doorway by now, watching the show. Then one of them spoke.

"Clearly he doesn't know his place," the man in the funny hat said. "You ought to throw him back in and be done with it."

The man who had pulled Thoman out of the water gave the fellow in the funny hat a look, then said, "Was there anyone else on the boat?"

Thoman shook his head.

"We can talk about restitution once we get you back to shore. Meanwhile, step inside where it's warm."

It actually was warm inside the thing. And the seat the man showed him to was comfortable, although he didn't much like the seat belt. And he wasn't too impressed with the giggling little boy who kept peering at him from between the seats in front of him. And sticking out his tongue.

Plus, there were too many languages being spoken—particularly by the man in the funny hat. Who kept

looking at Thoman and sneering.

Not to mention, he was still angry about the boat. These people were going to pay for that boat. Or else.

In a day of strange happenings, probably the strangest was after they'd gotten this monster machine to shore and unloaded. A man came struggling out of the front of the machine, using a very odd contraption that he called a walker. A man with, of all things, fake feet. Thoman had seen a peg leg before. But never fake feet.

"My name is Merton Smith. What is the lake called?" the man with fake legs asked.

"Heiterwanger See," Thoman told him.

"Where's the nearest large town?"

"Why do you want to know?"

Merton Smith gave Thoman an apologetic look. "We got off course. We were landing here to ask for directions. It's happened before and usually it's no problem, but the mist hid your skiff."

"Well, you'll get nothing more out of me or the rest of the village, either. Not until you've paid for my boat and for nearly killing me."

* * *

"How much?" Lucco Ricci, one of the businessmen from Venice, squeaked. "For *that* ?" *That* was what was left of Maximilian I's rustic cabin. Located outside the village of Heiterwang; it was not in good repair.

"This is a small village, milord. There is no inn. And Her Grace's letter of transit doesn't give you the right to just take what you want. You could, if you like, sleep in that contraption you arrived in." It was said with all the proper deference but it translated to: Take it or leave it.

The very scruffy—and quite sharp—headman of the village gave Ricci a look. One that David could understand. It was a small village and you could tell it didn't have an easy time of things in general. Plus, here in the late spring, there wasn't a lot of surplus food to be found in most places. Still, David thought the villagers were making a mistake. He looked around. While not the best time of year, this was a beautiful place. The fact that Maximilian I had liked it for trout fishing suggested that with a little work it would make quite a nice resort, with fishing in summer and skiing in winter. Which would be a really nice source of additional income for the village. Lucco Ricci looked over to Johan.

"They have canvas and leather that we can buy. We can fix the bag with that and the patch kit and a bit of help sewing from the villagers," Johan said. "It'll take some time, though, so you may as well take their offer. We won't be able to leave until tomorrow. If then."

Lucco Ricci nodded and gave over the coins. The village had insisted on silver, not trusting USE dollars. Luckily Lucco had been in Grantville doing a bit of arbitrage. He had brought a couple of hundred thousand USE dollars to Grantville and used them to buy silver which he was taking back to Venice. Most in slugs of ninety-nine percent pure silver electrically separated from copper, but some in silver coins of various denominations and from various mints. It was all destined to make Venetian coins.

Merton and Johan had gone through their books and charts and found what they thought was the right lake. There were two of them connected by a narrow waterway, the Plansee and the Heiterwanger See. "See" apparently designated a mountain lake. The village that the *Monster* was sitting near was called Heiterwang, which fit. If that was where they were, they were over forty miles west of where they were supposed to be.

"Can I help?" David asked.

"Yeah," Merton said. "You can help me get back to the plane. I'll be spending the night guarding the cargo. These are Claudia de' Medici's lands, but considering the attitude of these people, better safe than sorry."

With a lot of help from the villagers—some of who seemed to really be enjoying the novelty—they'd managed to get the plane up on jacks. Johan and some of the local men who sewed sails were working on repairing the bag.

It was a long, cold night.

No one but Signore DeLuca had very much in the way of coins. And while they grumbled, the right of transit document that Claudia de' Medici had given them did stop the villagers from trying to impound the plane and hold them all prisoner. Still, Johan had to sign a promissory note with Signore DeLuca for funds to pay for the damned boat and their lodgings and food. Probably it wouldn't be a problem, since they truly didn't have much choice. Magdalena would understand that they had to do what they had to do.

Sultan or vizier or whatever-he-was Sidi Uthman was very unhappy with the provisions they found. He was happy to make that displeasure known, too, and kept threatening to sue.

Johan could hardly wait to get out of Heiterwang.

* * *

"Magdalena! *Magdalena* ! Venice wants to know if the plane took off on time."

"Certainly it did." Magdalena van de Passe looked up from the invoices and other assorted paperwork on her desk. "It arrived in Nürnberg on time, too, and departed nearly on time. Why?" Magdalena didn't panic. It was quite common for their flights to be off-schedule. It had happened before, and was very likely to happen again. Almost anything could cause a delay, from sudden storms to adverse winds.

"Because it hasn't arrived in Bolzano yet. And Duchess Claudia was expected at a dinner in Venice tomorrow night. She was planning to take the *Monster* from Bolzano." Which Magdalena knew was a hundred miles even as the *Monster* flew. There was no way Duchess Claudia would make her dinner party if the plane was delayed too long. And that could well have political consequences.

Magdalena looked at the clock, then did some calculations. Really, the *Monster* should certainly have been in Bolzano by now. "If it hasn't arrived in another two hours, then I'll worry," she thought.

Actually, she worried every time the plane took off. It was the only plane TransEuropean Airlines owned. Markgraf Smith Aviation nearly had a two-engine model, the *Neptune* , ready for test flights, but it would be at least a month before that plane was ready.

Magdalena didn't get back to the paperwork. The first call came from Delia Higgins, wondering if she'd heard that the plane had arrived in Venice. She was worried about her grandson, David Bartley.

The next call was from Farrell Smith, worried about Merton.

The calls kept coming for the rest of the afternoon, then stopped as all the people concerned drifted over to the airline's offices, waiting for news.

Magdalena and her secretary stayed busy serving refreshments and trying to reassure everyone that things were all right.

"Perhaps they had to set down at one of the customs stations. We have an agreement with Duchess Claudia, but the radios don't always work well in the mountains."

"Oh, I'm sure everything is fine. It's probably interference from the storm."

By the time darkness fell and there hadn't been any news, Magdalena was finding it very hard to reassure anyone. Including herself.

* * *

"Is there any word?"

Farrell Smith looked like he hadn't slept a wink. Magdalena figured he probably hadn't. Neither had she. "Not yet, Farrell."

"There's so much that can go wrong . . ."

"Merton and Johan are experienced, Farrell. As experienced as any of us. You know that."

"Yes. But . . ."

"All we can do is wait, Farrell. Someone will be at the radio twenty-four hours a day until we hear."

Not much got done at Markgraf Smith Aviation that day. Farrell Smith was too worried to leave the radio shack and go work on building another airplane. Delia Higgins joined him, along with Johan's wife and a number of others.

It didn't help matters that the press had gotten hold of the story, either. Nosy reporters were constantly asking family members how they felt, which at one point almost caused Farrell Smith to bloody a nose. *The Street* 's headline read DAVID BARTLEY MISSING and the *National Inquisitor* asked WHAT'S REALLY IN THAT SKY? Both headlines were in 32 point type and hard to miss.

* * *

By the beginning of the third day, none of the crew or passengers could wait to get out of Heiterwang.

"Let's just get in the damn thing and go," Merton said. "I'm getting tired of being looked at like I'm a freak, for one thing. For another, I'm sick of dried fish and peas. Rain or no rain, cold or no cold, let's get out of here before we have to pay three times the going rate for something else."

"Amen," Matthew said. "I'm deadly tired of this backwater."

Johan checked the bag one more time. It was holding air. Sort of. Just at the moment, it was still leaking in some places it wasn't supposed to—but they still had a bag. Then he looked up at the sky. The weather was a concern, but he had flown in rain before. Just not very often. Still . . . He signaled Merton cut the air cushion fan, then he and the passengers climbed aboard.

"Fasten your seat belts folks." Johan smiled. "We are *so* out of here."

Merton had already restarted the fan when Johan took his seat. "Give the bag a bit more power, Merton."

It was choppy almost from the moment they left the ground. Turbulence was coming off the back slope of the mountains. Johan tried to climb above it and ran into a monstrous head wind. The valley had clearly been protecting them from the worst of the storm. The *Monster* clawed its way east for about twenty minutes, then sleet started falling. The icy rain from the north that had been blocked by the ridge on their left was blocked no more. They started looking for a place to land. But it was hard to see with the icy rain. They kept flying with their wings getting heavier from the ice every minute. Wing icing was a danger to aircraft and passengers because it added weight and disrupted air flow over the wings. It could also literally freeze the control surfaces in one position. The *Monster* didn't have deicing systems. They had to land soon or they would crash.


"Grantville Base, Grantville Base. Jupiter One, Jupiter One." Merton tried to radio, but he was needed to help control the plane. They had no way of knowing if any of their message got through.

It was several minutes later when they found a flattish piece of ground. The landing wasn't a problem. And there were a couple buildings off in the distance. They used the bag to get close. No one was out in this whether and the wind hid the sound of the engines.

Once they got close to the houses, they cut power to the bag and settled. Then Johan went out and tied the plane down.

It wasn't a village; it was a high pasture with some woodcutters in residence. The sheep would be coming up in a few weeks. Perhaps because they hadn't landed on anyone's head, the people seemed much more friendly. The villagers were willing enough to take USE dollars, but only at a lousy rate of exchange. The crew and passengers spent a fairly comfortable night and the next day, waiting for the

storm to pass. Johan stayed on board the plane that first night and Merton the second.

* * *

"The storm is getting worse, according to Bolzano."

Delia Higgins' face went even paler, but Magdalena kept on. "Bolzano also says that they got what they think is a message from them. But there's a lot of interference from that storm. We just don't know yet."

The newspaper headlines that day were even worse. And they had reporters hanging around looking for comments.

* * *

Siegfried looked at the plane. "I'm not sure about this, Karl." He had had a tour that afternoon. It was impressive. What they called the cockpit was more of a cabin. The whole plane was roomy. "It's one thing to pick up a bit of the readies knocking off the occasional stranger on the Brenner Pass. But these are important people."

"Important people bring big ransoms. Now shut up and help me up onto the wing." Siegfried made a cup of his hands and Karl climbed up. The plane wobbled a bit, not much.

* * *

Merton wouldn't have noticed the plane wobble if he had been asleep but the cold weather was making his stumps ache. He looked out the window thinking the wind might be picking up again. But it was still as death. Then the plane shook again. Someone was on the wing. A little nervous, but mostly embarrassed, Merton closed the cockpit door and started putting his legs on. He started to call a greeting but checked himself. What would anyone be doing out at the plane at this time of night? He checked the clock. It was three in the morning. Well, three fifteen.

"I don't see the cripple they left guarding the plane, Karl."

"Will you shut up," hissed another voice. "We want him alive. He's an up-timer and they're all rich, so he will be worth a good ransom."

Merton forgot about his right artificial leg and opened the gun case just as quietly as he could. The gun case had four Suhl revolvers and a 30.06 for just this sort of situation. He managed to get the case opened while Karl and whoever it was continued to argue about whether this was a good idea and whether they should take the risk of trying to take him alive or just cut his throat. He gathered that there had been an ongoing debate about whether to rob them since they had arrived. Their planned morning departure had brought things to a head.

Merton was sitting in the copilot's seat by then, with it turned to face the cockpit door, a blanket on his lap and a six-shooter under the blanket. He'd been as quiet as he could. The plane itself, to prevent engine noise from bothering the passengers and because it was a natural function of the way the body of the plane was made, was pretty close to soundproof. But the partition between the cabin and the cockpit was about as soundproof as a Japanese paper wall.

Merton was sitting in the cockpit wondering what he could do. When the cockpit door was pulled open, he saw the long knife silhouetted by a lamp, and reacted. The barrel of the forty caliber six-shot revolver

came up two inches. He squeezed the trigger and the hammer fell. From four feet away the bullet hit the center of the sternum and didn't even slow much. Instead, both bullet and sternum disintegrated into an expanding shock wave that went a long way toward destroying both lungs and the heart of the knife-carrying bandit.

As the first bandit fell out of his sight picture, Merton fired again. It wasn't until later that he realized that the second bandit was not advancing, but stood still in shock, perhaps beginning to bring his weapon up or perhaps just raising his hands to surrender. Merton would never be sure which and the question would haunt his dreams.

But that would come later. For right now Merton needed to find out what was going on. He finished putting on his legs, cursing the darkness but afraid to turn on a light. The lamp had gone out when the second fellow dropped it. He stuck another couple of pistols in his coat pockets and grabbed the 30.06. Then he checked the windows. The sleet had given over to rain that afternoon and by now the ground was muddy not icy. It was black as a pit. He couldn't see a damned thing. Stepping over the bodies of Karl and his whiny friend was a chore in itself with his walker and his fiberglass legs.

The *Monster* had two doors, the passenger hatch and an emergency exit/cargo hatch on the other side in the back. The passenger hatch let the passengers step out onto the wing on the right side of the plane, the cargo hatch was behind the wings which meant its bottom was about five feet off the ground. As might be expected, Merton much preferred the passenger hatch. But the passenger hatch was the one that the bandits had entered and, more importantly, it was visible from the buildings.

Merton went to the cargo door in the back. He opened it and hung on and lowered himself to the ground. As he was trying to manhandle his walker out of the cargo hatch he slipped on the wet ground and landed on his ass.

* * *

"What's taking so long?" Herman asked, more to himself than anyone else. This wasn't their usual mode of operation. Herman had figured that the plane was the greatest danger, or at least the most unknown. Who knew what it could do with a pilot on board?

The plan was to have Siegfried and Karl secure the plane, then Siegfried would report back and the rest of them would take the passengers. But they had been gone . . . it seemed like an hour, but honestly was probably closer to half of that. Still, they should have been back by now. And there were the sounds muffled by the rain but they might have been gun shots. And Herman had told Karl and Siegfried to be quiet about it. Could the pilot have gotten the drop on them? No, he couldn't have. He was a cripple and even if he had gotten a shot off, the other one would have gotten him. But it was taking too long. "Albrecht. Go check on those idiots. Find out what's taking so long. If they're going through the goods without the rest of us, they'll regret it."

Albrecht grunted and nodded. Then stomped out into the dark.

* * *

Francois had to pee. He was a big boy now so he got up without waking Nanny Badin. They were all sleeping in the one big room but there was a nice fireplace. What Francois was a little nervous about was going out to the outhouse on his own. He wished there was a chamber pot or that he knew where it was. After due consideration he went looking. In the process he inadvertently stepped on Sidi Uthman, then tripped and fell on David Bartley. Who jerked up in surprise, which woke Lucco Ricci.

The noise woke Nanny Badin, who directed Francois to the chamber pot. By then everyone was awake.

* * *

Merton froze when he saw the light. The *Monster* was positioned for takeoff first thing in the morning, which meant it was facing down a slight grade and facing mostly away from the woodcutters' cabin. To make it a short walk for the passengers, it was placed close to the cabin. The lamp and the man carrying it came into sight heading for the passenger door of the plane. Merton was standing in the open with his walker between the tail of the plane and back corner of the cabin. Which fortunately meant that the man with the lamp was facing away from him.

* * *

About the time Francois was doing his business, Albrecht was discovering a much worse mess on the floor of the passenger section of the plane. The door to the cockpit was closed and from the position of the bodies the last mistake Karl and Siegfried had ever made was to open it. It wasn't a mistake that Albrecht was anxious to repeat. He rushed back to report to Herman that everything wasn't going exactly according to plan.

* * *

Merton moved as fast as his walker would take him as soon as the man with the lamp reached the door of the plane. But Merton couldn't move fast. He had barely rounded the corner of the cabin . . .

* * *

Master Uthman, a Bey of Tunisia and member of the Hafsid family, didn't fly well and was not nearly as comfortable among heathens as he had expected to be when he volunteered to undertake this journey for his family. It wasn't that he was treated badly. In fact, he had been treated extremely well . . . but flying terrified him. He wasn't used to feeling helpless and at the mercy of others. So he had lashed out, which he sort of regretted. Sort of. The notion that he terrified a little boy didn't appeal to him. Made it hard for him to sleep. Not that he could apologize. A person in his position didn't do that. But he found that he wasn't sleepy after the little boy woke him. Rather than lie there, he got up and found a seat in a corner to think.

He had just sat down when the woodcutters came though the door armed with pistols and knives. Which, as it turned out, was a very good thing. He wasn't where they were expecting him to be and he was armed. Unlike an airplane bumping around over hills and dales in the sky that couldn't be seen, this was a danger that Uthman could deal with. It was almost with a sense of joy that he reached into his robe and pulled out his brand new Suhl revolver. The bandits were looking at the passengers sleeping on the floor of the large room. And Uthman didn't hesitate or ask them to put down their weapons. He started shooting.

*Blam*. Aim. *Blam* . Aim.

Now the bandits were reacting, turning in his direction. That's when Bartley opened up, followed a second later by Peter. Lucco Ricci and Alberto DeLuca had their guns out, but by then there was nothing left to shoot at. Matthew Howard had put himself between Miss Badin and the bandits, the last few of whom had turned tail and run.

The room was full of gunpowder smoke. Uthman was shocked at the amount of firepower a few people with revolvers had compared to single shot weapons. Four men lay dead . . . more than dead. Ground up for sausage. Then he heard more shots from outside.

* * *

Merton had almost reached the back door when he heard the shooting and turned in time to see the bad guys making a quick exit. They were running away from the cabin and didn't seem to want to get close to the *Monster* either. He pulled a pistol from his coat pocket and fired off a few rounds. He doubted if he hit anything. They kept running anyway. "Hello in the house!"

"That you, Merton?" Johan's voice.

"Yeah. Everybody all right in there?"

"It appears to be. Come ahead."

Merton made his way into the building to a scene of carnage. And a room full of armed people. "Where did all the guns come from?"

"Who would go all the way to Grantville and fail to buy a repeating pistol?" Sidi Uthman said.

David Bartley snorted. "He's right. I'd be surprised if Frankie doesn't have one."

"It's in his luggage. For when he's older," Miss Badin acknowledged, still holding the small lady's gun that she had failed to bring into action. All the guns were on the small side, suitable for hiding in a large pocket or a shoulder holster. Concealed weapons. Holdout guns.

"Turns out me and Frankie were the only ones in the room that weren't packing," Johan said. "And it's the last time I'm not going to be packing for some time to come."

David looked at Merton. "Johan Kipper got mine for me years ago. He's told me more times than I can count that I have to be ready to be my own last line of defense. It was probably true up-time too, but having money makes you a target. I suspect that most of your passengers have been armed, just not in a hurry to advertise how."

* * *

Johan and Peter removed the bodies from the *Monster* , while Uthman, David Bartley and Merton kept watch.

"You did well, Mr. Bartley," Uthman said.

"If money makes you a target it can also provide you with excellent training." David smiled. "Johan Kipper insisted that I take advantage of that training. He provided most of it. I'll probably hear I-told-you-so for the next year, about his not being along. I assured him that flying was perfectly safe."

Uthman snorted, amused at the notion that anything in life was safe. He also realized that the safest he had been in the last few days was while he was in the air. It wasn't going up into the air that should frighten him, it was coming back down to the ground.

* * *

They took off with the sunrise, not seeing any sign of the bandits. The weather was clear and cold with only high clouds so they climbed looking for landmarks and found what they figured had to be Innsbruck. So they turned south along the Isarco River valley. When they saw the Torre delle Dodici and Reifenstein Castle they knew they were back on course.

Merton checked the fuel gauges "From what I can tell getting lost didn't cost us much fuel. Mostly landing and taking off."

"Bolzano Base, Bolzano Base. This is *Jupiter One* . We're about fifteen minutes out," Johan radioed.

"Grantville will be glad to hear that, *Jupiter One* ," a voice reported. "You've had half the world in a fizz. What the hell happened to you?"

Johan glanced back toward the passenger compartment. Mr. Howard and Miss Badin were sitting next each other which amused little Frankie no end.

"It's a long story," Johan replied. "Mostly weather."

* * *

"Man, I need a shave," David said, rubbing his chin. "And a shower. A hot shower. Real soon."

Uthman laughed. "If you'd only grow a proper beard, Herr David, you'd only need the shower."

David glanced around at the passengers who were debarking. "None of us look any too pure, I guess. But we did get here."

"Well, not quite yet. We still have to fly from Bolzano to Venice. Still, Her Grace keeps a house especially for air travelers. Electricity, hot and cold running water and quite a nice restaurant."

* * *

"We got word from Bolzano. They're down and safe. Everybody is fine. No details yet."

*Oh, thank God*, Magdalena thought as she fought to keep from bursting into tears. That wouldn't do at all. She had to go to the waiting room and reassure the people who'd been waiting for nearly five days.

She also had an airline to run, so while she had the radio on the line, and before the morning window closed she said, "Find out what the delay was if you would and how soon they can be back here. This has thrown our schedule all to hell. Oh, and if you could, see who is going to sue us over the delay." Magdalena didn't realize that she came off as awfully hardnosed about it all. And in truth she didn't, not more than the radio operator thought she should. She came across as what she had become. The Boss.

* * *

"So, you had interesting times, I hear." Duchess Claudia took a sip from her wine glass. "But all is well that ends well."

"I'm glad your agent was able to reimburse Don DeLuca," Johan said. "There are a number of things I'm going to recommend to Fraulein van de Passe when we get back. We've become too accustomed to dealing in USE dollars and forgot that not everyone is willing to deal in them."

"The villagers in Heiterwang are going to soon receive a . . . ah . . . visitation." The duchess sniffed. "All of my people should know by now that I believe in business. Running off business on their part does nothing to improve the duchy. Should you ever happen to land there again, I can assure you of a better reception."

"I wouldn't be too harsh on them, Your Grace," David Bartley said. "All in all their attitude was understandable, if not the wisest in the long term. They overcharged but didn't threaten, at least not after they saw your letter of transit. And overcharging travelers in distress is a tradition of long standing . . . plus it's one that continued into the twentieth century." He snorted. "Even Herr Klein's attitude was understandable, given the circumstances. What I'm worried about is the 'woodcutters' at the second landing. We shouldn't have run into bandits in a random landing. It's not just finding a needle in a hay stack. It's sitting in a hay stack and finding the needle the hard way. Which suggests that they might actually have been woodcutters and if your woodcutters are moonlighting as bandits, you have a real problem."

She paused a moment. "As for the woodcutters, I appreciate your actions. And I'll be sending people to investigate that, as well."

"I won't say we got them all," Merton said. "But we got a lot of them. We'll write it up in detail while we're in Venice, but, we've got to get going." He held up the radio telegram. "We're behind schedule, you know."

Duchess Claudia nodded. "Please do get us a report, as soon as you have the chance. Meanwhile I need a ride to Venice. I will have to apologize for missing the dinner last week."

"Well, I'd better get out to the plane." Merton got to his feet and grabbed his walker. Then he headed to the refueled plane and got back aboard ahead of the passengers.

* * *

Johan was checking the plane out as thoroughly as he could here. Due to all the bouncing around, both in the air and in the water—not to mention on the ground—he was concerned about cracks in the body. He was particularly careful around the fuel tanks, since they'd found out the hard way that the fuel could essentially melt their composite. The last leg to Venice had been blissfully uneventful. Still, Johan wanted to know what he was working with as much as possible before they took off for the return trip. Safety protocols from the up-timers were making their way into the down-timer consciousness. "Looks okay."

Merton said after looking over the lists.

"Yes it does." Johan agreed. "I'm a bit surprised."

"Wood and glue are easier to maintain, Uncle Hal says. But they also take more maintenance too. What surprises me is how little flack we've gotten from the passengers. Granted, everyone was getting along all right by the end of the trip but I would have expected some heat after we got where it was safe."

Johan looked up from his examination in confusion. "Why?"

"Why?" Merton's confusion was clear on his face. "We crashed! Then we landed in a nest of bandits!"

"Yes. So? No one died in the crash. No one was even that shaken up thanks to the seat belts. Wagon wheels come off all the time; horses go lame or step in a hole and throw their rider to the ground; people sometimes die and are always thrown around. And most people think themselves lucky if they make a four hundred mile trip without running into bandits."

What was confusing Johan and, for that matter, Merton was a difference in world view. One that had been shrinking since the Ring of Fire but was still there. Call it a difference in "comfort level with risk." Not that West Virginia miners were a particularly risk-averse group by up-time standards. By the standards of people who had grown up in war torn seventeenth-century Germany, the up-time attitude toward risk versus reward—even among West Virginia coal miners—was a bit on the squeamish side. Of course, an average up-timer would see the large majority of down-timers as shell-shocked adrenalin junkies with no regard for safety or even sanity.

Still, people adapt. Johan was still willing to take what an up-timer might consider insane risks if there was a profit to be made in the doing—but at least now he studied the risks so he knew what they were. And Merton was willing to get back in the *Monster* and fly back to Grantville; he was just surprised that the passengers were not screaming bloody murder.

About then a woman showed up. Nose in the air. "Signore Lucco Ricci informs me that if one is to travel to Grantville, this device is the best means."

The woman so obviously felt superior that Johan took a step he knew was going to get him a dirty look from Merton. He cast a quick glance at Merton, then spoke quickly—before Merton could stick his foot in his mouth. "I'm glad Lucco enjoyed the trip. I'm Captain Johan Schroeder. This is my copilot Merton Smith von Up-time."

Sure enough, Merton started to open his mouth and blow the whole gig, but Johan gave him his best glare and he settled back down. Johan knew that Merton figured the whole "von Up-time" thing was silly, but he also knew that most people considered matters of rank vitally important. Johan's rank as captain gave him a degree of social position, but not as much as the von Up-time gave Merton. It was another area where up-time and down-time attitudes were at odds.

Johan smiled his own superior smile. "We do have a couple of seats available for the next flight to Grantville. We leave on Tuesday, but you'll want to buy your tickets now."

* * *

# Turn Your Radio On, Episode One

**Written by Wood Hughes**


**Prologue**

## *April 1634, Grantville, State of Thuringia-Franconia, United States of Europe*

"Der Kronz" was in an exuberant mood as he walked into the Voice of America offices, whistling an up-timer tune by the name of "Do the Hustle" and without a care in the world.

That lasted until he ran into his boss.

"To top everything else off," John Grover growled ten minutes later, "Art Berry's set up a deal with *your* Pentecostals to demonstrate how his remote relay system works by broadcasting one of their revivals live."

" *My*Pentecostals?" Marc Kronzburg replied, a little defensive. "When did they become *my* Pentecostals? I sell advertising, remember? And I'm Jewish."

**Chapter One**

## *Late September 1631, Camburg a.d. Saale, Thuringia*

It was the screams that woke him. As Dieter Fischer regained consciousness, he felt again the pain of the deep gash on his forehead and the scrapes from being knocked so brutally to the ground by the mercenary with that Swedish sword.

At the sound of a building collapsing from the raging fire that engulfed it, he opened his eyes. The flames that reflected off of the blood pooled around his head stole his attention, until he again heard the screams. He knew the girl. Just this June he had performed her confirmation. She was the first Christian he'd confirmed on this, his first call, taking on his own church after his predecessor's untimely death in late May.

Now she was naked, being brutally raped by a gang of mercenaries right in front of his eyes.

His first thought was to save her, but his body had other ideas. It had decided that he had already done enough and was going to continue to lie there as if dead like the mercenaries believed him to be.

That's when she opened her eyes. In the midst of her degradation, her vivid violet eyes seemed to stare right at him. Tears streamed down her cheeks as she seemingly plead for his intervention or forgiveness

for what she was enduring.

He lay still, captivated by her anguish. He couldn't help but watch until he was finally able to close his eyes amidst the sounds of even more carnage. After the Protestant victory over the Catholic mercenary armies at Breitenfeld, his parish of Camburg had been excited at the prospect of the strong Swedish Lutheran King who could protect them against the evil forces of Tilly. The council even authorized sending a portion of the militia off to reinforce the victorious Lutheran forces, leaving just enough to man their village keep in the upper castle walls. So when the approaching mercenaries under the Swedish flag were spotted coming down the old Salt Road, they were welcomed as heroes.

Once inside the walled compound, however, the leader pulled his saber and gutted the mayor. Another soldier swung his sword in an attempt to cut off the head of Reverend Dieter Fischer. Only Fischer's quick reaction had allowed the blade to cut his forehead instead of his neck.

Now, Fischer's body had had enough. It let his mind know that it was taking charge until the dangers were past. As he felt his consciousness flow away, his final thought was, "God *damn* the Swedes!"

## *October 1631, Northern Franconia*

The "Snow Plow," Ake Henriksson Tott, leaned over his saddle to get a better look at the prisoners. The field marshal about whom Gustavus II Adolphus had bragged "He'll sweep his opposition aside so the rest of the army just has to follow along behind" was hopeful that this was the end to a diversion of military resources. Resources he could ill afford at this critical point.

A motley bunch they were, he thought, even under the conditions that prevailed in the Central Germanies.

"Are these the last of them, Captain Leslie?" he asked.

"Aye, sir," replied Captain David Leslie of the Scottish cavalry command in service to the Swedish king.

"When we caught up with them . . ." Leslie gestured at the captives. ". . . these ever-dependable Saxons and the rest tried to bluff their way through. Then we ordered a search and found the Swedish flag they'd stolen. As well as a few other baubles stolen as they fled the battle. That's when they decided to put up a bit of a struggle."

The flag had been in the Swedish supply trains at Breitenfeld. The Saxon forces had paused to loot it after their rout at the hands of Tilly's Catholic army early on September seventeenth. At that point, it seemed like the Lutheran army was done for. But then Gustav Adolph had turned the battle around and destroyed the Catholic army, coming out with a decisive victory.

"Most died right there, but these—" Leslie sniffed. "These fine laddies threw down their arms and offered to come into the service of the king. Of course, I'm not seeing where they might have had other options at the time.

"My men have heard them admit to their crimes of pillaging Camburg under a false flag, and ask forgiveness. I guess the damned papist idea of confession runs deep in their souls, even if the Saxons have been Lutheran for a century. Anyway, it's them all right. The rest are dead. What shall I do with them, Field Marshall?"

Tott wiped the beads of sweat from his balding pate and shook his hand to loosen the hairs that he had lost in doing so. Never taking his eyes off the prisoners, he pulled on his goatee. "Hang them. We need to move on south as fast as we can." Tott pulled his horse around to ride back to headquarters with his guard.

**Chapter Two**

## *June 1632, somewhere in Thuringia*

Much to his amazement, Fischer was looking through the grass at something that couldn't exist.

The thing rapidly moved past him as he lay in tall grass beside the road. It somewhat resembled paintings of siege machines, boxy but made of metal, and it moved faster than any horse Fischer had ever seen. Then there was the noise that it made, a low roaring noise like a blast furnace in hell, with a smell unlike any he could remember.

After raising his head to make sure no others were in sight, Fischer got up and walked into the middle of the road. What kind of tracks were these? He kneeled down in the late spring snow encrusting the roadway and placed his finger into one of the tracks on the road. It was freshly embossed into the mud with a curious pattern. The track was deep, up to his first knuckle. After a moment, he brought the finger up to touch his forehead.

*The scar seems to have healed. And the Other self has gone away. I wonder how long it's been this time?*Fischer felt the long strands of black hair flowing down over his collar and concluded that it must have been only a few months. *Less than a year at the most since . . .*

Since what?

There was the occasional memory of snaring a rabbit, or catching fish with his bare hands in the middle of an ice-cold stream. Things that his body had needed his consciousness to take care of. Little survival skills his father had taught him as a boy as they fled Upper Austria and Tilly's armies in the 1620s.

He could remember that part of his life. He could remember how many cities had refused his family entrance due to their citizenship laws. He could remember his father finally finding shelter for his family in Wittenberg and his attending the university there, his ordination, but since then . . .

*Curious. I wonder where the thing came from?*Looking around again, he rose and decided to follow the embossed tracks back to their point of origin.

## *Grantville, New United States*

Fischer was still amazed at this city from the future. He'd been warmly received and directed to the refugee center located by the power plant. He'd been staying there since his arrival a few weeks earlier.

He'd gladly pitched in with the required labor gang work that was requested of him in exchange for his room and board. This week was digging new footings for some kind of stone tower the up-timers were building just outside the edge of the Ring of Fire cut. It was hard work, but very satisfying. Someone had even registered him to vote in future elections for the newly created New United States. Clearly, this future had much to offer.

Even if there were no Lutheran churches.

On this night, like many others since he'd gotten here, he was walking around town seeing the incredible things that man had—or would have—accomplished in another three hundred years. That's when he heard the music.

It was coming from the direction of the fairground on the other side of Buffalo Creek. Fischer followed the sound as it strengthened, up the hill to the fairground. He had worked on fixing the fences there just last week.

Now, in what had been referred to as the picnic area, there was a large white tent. It was brightly lit from inside and the music was coming from there. He decided that he would go in to listen.

When he walked through the open flap, a woman, an up-timer woman, came over to him and shook his hand with both of hers. "Welcome, Brother! You're just in time for the sermon. Let me help you find a seat.

"It'll have to be up front," she continued, grinning as she took hold of his upper arm to guide him to the front. "You have to come early to get a back seat! If you don't speak English, don't worry. Reverend Chalker was a chaplain's assistant stationed in Stuttgart, and speaks German well."

After some jostling to move the people on the second row down a bit, she placed him on the aisle with a wonderful view of the choir that was singing some song in English with a rhythm and harmony unlike anything he had ever heard. They had several musical instruments accompanying them, also unfamiliar to Fischer, along with violins. But they played the violins unlike anything he could remember either.

Finally, the choir finished as the audience—Fischer couldn't quite think of it yet as a congregation—applauded. Some held their right arms up in the air above their heads, and several people around him yelled out, " *Praise Jez-sus*!"

A man dressed in a grey suit and using a cane walked up on the podium and took his place behind the pulpit. He was old even by up-timer standards His hair was full, wavy and snow white. It seemed to capture the lights aimed at the stage with almost a halo effect. He leaned his cane beside the pulpit and shuffled some papers on its top. He took a sip from the mug at the edge of the podium and leaned forward.

"My name is John Chalker and . . ." He paused for a moment, then yelled, " *I am a sinner*!"

The old man's voice was obviously just a shadow of what it had once been years before. Even though it wavered from his tired old throat, the force behind it was still there.

As a child, Fischer learned from his father that he must learn to fit in if his family would ever be able to find a new town that would allow them to stay. He'd not only learned the catechisms of the locally

mandated religion, he'd also learned to pick up the different ways people pronounced their words from one town to another.

Later, as a student at the university, he'd learned to amuse his classmates with imitations of a number of his professors. The professor from the North Sea area spoke in a very guttural Plattsdeutsch dialect. The imitation that Fischer performed always made his proper-sounding Saxon classmates laugh.

This old man in front of him, preaching of love and acceptance and second chances had such a different way of molding his words that Fischer could not help but try to form some of those words with his own lips. It was very similar to how they spoke in Saxony, but just a little off.

The person to his left bumped into him. Fischer looked around and noticed a large number of the others in the tent swaying to the old preacher's pacing, holding their right hand up to the sky as if reaching out to be picked up off the bench.

After a time Chalker, who had been leaning heavily on the pulpit, reached for his cane and began to walk toward the front of the podium, all the while continuing his sermon, "You can only die once if you are born twice."

Taking a few more steps, he said, "Christ said to Nicodemus, John 3:3 'Except a man be born again, he cannot see the kingdom of God.'"

Another few steps and he thundered, "In Revelations 2:11 it is written, 'He who overcometh shall not be hurt of the second death.'"

Yet another few steps and the preacher deepened his voice and continued, "In Romans 10:13 Paul said, 'For whosoever shall call upon the name of the Lord shall be saved.' Are you saved tonight? Are you safe from the second death? Are you guaranteed a tomorrow?"

Now having reached the very edge of the stage, Chalker gestured to the lady in front of the choir and said, "As Sister Jennifer Copenhaver leads us in our closing hymn, if there is any doubt in your heart of your salvation, if there is any question in your mind of where you are spending eternity, if you are not absolutely certain that God will look you in the eye come Judgment Day and say, 'Welcome home' . . ."

The preacher paused a moment. Then he gestured over his shoulder and continued. "That is not a fancy pulpit. This old band stand is not a fancy altar, but you know that Jesus ate his last supper at a plain wooden table and just stood on some big old rocks to give his sermon on the mount. It just goes to show that what's important is not the physical things around us. It's the golden things that need to be in our hearts.

"So make your way to the steps of this simple old altar tonight where we will open the Bible and help you to claim the promises of God."

Sister Copenhaver held up a blue hymnal in her right hand, and signaled the band to start their lead in. The choir behind her began to hum along with the band and she broke forth in her incredible clear, sweet voice with the words, "Just as I am, without one plea."

All around Fischer, people began to sing. Some floundered under their benches for a book and a page, others joined in from memory aided by Sister Copenhaver's prompting. Those without a book seemed to all have one—and more often both—hand in the air.

***But that thy blood was shed for me.***

The woman across the aisle from Fischer not only had both hands in the air but she seemed to bob up and down as if she were floating and was about to leave the ground. Then she left off singing the words of the song in English for another language Fischer couldn't make out and then left off singing all together to repeat the same mumbled phrase over and over interspersed with "Thank you, Jesus" and "Praise the Lord."

At the end of the first verse the preacher held up a hand. Sister Copenhaver fell silent but the choir continued to hum and the band played softly.

"Are you are here tonight without the Lord? I *know* you *are* ! The spirit has revealed to me that we have people here who have not claimed the *Lord* as their personal *savior* ! If you are here tonight, search your heart for the peace that passes all understanding and if you can't find it, as we sing a second verse of 'Just As I Am' make your way to the altar steps here in front of me."

Sister Copenhaver, both hands still in the air, with the voice of an angel incarnate sang, "Just as I am and waiting not."

Fischer thought the preacher standing before him seemed to shed his years like an overcoat, becoming younger as he stood at the edge of the bandstand that Fischer now clearly saw as an altar. Pitching his voice to be heard over the song, which did not stop, Chalker looked around the crowd gathered in the tent, stopping just as he made contact with Fischer's eyes. The preacher seemed to point with his cane right at Fischer as he boomed out, "You can only die once if you are born twice!"

The hairs on the back of Fischer's neck and arms stood on end. He felt himself rise from the bench and walk to the steps of the altar in front of the old preacher. He fell to his knees and bowed, aware of others also making their way to the steps beside him. He felt a powerful hand place itself on the crown of his head, and the old man said, "Bless you, Brother! The Holy Spirit has much planned for you!"

* * *

Brother Chalker settled into the rocker on the back porch and opened the notebook that was in his lap. "Well, I guess it's time we got started. First, let's thank Elder and Sister Paul and Ingrid Nemeth for letting us have our Bible study in their back yard tonight."

After giving some time for the amen's, scattered applause and thanks to die down, he continued, "Let's not forget their children Alexis and Jacob for taking care of all of our younguns for us."

Again some warm applause interrupted him. "Elder Paul was telling me that his oldest, Terrell, is really enjoying being in the army. He might even decide to make it a career. Let's all hold him up to the Lord so that he might remain safe.

"The pickin' and singin' over at the covered-dish dinner was as enjoyable as ever. Now, we've been blessed with a lot of new folks here tonight who found their way to our family during last week's revival. I'm glad to see how well all of you made them feel at home. I do want to specifically recognize one new church member. Brother Dieter Fischer, would you please stand?"

Fischer was startled to be pointed out, but he stood up and brushed the grass off his threadbare pants. "Brother Fischer came over to me after last Sunday's service and told me that he's an ordained Lutheran minister!"

As the gathered crowd offered scattered amen's, Chalker continued, "We want to help Brother Fischer find the gift of becoming a voice for the Holy Spirit that's inside him waiting for the right time. I have a powerful feeling that Brother Fischer is going to help us spread the Word in this new world."

Finished with his business, the old preacher set down the notebook and thumbed open his Bible. "Let's see . . . after the Ring of Fire brought us here, I started these Bible studies by just starting to read through from Genesis 1:1. We've continued on every Wednesday since then. Tonight we're up to Mark 1: 4."

Chalker gave those with Bibles time to flip open to the night's passages, then began, "'John did baptize in the wilderness, and preach the baptism of repentance for the remission of sins.And there went out unto him all the land of Judaea, and they of Jerusalem, and were all baptized of him in the river of Jordan, confessing their sins. And John was clothed with camel's hair, and with a girdle of a skin about his loins; and he did eat locusts and wild honey.'"

Chalker smiled and related the thoughts that this passage brought to his mind. "You know, I felt that way after the Ring of Fire. I had given my service that morning at my church in Fairmont and they surprised me with the keys to a brand new Chevy Suburban.

"I was absolutely tickled to death. We had been needing a car to get around to do visitations of our shut-ins and to carry meals and such. So, I decided to drive up Highway 250 to visit Sister Lana Soper at the Manning Assisted Living Center.

"Anyway, I was finishing up praying with her, that's when I heard the thunder of the Ring of Fire. I didn't know what was going to happen to me, but I knew that the Lord would provide. There I was, with just the camel hair coat on my back, a leather belt, no more paychecks and a comfortable home back up-time lost to me forever.

"After the Emergency Committee prohibited any driving to conserve the supplies of gasoline, the Lord guided me into the local car dealership to trade it in for something that I could ride around in."

The old preacher paused and drank a sip of water before continuing. "Now, I had hoped that that fine new Suburban would have gotten me a wagon and a team of horses and maybe some money to keep going until the Lord was ready to provide me with guidance as to what to do next.

"But the Lord was way ahead of me on that one! The car dealer had just finished his spring tent sale on Saturday before the Ring of Fire and he took me out back to show me the beautiful tent that he had planned on returning to the rental company the next week. Since he didn't need it, he threw it in on the deal.

"So now, here I was. Cast into the wilderness and the Lord was providing me food and shelter so I could continue in His plan."

Chalker continued on with his reading of the Bible until he came to Mark 1:16. "'Now as he walked by the sea of Galilee, he saw Simon and Andrew his brother casting a net into the sea: for they were fishers. And Jesus said unto them, Come ye after me, and I will make you to become fishers of men. And straightway they forsook their nets, and followed him.'"

Chalker paused, then re-read the passage to himself and his eyes lit up. "God be praised!"

Looking at Fischer in the crowd gathered before him in the Nemeth's back yard, Chalker smiled, "Fischer? That means 'fisher' or 'fisher of men' doesn't it?"

Fischer felt uncomfortable as others around him turned to look at him with wide eyes. He acknowledged with a simple nod.

"Brother Fischer, I don't believe in coincidence in matters of the Bible. That you would come to our revival and the very next Bible study should contain this passage . . . Well, the Spirit is strong in this assembly tonight."

A man in the back of the gathered crowd began to speak out. But not in any language that Fischer could recognize. It seemed to have an internal structure like a real language though. Then another began chanting out in a different-sounding tongue, and another, and another.

Fischer looked from one to the other, and then several others begin to laugh and cry out, "Amen!" All those around him seemed to be simultaneously raising their right hands above their heads and waving in unison. God help me to understand what they are saying. Help me to learn to do as they do, he thought. But the gift of tongues was not to be his that night.

* * *

It had been warm these last few days, even for July, but the kitchen was not hot. Susannah Becker took one last look into the oven to make sure the pork was done. Satisfied, she smiled and ladled the vegetables into Herr Enriquez's serving bowls. She wiped her hands, walked to the doorway and called out, "Soup's on! Wash up and come to the table."

Where these West Virginians came up with the idea of announcing meals by calling out something that was not being served escaped her, but it was one of the small mysteries which she had long ago decided she would never learn the answer to. Like these odd spices that Peter liked so much, she figured that by now she could get used to anything.

Susannah was almost knocked over by the Beyer's children, little Anton and Vittoria, as she entered the dining room carrying her load of steaming vegetables. "Excuse me, Fraulein Becker," Vittoria exclaimed in her "too mannered for four" voice. "Papa said the last one to the table gets no dessert."

Susannah smiled at the little girl. She placed her load on the table and noticed the sly grin on Tony's face as he climbed into his chair and stuffed the napkin into his collar. "Don't worry, my little ones. I have enough dessert for all."

"Don't be so sure, Fraulein Becker. Our task master of a boss almost worked us to death today," Anton Becker said as he entered the room hand in hand with his wife Sybella. "It's good he invited us to dinner, or Belle would have had to spoon feed me after I finally was able to pluck the chicken that we would otherwise have had tonight."

"Huh," Belle retorted, "I practically spoon feed you most days anyway. How any man ever gets along without a woman, I'll never know." Anton feigned a hurt look, but he laughed just as hard as the rest did.

"That's why I'm so glad that Pete found Susannah, Sister Belle," Fischer added as he followed the Becker family to the table. "Just two bachelors like us in this big of a house wouldn't, how do they say it . . . wouldn't have been fit to shoot!"

"That makes two of us, Fischer." Pete made his way to the chair at the head of the table. "Who would have figured that a Mennonite would be able to prepare Cuban Pork Roast so expertly and keep this house looking like something out of *Good Housekeeping* magazine?"

Susannah came back from the kitchen with the main course, then sat down at the foot of the table. She had, at first, resisted sitting at the main dining table as if she were a member of the family. But, as with so many curious habits of these up-timers, she had found that they were stubborn in their sense of equality.

After Pete said grace, and everyone had filled their plates, the conversations continued interrupted only by the Beyer's Tony. He seemed intent upon grabbing everything that came into his sight. His mother picked him up out of the high chair and nestled him close to her breast to finally quiet him.

"I suspect that the Lord knew what He was doing when he took Adam's rib," Fischer commented.

"So, then why are two of the most eligible bachelors in Grantville sitting at this table unattached?" Belle inquired.

"Whoa! Don't look at me," Pete responded. "Kelly Construction has kept me busy six days and at least five nights a week since we got here. I haven't had any time to date. Now, Fischer, here's another story."

Fischer felt his face flush when Pete brought him into the line of fire.

"A fine young minister like Fischer, always working with the new prospective members, should be able to find a wonderful young lady very easily."

"A time for all things, Brother Peter, a time for all things," Fischer responded. "Maybe you're right, though. Maybe I should be looking for the proper match for you while I meet the new visitors to our church. Yes, that's exactly what I need to do."

Pete didn't expect to have his argument turned on him quite this smoothly and couldn't think of a retort. Luckily, Susannah did it for him. "That's a wonderful plan, Brother Fischer! You look for Peter. Belle and

I will look for you!"

All but the children laughed at this comeuppance and continued with their meal and conversations. Afterwards, when Susannah and Belle had cleared the plates from the table and served the fresh hot streusel, the idea came back to her.

Why not keep an eye out for Brother Fischer? He was always with Reverend Chalker when Pete didn't have him working on a job. His nose was always buried in his Bible or scribbling some notes when he came home. Maybe he needed some help adjusting to this strange place from the future and its secular ways. She must talk further with Belle about this later.

* * *

"Honey, what's wrong?" Ingrid exclaimed, woken from a sound sleep by her husband bolting upright in their bed.

Paul Nemeth was now sitting upright, bracing his arms behind him, and feeling sweat beginning to glisten on his exposed skin. Leaning over to turn on the light beside the bed, he pushed himself up into a fully sitting position, "It was the weirdest dream. I was at my own funeral. You were dressed in black, Brother Chalker was dressed in a white suit, and Brother Fischer was there in a grey suit. But the oddest thing . . . there were flames flickering behind his head!"

He looked down at Ingrid, still lying on her pillow, "When he went over to comfort you, the flames didn't burn you or harm you in any way."

"Paul, if that was the Holy Spirit talking, what could it mean?"

Paul thought for a moment. "I hope it was no prophecy, but why the flames?"

Ingrid scooted up next to him and took his hand. "Well, it could be a prophecy. Fischer is the best chance we've got right now for our faith to continue after Brother Chalker passes. Maybe the time is at hand for him to be baptized in the Spirit.

"I'm more worried why it's your funeral that it happens at. Are you feeling all right? I've been worried about your coughing lately."

Paul frowned. "I guess it wouldn't hurt to go get a check up."

* * *

"Why, Reverend Chalker, what a nice surprise to see you today." Lana Soper just beamed as she sat in her wheel chair in the recreation room overlooking Buffalo Creek.

"Well, I had to get some things at the Rainbow Center next door, and thought I'd drop in." Chalker pulled a chair over to where Lana was sitting and eased himself into it. Lana was one of the few babies born in the United States during the 1960s with birth defects due to mother's being given prescriptions for Thalidomide. As a result, she had been born with toes but no legs or feet, and flippers with finger nubs instead of arms and hands. "And how have you been feeling?"

"Fine, fine." Looking over Chalker's shoulder, Lana called out, "Johann! Could you come over here, please?"

She turned back to Chalker, "We've got a brand new nurses aide I want you to meet, Reverend. He's just arrived in Grantville and I told him about you and the church."

"Johann Friedrich, I'd like you to meet Reverend John Chalker. He's the man I've been telling you so much about."

Chalker stood and grasped Johann's hand with both of his. "Nice to meet you, Mr. Friedrich. Lana's telling me you're taking wonderful care of her."

Johann smiled. "Thank you, Reverend Chalker. She tells me you have the gift of the spirit."

"God blesses us all with that. You've just got to listen closely when He tries to tell you about it." After a short conversation, Friedrich went about his duties and Chalker sat back down with Lana.

"So what book of the Bible shall we go over, Reverend? Oh! Wait a minute. This is your anniversary, isn't it?"

The sad smile that flashed on Chalker's face confirmed that Lana had remembered correctly. "God bless you, Sister Lana. This would have been Helen and my fiftieth anniversary."

Helen Chalker had introduced her husband to Lana Soper. She'd moved into the Manning Assisted Living Center when the symptoms of her Parkinson's disease had advanced beyond John Chalker's ability to provide for her care himself. Before she passed away a few years later, she had been like a lighthouse at the Center, always holding the hands of those who were depressed, and praying for them. She had practically adopted Lana.

"Reverend, did you ever think about what might have happened if you had found a different care center back in Fairmont instead of way up here in the hills? You might have still been back up there today instead of in the middle of the seventeenth century."

It seemed like this train of thought gave Chalker a fresh head of steam, "Why, child, it was the best thing that ever happened to me! Dropped in a whole world of souls to save who have never heard of the power of the Holy Ghost. What more could I want?

"Just last week the Lord brought me a fine young man, a trained Lutheran minister no less. He just wandered into our revival and, halleluiah, he heard the call of our message." Chalker looked out at Buffalo Creek flowing by. "I tell you, Lana, he's hurting right now, but it's all part of God's plan somehow. You mark my words, he's got the gift."

* * *

Running his fingers through his hair, Fischer grinned. He still wasn't used to this up-timer fashion of short haircuts. Sister Doreen Murray had offered to cut his hair shortly after he started coming to the Wednesday night Bible study after he joined the church in April. Short on the sides, with longer bangs in the front to somewhat hide the scar on his forehead. Now it was August, and he still thought his hair looked funny, but it was the up-timer fashion, so that's just what it would be.

He again thought about what a pretty view it was from up here. He had found this spot by an old logging road above the Five Hollows. It overlooked the roofs of Grantville. With the sun just over the horizon, the morning dew made everything glimmer like jewels.

When Reverend John Chalker found out that Fischer was an ordained minister, he just beamed with joy. Ever since the Ring of Fire had taken Chalker away from his home and congregation, he had been trying to record all the things he knew of the history of the Pentecostal movement and beliefs. There were some books in the Grantville Library that covered a bit, and some of the local churches had books that covered some of the details, but John Chalker believed that the fire behind the central tenets of his church would be lost if he didn't get them back in written form somehow.

Now, with a university-trained convert at hand, Chalker was sure that Fischer was sent by God to translate his papers into German so that they could convert others. Chalker may have been able to speak German well enough, but he certainly couldn't write it with any skill.

Not as easy as it seemed, thought Fischer. I read and I think, and I pray about it, then I have to ask more questions to make sure I understand what he means.

For some reason, Fischer found this secluded little spot the best place to try to understand Chalker's ideas. Life had been good to him since he found his way to Grantville. Brother Pete Enriquez had invited him to move out of the Refugee Center and in with him. Pete had even gotten him some work as a carpenter's helper that didn't interfere with the time Fischer devoted to learning the Pentecostal faith as Chalker understood it.

True, he hadn't yet been blessed with the gift of tongues, but as Brother Chalker said, "Son, you just need to keep on seeking and be open. God will fill you in His time. Luke 11:9 and 13. 'And I say unto you, Ask and it shall be given you; seek, and ye shall find; knock, and it shall be opened unto you. For every one that asketh receiveth; and he that seeketh findeth; and to him that knocketh it shall be opened. If ye then, being evil, know how to give good gifts unto your children: how much more shall your heavenly Father give the Holy Spirit to them that ask him?'

"I think we can afford to wait just a little bit longer, don't you?"

Fischer turned back to studying his papers and lost track of time . . . until the Other brought him to instant awareness with a vision of fire and blood. He grabbed all his books and papers and dove down the hill behind a big rock without any conscious thought.

*What happened? Why did I do that?*He felt the state of panic and the memory of flames subsiding. Still with little control over his own actions, he began listening as carefully as he could to what was going on around him.

It was the birds. He must have heard a flock of birds startled from their roosts. But why should that scare him? After all, here he was in the middle of the Ring of Fire! The mighty army that defended this place had crushed forces in ways unequalled since biblical times. Then he heard the hoof beats. It was a

fast, trotting noise, but unaccompanied by any clattering or other extraneous sounds whatsoever.

*That can't be a group of up-timers out for a ride.* Fischer grimaced. It must be danger.

Sure enough, when the six riders came past Fischer's hiding place, he knew the danger was real. *Croats!*

The panic once again overcame him as he drifted into the dark recesses of his own mind.

* * *

He heard a series of quick pops from below, which then erupted into the sound of a hail of up-time gunfire. Fischer moved up into a crouch to look at what was happening in the town below. Smoke from the gunfire drifted up over the rooftops of Grantville and he saw several hundred Croat cavalrymen bolting away in an unorganized retreat.

It was already noon. Fischer stood up and, after examining the newly ripped patch in his up-timer jeans, made his way down the hill to see what these up-timers had done to this latest threat that had been hurled against them.

The street leading to the bridges looked like a butcher's market. Dead horses were stacked like cordwood, bodies of dead Croats were still being pulled into neat rows on the sidewalk, and the faint smell of that acrid smoke from the tailpipes of the school buses lingered in the air. But, Fischer noted, there was not one up-timer body to be seen.

"Brother Fischer! Are you all right?"

Phyllis Dobbs, also a member of the congregation, was rapidly walking toward him with a deer rifle resting in the crook of her right arm. "These sinners will sin no more, hey, Brother?" She grinned. "Slater and the rest of the men lit off to help out at the high school. That's where the rest of these murdering snakes came to attack."

She looked him over and asked, "How are you? You didn't get hurt, did you? How'd you rip your new jeans?"

"Oh that. It's nothing, Sister Phyllis. I fell as I was making my way down the hill into town." Holding up the bundle of paper in his left hand, Fischer explained, "I was up there translating Reverend Chalker's work again when I heard the noise down here. I'm fine.

"How can I help?"

Fischer pitched in to help the women and old men pull even more Croat bodies to the row on the sidewalk and kept thinking. *Even here we are not safe, but it is better. Yes, it is better.* Then frowning, he thought, I could have done something. I could have helped.

It was hard to concentrate. He kept imagining that he saw, out of the corner of his eyes, a reflection of fire in the store windows around him.

## Chapter Three

Slater Dobbs laid down his hammer, stretched, and sat down on a keg of nails to roll a cigarette.

September already. "Summer's almost gone; winter's comin' on," he whistled. Not that he'd be going anywhere. This job was the kind of work that he enjoyed doing, when he enjoyed working. Mostly, however, he enjoyed fishing and hunting in the back woods.

With all the game native to this part of Europe steadily drifting into the forests inside the Ring of Fire, and no game wardens to chase him off, he just didn't know what kind of animal he might come home with on any given day. But while the competition was up, a lot of folks didn't have the passion for hunting like him. The backwoods folks always had poached to fill the pot; now it was just a bit easier to get away with it. Hunting could be profitable if you knew a farmer. Hell, you could get paid just to watch his fields and fill your game bag at the same time!

Still, he'd promised his wife Phyllis that he'd stick with this job for Brother Enriquez until it was finished. Getting on the wrong side of Phyllis was never a good idea. Cracking a grin, he thought, When Mamma's happy, everybody's happy. But when Mamma ain't happy, ain't nobody happy! And that Phyllis never let you get away without knowing when she was not happy!

Even working with the Kraut preacher wasn't as bad as Slater had feared. *Just because these down-time Germans aren't as advanced as us West Virginian's, it doesn't mean that they're stupid* . His buddies down at the 250 Club wouldn't agree with him on that, but what were you going to do? It was way too late now to build a wall around the Ring of Fire and kick them out. Might as well just deal with the damn Krauts. They weren't all bad.

The Kraut preacher took a swig of water before getting back into reading his Bible. Slater thought he was a good sort. Slater lit his cigarette and called out, "Preacher, wanna cigarette? Nothing in the Bible agin smoking, is there?"

Fischer smiled. "No, thank you, Brother Dobbs. Nothing in the Bible against smoking. I just don't know how it might make my pickled cabbage taste."

For a moment Slater didn't know what to think, then seeing Fischer's grin, he realized he'd been poked fun at and started laughing himself. "All right, Preacher. I promise I won't call you a Kraut any more. That's a good 'un!"

The construction job they were on was for the silo manufacturing plant in the new industrial park on the Saale River just outside the Ring of Fire. Slater and Fischer were assigned to finish the punch-outs of the rafter supports that would be holding the new crane rails. Every bent nail left behind by the building crew had to be reinforced by two nails from the punch-out team. Every structural piece of wood had to be braced and supported by an additional piece of wood below it. When they weren't placed exactly to specifications, Fischer and Slater had to carefully remove and place the offending support back in the right spot or refit them entirely.

It was later that afternoon when the miracle happened.

A cross-tie Fischer was working on slipped out of position, pinning Slater's hand in a painful squeeze. He climbed over to lift it, then grabbed Slater's wrist with one hand and examined the damaged hand. Three of Slater's fingers were bent the wrong way in more than one place. Several felt like they might be broken. The pain hadn't hit yet, but from the color of the nails Slater was sure to lose more than the use of his hand for a long time, if it could be fixed at all. Slater swallowed back a scream as Fischer handled his mangled hand.

Below them, Slater heard someone call, "Mr. Enriquez! Where are you? I need you now!" The voice

came up clearly to them, even though Slater couldn't move his attention away from the throbbing of his hand, which was just announcing the abuse he was seeing. For some reason he could only think, *Boy, is Phyllis going to be pissed at me* .

"Over here! Hi, Lieutenant Ivarsson. What can Kelly Construction do for the Swedish Yellow Regiment today?" Pete smiled as he looked up from his blueprints, down below on the job floor.

Slater felt Fischer tighten his grip on the injured hand and grab hold further up his arm with his other hand. Bones and ligaments popped. Slater inhaled deeply, shocked by the suddenness of it. He looked up into Fischer's face and saw Fischer's deep blue eyes turning steely and his complexion darkening, making the long scar on his forehead almost glow.

Below the conversation continued, with Ivarsson forcefully demanding, "I have to have you back at the barracks now. The windows, they still stick."

"Lieutenant, I told you before. Those new double-hung windows we installed in your barracks needed to be given some time to cure in place before we come back to adjust them. You weren't supposed to fool with them yet," Pete answered.

Ivarsson scowled. *"What good are windows you cannot open or close? We have twelve barracks and one staff house with no functioning windows. Thank God, the barns have no need of windows! I told you. I want real windows that swing open and closed like proper windows."*

"That decision was made by your superiors long before we started the contract to build your barracks. Listen, I can't pull a man off of the job we have here, but at the end of the day, I'll send someone over to close them back up. Give them two weeks to cure in place, and if you and your men still don't like them, I'll swap them out for some 'proper' windows." Pete offered his hand to the forceful young lieutenant, and asked, "Fair enough?"

Clearly Ivaarson had expected to come out away from this exchange with nothing short of victory, but since his superior officers had made the decision to install those god-awful, American, double hung, sliding windows, he had no choice but to accept the contractors counteroffer. *"Fair enough. However, this time it is two weeks. And two weeks consist of fourteen days, Enriquez. Two weeks! Did they train you up-time contractors to say 'two weeks' when you meant 'later sometime' or 'when I feel like it'?"*

With that, Ivaarson spun about and marched out.

Slater had lost track of the conversation going on below, even though the anger in the officer's voice kept echoing somewhere in the back of his skull. He was astonished and engrossed by the sounds coming out of the mouth of Fischer, who was still gripping Slater's injured hand and arm with what felt like a vise.

Slater forgot about his hand as he watched the change in Fischer's face. *My God! This man is speaking in tongues!* Fischer's eyes snapped back up to his at that moment, however they still had a far off focus.

Just as Ivarsson walked out of the building, Fischer seemed to relax and let loose of Slater's hand. The steely eyes returned to a glowing, caring blue once again. Slater felt the blood rush back into his hand. Only then did he remember the ugly state his fingers had been in only moments before. Slater held the hand up to his face and turned and flexed it. "God be praised, Preacher, you healed it. You healed my hand!"

Fischer blinked, looking tired and confused, then nodded as he sat down on the nearest crossbeam.

"Pete! Get up here! Reverend Fischer has performed a miracle! He's healed my hand!" Slater shouted, all the while flexing and turning his hand before him as if he'd never seen it before.

Slater wasn't a simple man, nor was he highly educated, but he was faithful. Phyllis made sure of that, too, and here he'd witnessed a man speak in tongues and heal him. Had anyone else told him the story, he would have dismissed it. He flexed his hand again. He'd still lose a few nails, but his fingers weren't even swollen and didn't throb anymore. "I'll be . . ." He'd been touched by God through this man and saved again.

The telling couldn't wait till the next meeting. "Pete! Pete!"

* * *

John Chalker secured the flap of his church tent after his visitors left and made his way to the small tent that someone in his congregation set up for him to use as a private space to pray, study and sleep. He hoped the new church could be finished before winter set in.

He stoked the coals in the new iron fireplace he'd recently received, and sat down in his rocking chair. He then turned up the kerosene lantern for some light and laid his Bible on his lap over his knitted blanket. For some time he just sat rocking and thinking. As far as he could see, the future of the entire Pentecostal movement in this new time depended on his next decision.

He had heard the testimony of Slater Dobbs and examined the hand that had been crushed in the accident yet miraculously cured leaving no evidence of any harm. He'd listened attentively to Pete Enriquez as he told of the condition in which he had found Brother Fischer when Pete had climbed up into the rafters after hearing Slater yell.

He'd spent so much time with Fischer over the last few months that he had come to feel like he knew the man had a good heart and a legitimate calling to serve the Lord. Back up-time, Chalker had known many excellent Pentecostal ministers who had come to the anointment after years of struggling to let go and let the Holy Spirit take control of their lives. That it should come upon Fischer in such a crisis was not an uncommon event.

Chalker had looked into Fischer's eyes as he told what had happened in those rafters from his point of view. It certainly sounded consistent with the presence of the Holy Spirit. Chalker saw no attempt to bluff or to state anything beyond what Fischer knew had happened up until the moment that 'The Other' had taken over his actions.

"The Other?" Chalker had asked as Fischer poured out his memory of what had happened in the rafters.

"Yes, Reverend. When I find myself in a dangerous situation, I feel like some other power, other self, takes control of my body and protects me. It used to be that I would lose consciousness when it happened, but lately, it's still me. I have control, but it's like I become an observer to the actions this Other takes. I seem to feel the image of flames just out of my sight and then something takes me over and guides me."

Even Fischer's description of the experience reminded Chalker in so many ways of his early days of feeling the Tongues of Fire take control of his life and work It's way using him as It's tool.

"Oh, touch my lips with fire divine, Here I am, send me. The dross consume, the gold refine. Here I am, send me!" The old song came out of Chalker's memory.


Chalker trusted that the Lord would provide a young minister to continue His work and to spread His word. Clearly Fischer had been called to the ministry before the Ring of Fire to the best religion available to him to do God's bidding in this place and time. Equally clearly, something had drawn Fischer to this very tent and this very doctrine for a reason. The only question was: was this event the anointment of Fischer by the Holy Spirit or was it something else?

Chalker continued to rock as he pondered that question. Finally, opening his Bible to the Book of Acts, he read, "One must be ordained to be a witness with us of his resurrection. And they appointed two, Joseph called Barsabas, who was surnamed Justus, and Matthias. And they prayed, and said, Thou, Lord, which knowest the hearts of all men, shew whether of these two thou hast chosen, that he may take part of this ministry and apostleship, from which Judas by transgression fell, that he might go to his own place. And they gave forth their lots; and the lot fell upon Matthias; and he was numbered with the eleven apostles."

They cast lots. *They tossed the dice* , thought Chalker. On a matter of the greatest importance, they basically flipped a coin.

* * *

# Hallelujah, Part One

## Written by David Carrico


## *Magdeburg - July, 1634*

"It's here! It's here!"

The three men looked around as Marla Linder burst through the door. Next moment, she laid an oblong package on the table in front of them.

"What is here?" Franz Sylwester asked his wife. The inevitable smile crossed his face as he looked at Marla.

It seemed a lifetime since he had sat, pfennig-less, in the Thuringen Gardens and listened to her sing for the very first time, yet it had only been two years ago. It still amazed him that she had agreed to marry him. As an up-timer, she had had so many options open to her, but she had "fallen in love", to use the up-time phrase, with him, a crippled vagabond who had once been a musician. And it was from her support that he had fought his way through therapy in Grantville to reclaim his musicianship, and more.

Others might find flaws in Marla; Franz knew that. Indeed, some of his friends would mutter about "Minerva in jeans" sometimes after an episode of Marla's strength of will being displayed. And objectively, he knew she wasn't perfect. But when he looked at her—lustrous black hair, unbound and flowing over her bosom; blue eyes, capable of a gamut from flaming passion to piercing iciness, now sparkling with excitement; red blush shining through her translucent skin—all he could see was beauty. God Above, how he was blessed, and not just because of her appearance. Marla's passion for music equaled his own, and that was no small thing.

Franz's attention was drawn back to the moment when Andrea Abati asked, "So what is it?"

Marla finished unwrapping the package, almost bouncing in her excitement. When she folded back the last of the paper, a large book was revealed. It looked to Franz to be about eleven inches by fourteen inches. The worn cloth binding was a dark blue, closer in hue to navy than royal. Printed in gold on the front cover was the following:

**HANDEL**
**MESSIAH**
**FULL SCORE**

"This," Marla declared, "is our Christmas concert for this year." She definitely bounced after she said that. "I knew that Marcus Wendell had this on his shelves, and asked him to lend it to me. He hemmed and hawed a bit, but finally agreed to let me borrow it."

Christmas already, Franz thought. They had just finished their huge concert not two days ago; Bitty

Matowski's production of her new ballet *A Falcon Falls* was to begin that night; yet already Marla was thinking about Christmas. Once again he had the feeling that he was running as fast as he could just to keep up with her.

"So, again I ask, what is it?" Andrea was smiling. As usual, Franz noted, Marla's enthusiasm was infectious.

Franz reached out and opened the book, turning the pages carefully. The sight of printed music drew the attention of all three men. Heinrich Schütz drew the book in front of him. Andrea adjusted his chair to sit at the *Kappellmeister's* right hand to observe the turning pages.

"A full orchestra conductor's score." Franz's surprise was evident in his voice. "By what miracle do you present this?"

Marla bounced again. "I was looking at my vocal parts copy, wondering how long it would take Thomas to reconstruct the orchestra parts from one of the recordings in Grantville, when I remembered seeing this in Marcus' office a year or so before the Ring fell. I thought it was so cool then, especially when he told me that it was the work that his conducting teacher used to introduce him to instrumental conducting. It still has all of his notes and cues penciled in."

"Does it now?" Franz muttered, his interest definitely caught by that last statement.

"It is an oratorio, yes?" Heinrich asked in his careful English. "A good one?"

Marla looked to the man who was the preeminent composer in the German states in 1634. "Yes, Master Heinrich, it is an oratorio. It was written in 1741 in twenty-four days by a German named Georg Friedrich Handel." Heinrich looked intrigued. "And it is arguably the greatest oratorio ever written; certainly the most famous in the up-time. One of the choral pieces from it is one of the two or three most widely recognized musical works in the up-time culture."

Master Schütz looked back to the score with an avid expression and patted a page with satisfaction. "So . . . Handel . . . a German, one who has much to teach me. I can handle this." He smiled as the

others burst into laughter.

After her laugh ceased its pealing, Marla said, "Oh, Master Heinrich, that joke was so old up-time it had whiskers."

"Ah, but you are not in the up-time now, are you?" Heinrich's smile grew even broader. "It is a new joke here, now."

"As you say, Master Heinrich," Franz chuckled. "As you say." The sight of the usually somber composer indulging in a bit of humor was enjoyable in itself. Franz had the impression that Master Heinrich had not laughed much since his wife Magdalena died several years earlier.

"So," Franz turned to Marla, "you already had a copy of the vocal parts, and now we have the full score. Knowing you, you have a printer in mind to make copies."

"Yep. Herr Zopff."

Marla's smile lit the room up again. This time, however, Franz's heart did not respond with its usual leap. Instead, it descended to the region behind his belt buckle.

"Tell me you jest."

"Nope."

"Marla, the man is utterly outrageous!"

"I know, but he does good work."

"He will not deal with you!"

"I know, but that's okay." Franz's dumbfounded state increased as Marla's smile grew even brighter, if that was possible. "I know someone who's even more outrageous that I can turn loose on him."

Franz watched as Marla turned her smile on Andrea Abati.

* * *

Franz trudged along beside Andrea Abati. The day was warm enough that he wished he had left his jacket behind. Dust hung in the air, stirred up by wagons that trundled by with some regularity. The most recent wagon had rolled through the dung deposited in the street by preceding teams of horses. Andrea, on the outside, had nimbly avoided the splash, but his muttered response was both expletive and description of the matter.

Franz grinned in sympathy. "You are getting quite proficient in vulgar German, you know."

"It is the low company I keep," Andrea responded with a dry smile. "On the other hand, as an Italian, I have a certain standard of decadence I must live up to." That quip evoked a laugh from Franz.

True to her word, Marla had left the dealing with the printer Zopff to Andrea, who had promptly drafted Franz to accompany him to beard the lion in his printer's den. Now Franz pointed ahead.

"There . . . there is Herr Zopff's place of business. See the sign says 'Zopff and Sons.'"

"At last," Andrea sighed dramatically. "Let us fulfill our charge, so that I can return to the warmth of my rooms."

"Warmth?" Franz said incredulously. "How can you be cold, man? The sun is high and warm, summer is in full bloom."

"Ah," Andrea gave a bit of a shiver, "but you are not from Roma. Trust me, this air would be considered chilly, there."

And with that, they arrived at the door to the shop. Franz held the door open out of respect, allowing Andrea to enter before him. He turned from closing the door, to see Master Agamemnon Zopff stepping forward to confront—that was the only word that came to Franz's mind—his companion.

Herr Zopff was—impressive, Franz decided. He had seen the man at a distance before, but never up close, and never in his working dress. With a coat on, Herr Zopff appeared to be stocky. Without a coat, with his sleeves rolled up and his printer's apron strapped on, the printer was revealed to be barrel-chested and heavily muscled. True, his belly did indicate a fondness for the fare of the taverns, but Franz would not have wanted to trade either blows or handshakes with the man.

His thought of a lion earlier was also somewhat on pitch, Franz decided. Herr Zopff's hair was thick, and flared out like a mane where it had pulled loose from being tied back. His steps, despite his size, were not ponderous. And there was a definite glint to his eyes, not unlike a carnivore sizing up his next prey.

"And what can Agamemnon Zopff do for you distinguished gentlemen?"

Zopff's voice completed the leonine resemblance as it rumbled out of his big chest. Despite being low, it was smooth, not gravelly or hoarse. Franz saw Andrea tilt his head a little to one side as he appreciated the timbre of the printer's voice.

Franz found Zopff's habit of referring to himself in the third person somewhat pretentious. That was, however, in keeping with the man's reputation, along with his scorn of all other printers in Magdeburg. He was, unfortunately, almost as good a printer as he thought he was, so Marla was right selecting him to print the music of the oratorio.

"I am Andrea Abati, and this is Franz Sylwester. We have a proposal for you to print—or I should say reprint—some music from Grantville," Andrea began.

Franz saw Zopff blink as Andrea's soprano voice registered with him. The printer's eyes widened and his lips parted as it dawned on him that he must be talking with the famous Italian castrato that had been the talk of *Hoch-Adel* society for several months now.

After a moment, the printer said, "Come, then, and let Zopff see it." He turned and beckoned to a younger man who was cleaning a press in the rear of the room. "Patroclus, come."

Andrea waved Franz forward to the desk that Zopff led them to. Franz opened his satchel and laid out both the full score and the vocal parts book that Marla had given him. Then he opened both of them, to display the music printed within. Both Zopff and his associate leaned over the pages, avidly drinking in the music printed within. The young man, who from his appearance must have been one of the advertised sons, wiped his hands on a cloth several times, then turned pages in both books by barely touching the

edges. The two men examined the books carefully, spending almost as much time looking at the paper and the bindings as they did the printing. Zopff definitely sneered when he saw the paper binding on the vocal parts book. At length the two men straightened. Franz saw the younger give a slight nod in response to Zopff's querying look.

"So, what is it you want?" the printer's voice rumbled again.

"For immediate use," Andrea responded, "five copies of the large score and one hundred copies of the parts book."

"Bah! That is not enough to make it worth Zopff's effort!" The printer smacked his chest, evoking a sound not unlike an ax blade sinking into a tree trunk. "You insult Zopff! Zopff, who once printed for the Elector of Brandenburg himself!"

The young man laid his hand on the printer's arm. "Father, hear them out." Grumbles resulted, but Zopff calmed down.

"For immediate use," Andrea repeated, an edge to his tone. "But we anticipate that this will sell many, many copies. This is the first of the great Grantville works to be printed here and now, and musicians from Moscow to London, Stockholm to Madrid and Naples will want copies of this." He paused to let that sink in. Franz saw the eyes of both the printer and his son take on a far away look. "Thousands, no, tens of thousands of copies," Andrea resumed, "all of which can come from your presses." A smile began to grow on Zopff's face. "All under the auspices of the Royal Academy of Music."

The smile disappeared.

"Who is this Royal Academy of Music?" the printer thundered. "Zopff is the printer! Zopff is the publisher! Zopff, who once printed for the Elector of Brandenburg, determines what is good, and what is not!"

Franz almost smiled. Despite the noise, the printer at that moment bore a strong resemblance to a character from one of the Grantville cartoons who had stuck his finger in one of the electric sockets. His hair was bristling, his arms were wide-spread, and his eyes were almost alight.

Andrea was manifestly unimpressed with the claims of past glory. "That, as the Grantvillers would say, was then. This is now. Who have you printed for lately?" Zopff turned red and seemed to swell up. "Whoever we settle on will print for the Royal Academy of Music, founded by Gustavus Adolphus Vasa. There are other printers in Magdeburg; Septimius Schneegasse, for example." Zopff's complexion now verged on purple. Andrea waited a moment. "And the last we heard, the Swedish king has a score to settle with your precious elector."

Once again the son laid a hand on his father's shoulder. Zopff stood tense for a moment, then deflated. Patroclus turned to the others.

"You are saying that we would become the exclusive printers for this . . . Academy of Music?"

"Yes," Andrea nodded. "Provided the quality is high." Zopff started to turn red again, but the son squeezed his shoulder.

"And this is just the beginning?"

Franz laughed out loud. "Only the veriest beginning. There is 350 years worth of all kinds of music to be printed, much of which will be in immediate demand."

Patroclus looked at his father intently. Finally, Zopff gave a grudging nod. He faced back to Andrea.

"Printers, now, music is a . . . a sideline. We print books. Sometimes those books contain music, most times they do not. It takes special fonts to print music. It can be very costly." Andrea nodded. "And the fonts we use do not look like the fonts in these books."

"True," Andrea nodded again. Now that the initial breakthrough had occurred, his voice was much warmer. "But we will insist on new fonts that match those in these books. This will become the modern style, and you will be the . . . how do the Grantvillers say it . . . you will be the leading edge. You will have an advantage."

Both printers' eyes lit up at that. They understood the concept of competitive advantage very well.

"And," Andrea interrupted their reverie, "there will be books as well, books that need some music printed amidst text. There will be treatises about music to be printed that will be in demand in every court and church and collegium in Europe. But you will need the new fonts for that work as well."

Zopff rubbed his hands together, smiling an acquisitive smile. "Zopff will do this."

"We have yet to negotiate prices," Andrea warned.

"Bah! We will do this."

"And we will have very strict standards about accuracy."

"Bah!"

Franz was starting to chuckle, watching the bombastic printer wave away the remaining obstructions as if they were nothing but the paper he printed upon.

Patroclus closed the books and set the vocal part volume on top of the full score.

"Can you leave these with us? The full score is about a quarto size, and the parts book is about an octavo size, but we must count pages and plan how they would be printed to tell you how much they would cost to print."

Andrea looked to Franz.

"Take great care," Franz conceded. "The full score is irreplaceable."

"As if it is a royal treasure," Patroclus affirmed, "for that is what it is."

The four men shook hands.

* * *

"Come in, come in." Franz opened the door to admit Patroclus Zopff. "Come, meet the others." He led him to the table. "You have already been introduced to Master Abati. Now meet Master Giacomo

Carissimi, master of the Royal and Imperial Academy of Music; Master Heinrich Schütz, *Kappellmeister* to the Vasa court in Magdeburg; and my wife, Marla Linder." Heads nodded around the table as names were called. Zopff had sufficient presence of mind to return the nods, but his eyes were a bit wide as Franz concluded with, "Everyone, this is Herr Patroclus Zopff from the printer's establishment that we approached." Franz gestured Patroclus to a seat, and took his own.

Marla giggled. Everyone looked at her. "I'm sorry, but . . . Patroclus?" She giggled again

Patroclus' face twisted into a wry expression. "Yes, well, you have to understand that my family is from Berlin." He sighed. "My grandfather, Conrad Zopff, was a leading printer in Berlin, often printing works by or for the Elector's family. The Hohenzollerns would often name their children with classical names, sometimes from Latin, but just as often from Greek. Grandfather, I suppose thinking to imitate or flatter those whose coat skirts he rode, named his children Agamemnon, Ajax and Penelope. And likewise, my father named me Patroclus, my brother Telemachus, and my sister Eurydice."

"Oh, the poor girl," Marla gasped, trying to suppress yet another giggle.

"Indeed." Patroclus smiled. " *My*son, however, is named Conrad." There was a general laugh at that statement.

After a moment, Franz said, "Well enough. What is your response to our proposal?"

Patroclus laid the original scores on the table, then consulted a small notebook he pulled from his pocket.

"The large book, the . . . full score, you called it: it has 421 pages of music, plus another six pages of associated introductory material, for 427 pages total. It is a quarto size, so that would require 54 sheets to print."

Marla looked confused. "Sheets?"

"Paper is made in a large sheet," Heinrich explained from his end of the table. "The size of a book is determined by how many pages are printed on the sheet and how many times the sheet is folded." He pantomimed in the air. "A quarto page is folded twice, so that the pages are one-fourth the size of the sheet . . . hence quarto."

Light dawned in Marla's eyes. "And an octavo . . ."

"Would be folded one more time." Heinrich smiled.

Patroclus held up the vocal parts book. "This is about the size of an octavo." He laid it sideways on top of the full score book. "And you can see that it is about half the size of the quarto."

"So a quarto sheet will have four pages on it," Marla concluded triumphantly.

"Um, no," Patroclus said. Marla looked confused again. "It will have eight pages printed."

Light dawned again. "Oh, front and back." Marla thought for a moment. "How do the pages line up next to each other, then? I mean, the folding . . ."

Patroclus laughed. "That is my job, to make sure the pages are arranged in such a way on the sheet that

when they are folded and combined with other sheets they are in the right place." He looked back to his notebook. "So, as to the paper . . ." he pulled samples out of his pocket and passed them around, "the price varies with the quality, of course."

Marla looked at a brownish piece, and shook her head. "This almost reminds me of the old paper towels the school used to use, the kind that would take all the skin off your nose if you tried to blow into them."

Patroclus looked mystified at her comments. "Ah, that is the cheapest. It runs around 4 florins per bale."

"Bale?"

"That is our standard measurement of paper. I would expect your proposal to use at least this paper." He pointed to a cream colored sample in Heinrich Schütz's hand. "That one will run 5-1/4 florins per bale. And this grade," he pointed to the sample held by Giacomo Carissimi, "this is 6 florins per bale. This I would recommend for your presentation copies."

"Presentation copies?" Once again Marla looked confused.

"The special copies a musician gives a patron, or a prospective patron," Heinrich responded.

"They are usually printed and bound to the highest degree of quality and presentation," Giacomo added.

Marla sat back and tapped her lips with her forefinger. Franz remembered seeing Mary Simpson doing the same thing. He smiled a little at the thought of Mary, wondering where she was and if she was safe. He prayed so, as she had meant so much to both himself and to Marla.

"We'll do presentation copies," Marla announced, then grinned. "But we'll do them with a twist. We'll do a superb one for the king and princess, then we'll do a few that are just a little less superb for the patrons. Then we'll tell them that the first ten or so who contribute so much to the support of this performance, including our printing costs, will receive one of these presentation copies, complete with autographs by the soloists and the conductor." She pointed to Franz. "That ought to interest them, bring out the excitement."

The discussion from there descended into the depths of printing operations and costs. Schütz proved to be very knowledgeable about the business of printing. But then, Franz reminded himself, the master had managed the printing of several of his own works and collections over the years. Printing costs per sheet or per bale; how many pages to the sheet; how many sheets to the signature; how many signatures to the book; the question of whether engraving should be done instead of typesetting; the costs of creating the special fonts for music and text for both books; all were discussed at length. Franz choked back more than one yawn before the final agreements were reached. Both Schütz and Carissimi were satisfied, so Franz was certainly not in a mind to object.

Hands were shaken all around. Patroclus leaned back in his chair, almost as if in relief. He looked around at the others. "Who will do your binding?"

Once again Marla looked surprised. Poor Marla, Franz thought to himself. She was certainly receiving an education in the down-time printer's world. Nothing was as simple as she thought it would be.

"Ah, I forgot to ask if you handled the binding as well." Schütz shook his head.

Patroclus sighed. "If you ask my father, he will say that we do. He looks to the past, still. When the

family was in Berlin, we were indeed publishers. We would print and bind and sell, both our own work and that of others. But today, here, now, we are printers only, with but enough work to keep two of our three presses busy. The war, you know, has been very hard on printers." There were murmurs of agreement around the table. "So, no, we do not bind. I can recommend to you Friederich Mappe. His work is very good."

After another round of polite conversation, Franz escorted Patroclus to the door. When he returned to the table, they all looked at each other.

"So," Marla broke the silence, "we are on our way."

"Indeed." Schütz agreed. "But as I sat here this afternoon, it occurs to me that the dissemination of the uptime music, if you want it to be in your hands, you must take steps to acquire it."

The resulting discussion lasted until late in the evening, and Franz didn't yawn once.

* * *

Lady Beth Haygood looked up at the knock on the door.

"Oh, hey, Marla. Come on in." She reached over and moved a stack of papers off the nearest chair. "Have a sit."

"Thanks, Lady Beth." Marla took a seat. Lady Beth observed to herself that married life really seemed to agree with Marla. She looked more . . . settled, somehow, than she had since any time after the Ring fell. But she was still wearing her favorite jeans, so she hadn't changed all that much. "So," Marla asked, "what did you need to see me for?"

"You remember that conversation we had a few weeks ago?"

"The one about the girls' school?"

"Yeah. You remember you said if we needed a music teacher to call you?"

"Uh-huh."

"Well, if you were meant that, the job's yours."

Marla's face lit up. "Seriously?"

"Seriously."

"Cool! Wait until I tell Franz!" Marla stared off into space for a minute or so. Lady Beth waited until she came back into focus. "So, what will my responsibilities be?"

Lady Beth searched in front of her for a particular piece of paper. "Where is it . . . ah, here it is." She looked over the top of her glasses at Marla. "We don't know how many students we'll have this first year. There's been a lot of interest shown, and we have over thirty girls enrolled now. We think the enrollment will top out at around seventy, maybe a little more."

"Wow." Marla looked impressed. "That many, huh? Great. And how many of them will be involved in

music?"

"All of them." Lady Beth smiled in response to Marla's surprise. "It's going to be a required part of the curriculum. In this day and time, music is looked on with almost the same favor as sports was in our time. Every parent who enrolled or is thinking about enrolling a student has asked questions about music, and about who would be teaching it. In fact, your name actually convinced some people to go ahead and enroll now, when I told them we were going to ask you to teach the music."

Marla now looked a bit taken aback. "Umm . . . seventy girls, huh? I know that people here and now take their music seriously, but I still wasn't expecting quite so many." She shook her head, then straightened up. "But that's great. Nice big choirs I'll have. Do you have an age breakdown yet?"

"We're going to run the equivalents of fifth through twelfth grades. Today, our guess is forty to fifty in fifth and sixth grades, with the rest spread across the higher grades. That balance will even out in a year or so, I expect."

"Okay, that's two, maybe three classes. I'll dig out some of my children's choir material from church."

Lady Beth chuckled. "Marla, dear, you're going to find that a lot of these girls are already pretty musically proficient. They all participate in their church liturgies in the congregations, so they all can sing—some of them rather well. And most of them, the older ones anyway, can play an instrument to one degree or another."

Marla shook her head. "There I go again, assuming that because I'm the up-timer I know everything and I'll have to start at square one."

"Well, you might have to in one respect," Lady Beth said. "I doubt that most of the girls, even the ones who play an instrument, are musically literate to any great extent. Most of them learn by rote, from what I can find out."

"So, I'll have to teach them at least some theory in the first few weeks," Marla concluded. She smiled in relief. "Good. I have some Kodaly materials I can use with the younger kids, and I'll just work the older kids through one of the basic theory sections of my theory book. By the time we get through those, I should know everyone and their abilities."

"Good." Lady Beth picked up another piece of paper. "I've been to the town house we're using until the school buildings are finished, and there's a harpsichord there. For other instruments, the girls will have to provide their own. So, what else do you need?"

"Blank staff paper, from one of the printers. Check with the Zopffs. Pencils . . . preferably some of those imitation #2 yellows that showed up in Magdeburg this year. Something to use for erasers. Books, when I can get them printed." Marla thought some more. "And a piano." Her gaze at Lady Beth was most direct. "It doesn't have to be a grand. In fact, it probably shouldn't be. But I need a piano."

Lady Beth smiled. "I already thought of that. Casey Stevenson is teaching here now. In fact, she and Staci Matowski are working with the girls we've already enrolled. Anyway, Casey's mom had a piano."

"Sure," Marla interjected. "A pretty good Baldwin console, if I remember right."

"Well, Casey said we could 'borrow' it, since there's nobody at home to play it anymore."

"Great." Marla smiled. "You and Casey send a wire to Ingram Bledsoe and tell him to get it shipped up here. Tell him it's for me, and he'll make sure you get it as soon as possible and in the best shape."

"I didn't think of Ingram." Lady Beth jotted a note.

"I was going to recommend that you wire him to buy one, but if you've got one for free, that's great."

Lady Beth finished her note, then looked up with a smile that could only be called sinister. "Another thing—how's your Latin?"

"Latin?" Marla looked perplexed. "You know me, Lady Beth. I took French in high school, and learned a bit of Italian and modern German from all the art songs I sang in my voice lessons. Since the Ring fell, I've spent most of my time trying to learn the various dialects of the nearby Germans. When have I had time to learn Latin?"

"Well, you'll have to learn it. Abbess Dorothea, who's the closest thing to a certifying agency here and now, says that all instructors must be fluent in German, Latin and at least one other language. French, now," Lady Beth dived for another paper, "yes, we're covered. Madame de Farge, one of the Huguenot French, has agreed to teach. So you're off the hook." Another evil smile at Marla.

"You're not serious . . . are you?"

"On the Latin, absolutely."

Marla heaved a sigh. "Well, I learned German in two years; I suppose I can learn Latin as well. Master Giacomo and Master Andrea can probably help me."

"I'm afraid not." Lady Beth turned serious.

" *What?* Why not?" Marla was starting to get peeved, Lady Beth realized, so she held up her hands.

"Calmly, calmly. It seems Latin comes in two flavors . . ."

"You mean Latin has dialects?" Marla demanded. "I have to learn how many versions of this stupid dead language?"

"You only need to learn one. But it can't be the one that the men from Italy know. The pope's Latin, it's sometimes called."

"Aha. Political correctness rears its ugly head." Marla settled back.

"Yep. And the pope's Latin has been very influenced by Italian speech patterns. No, you'll need to learn from one of the northern Germans. Their version is called 'humanist' Latin. It has the advantage that it sounds more or less the way it looks on the written page. You can't say that about the pope's Latin."

"Great. So all I need to do is find my choir materials, find a Latin teacher—for me—and figure out how I'm going to teach seventy kids who may or may not be able to play and sing, but probably don't read much music."

"I'd say you've got it." Lady Beth nodded in affirmation. "Although you can talk to Casey and Staci about the Latin, find out who's been helping them. For that matter, they can probably get you started.

You've got a bit of an ear for languages from all your training, you know, and knowing French and a little Italian should help."

Marla stared off into space again for a moment, obviously thinking. Lady Beth clasped her hands and waited for the train of thought to arrive at the station. After a moment, Marla's gaze focused back on her immediate surroundings.

"Do you have class size limits?"

"Well, we're going to try and hold the line at twenty pupils per teacher in the regular classes."

"Will that apply to me?"

"Does it need to?"

"Um, for choir, no." Marla was tapping her lips with her forefinger. "But for the theory classes, yes. I can't have fifty kids in a class. That's at least three, maybe four classes. At an hour a class, that's the max I can take in one day. In fact, that may be more than I can handle. You may need to think about having Casey available to at least help with the younger grades, maybe even teach them."

Lady Beth focused a very direct gaze on Marla.

"Why?"

"Because," Marla sighed. "Lady Beth, I'm a professional musician. I have a reputation. You said yourself that the mention of my name had convinced people to sign up for the school. But being that professional musician places major demands on my time. Just practicing on piano, voice and flute takes at least six hours out of my day."

"Good Lord, woman," Lady Beth exclaimed. "How much sleep do you get?"

"Enough. Fortunately, I've never needed as much as some people. But the thing is, that's my priority. I have a lot of repertoire to learn." Marla looked down for a moment, then directed her gaze to Lady Beth, locking eyes with her. "I almost went crazy when the Ring fell and I lost the chance to do this in our time. God's given me another chance, and I'm grabbing it with both hands. Right now I'm one of the elite in Magdeburg. I may not be in Andrea Abati's league—yet—but I will be. I'm riding the crest, and I need to stay there as long as possible. I want to shape the future for other women in music, which means I've got to be prominent for a long time."

"So what does that mean for the school?" Lady Beth asked. "I can't afford to pay you just for your name."

"I know that. I will give you as much time as I can, but I can't be a full time teacher. There's not enough hours in the day. I've got to have at least one assistant now for the younger kids. And if the enrollment's going to build like you think it will, then there may have to be more than one."

"Maybe, just maybe, I can squeeze a few hours of time a week from Casey's schedule," Lady Beth muttered, looking at the teachers' schedule she had pulled out of a drawer. "Staci's is out of the question." She looked up. "But where am I supposed to find more than that?"

Since it had been something of a rhetorical question, Lady Beth was a bit surprised when Marla

responded.

"I really want to use the Kodaly methods here. Send wires to the choir directors of the Grantville churches. Find out who's been leading and helping with the children's choirs in the churches, and what methods they use. That's where I got my training and a lot of my material, when I was doing that in high school. Maybe one of the helpers can be lured to coming to Magdeburg for a job in a prestigious girl's academy."

"Hmm." Lady Beth made another note. "That's actually not a bad idea. Marcus Wendell may know of someone, too."

"If no one is available, then look around locally and find someone who teaches children to sing in churches or schools and hire them away. I can teach the Kodaly methods to other teachers if I have to."

Lady Beth jotted that recommendation down as well.

"You can say that the music program is directed by Marla Linder," Marla offered. "That would be true. If you want my name, reputation and cachet associated with the academy, that's the best I can offer."

Lady Beth set her pencil down again.

"I think we can work with that. So when could you start?"

Marla thought for a moment. "I have to find my Kodaly material and begin refreshing myself on it. Say, next Monday?"

"Could we meet on Friday to talk about scheduling?"

"Sure."

"Deal. I'll see you then."

Marla rose to go, and turned toward the door. Lady Beth dropped the little nugget she had saved for last. "One last thing." Marla looked over her shoulder. "You'll have to wear a dress in the classrooms."

A wry expression crossed Marla's face. "Yeah, I figured that would be the case. I guess I'd better look up that seamstress that Mary hired to make my recital gowns." Her hand ran up and down the seam of her jeans. "I probably wouldn't get much respect as a teacher in these." She gave a lopsided smile to Lady Beth. "But that doesn't mean I'll like it."

Lady Beth started laughing as the door closed.

* * *

Marla looked up from the letter when Franz walked in the front door and walked over to where she sat to place a kiss on her forehead. She raised her face for a proper kiss.

Some time later, Franz pointed to the letter. "What is that?"

Marla finished settling her hair and picked it up. "A letter."

"I can see that much." Franz's grin took the sting out of his sarcastic tone. "Who is it from?"

"Marcus Wendell."

Franz grew serious. "What does he say?"

"It's a copy of a letter he sent to Masters Carissimi and Schütz, where he talks about the stuff we discussed a few weeks ago.

"The matter of publishing the up-time music?"

"Yep."

Franz moved Marla's feet over on the footstool, and perched on the edge. "What does he say?"

"The gist of it appears to be that they are going to found something called the Grantville Music Trust." Marla flipped through the pages of the letter, looking for a particular section. "The lawyers are still looking into what the best legal form will be, probably some kind of corporation. Everyone who contributes music will be given shares in the trust, but they're still trying to figure out the formulas on how those shares will be calculated. You and I and Masters Carissimi, Schütz and Abati will all have an initial share, plus anything else we can develop. The trust will try to gather as much up-time music as possible, both printed and recorded, in order to publish it on a regular basis."

She looked up from the letter to see a smile growing on Franz's face. "This is good." He took her hand in his. "This is very good. It means that we do not have to feel like it is our responsibility alone to see this work done."

Marla smiled back as she squeezed his fingers. "You're right. And I do feel as if a burden has been lifted."

* * *

"Come in, friend Patroclus, come in." Franz opened the door wide for the encumbered printer to step through.

"Thank you, Franz. I am here with the first set of the . . ." Patroclus was obviously searching his memory. After a moment, his face brightened. "Ah, yes . . . the 'proof' pages as Frau Marla called them."

"Then you had best come this way, for she is waiting your arrival with great anticipation." Franz led the way to the table where Marla sat. She smiled as the men stepped through the door. Patroclus almost tripped, Franz noted, when she turned her gaze fully on him. It was good to know, he thought to himself with a small smile, that he was not the only man she affected so.

"Ah, Patroclus, you brought the proofs. Gimme, gimme." She held her hands out like a small child begging for a treat.

The printer set the wrapped books carefully on the table, then opened his very large leather folio to take out several pages. They were of the cheapest grade paper, what Marla had called "paper towel brown."

"The music fonts have all been identified and designed." Patroclus had a faint air of pride. "You will receive a bill for the jeweler who did the work. We have cast and finished enough to do three pages of

the full score, which I have with me."

"What of the text?" Marla's forehead creased.

"There we were most fortunate, as the font used in your books is very like the fonts my grandfather used to print Latin works when we were in Berlin. My father is unable to dispose of anything from what he thinks of as our family's days of glory, and so I found the type stored in a shed behind our shop."

"Good." The creases smoothed out as Patroclus spread out the proof pages.

"We know that this idea of printing proof sheets for us to review before you do the actual printing is a new thing to you." Franz made sure his voice was warm. "But after hearing the stories from Master Schütz and Master Carissimi about how many times they and others had to manually correct printed books because of serious printing errors, this has to be done. The presentation of these works to, not just the *Hoch-Adel* , but the entire world, is too important for any preventable errors to be allowed."

"I understand," Patroclus sighed. "And in truth, their criticisms were fair. But you must understand that for most printers, music is a very minor part of our business. We do not have literacy in music, like we do words. We must just try to place symbols on the page, and sometimes it is not so easy."

"Musical literacy, huh?" Marla remarked. "Well, I hope you have your best people working this project, because by the time they're done, they will be very musically literate. If you think it would help, however, I can give quick lessons to your typesetters so that they will know enough about the music they're looking at to understand what they are doing." She grinned at Franz. "After all, if I'm going to be teaching basics at the school, I can do it for them as well."

"School?" Patroclus looked interested.

"I'm the new music director at the . . . let me make sure I get this right . . ." Marla took a deep breath. "The Duchess Elisabeth Sofie Secondary School for Girls." The school name all came out in a rush.

"Ah," Patroclus responded. "I have heard of this school. There is much discussion in the city about it. There are those who see women such as yourself," he gave a nod of the head that was almost a short bow to Marla, "and think that perhaps they will avail themselves of this for their daughters. You will be a part of it? You think it will be that good?"

Marla snorted. "It will be that good whether I'm a part of it or not. I know the people who are setting it up and getting it rolling. They're good people. The school will be great."

"Ah." Patroclus absorbed all of that. "My sister, Eurydice, reads and writes well—a printer's child, you see—and she can do some arithmetic, but there is more she should know. She is fourteen, so it is not too late. I will talk to Papa."

"Do that. It will be good for her," Marla said.

They all focused on the pages Patroclus had laid out. "You do understand that when these music books are set in type, you can't take them apart to reuse the type," Franz cautioned. "We expect these to be in demand for years."

"Generations, even," Marla offered.

"That was mentioned in our discussions some time ago." Patroclus was not smiling. "You are paying for the fonts, so that is not an issue. It is the storage that is a problem—that, and the frames. It would take over 200 frames to set and hold all the type for the pages of both the full score and the vocal parts book. We do not have that many. There may not be that many in all of Magdeburg."

"Can you build more frames?" Marla asked.

"Given time and money, of course we can. But even if we had the frames, we have no place to store that many." Franz opened his mouth, only to be overridden by Patroclus. "And you are not paying us enough to move."

"What do you suggest?" Franz got his question in.

"There are two things you need to consider. First, you—we—will not have exclusive editions of whatever works you publish forever."

"What do you mean?" The creases were back in Marla's forehead.

"Once they see the demand for them, other printers will copy your works and produce their own editions. I agree that the music font will be a problem for them, but they will do it. They will not be as good as ours, naturally." Patroclus smiled. "But they will find buyers."

"And this is legal?" The creases were now valleys.

"Yes. Oh, it is not considered ethical by many, but it does happen. Once the war is over and some measure of prosperity returns for both book readers and printers, it will happen more frequently."

"Copyright laws," Marla muttered. "Gotta get ahold of Mike Stearns or Ed Piazza and talk about copyright laws."

"You mentioned two things?" Franz asked

"Yes. The second is to determine now how many copies you wish to print. Printed signatures can be stored easily, particularly if they have not been bound yet. And the more we print, the less expensive the per copy cost becomes as the setup costs are spread across the total number of copies."

Franz looked at Marla. She looked at him. They raised their eyebrows at each other. "We will talk to the others about this," he said after a moment. "Meanwhile, we should finish the proofs, so that you may return to your shop." They all looked to the table again.

"This is the title page, about which I have two questions." The printer looked at them, and Franz motioned him to continue.

"First, who is this Carl Fischer, Inc. who is mentioned at the bottom of the page?"

"Actually, that was the up-time publisher who produced the full score," Marla replied. "And it wasn't a person, it was a company."

"Ah. So the G. Schirmer, Inc. on the vocal parts book is also a publisher?"

"Correct."

Patroclus pulled a pencil out of his pocket, and made a note on the sheet. "So, we can replace their names with ours."

"And the Royal Music Academy, and the Grantville Music Trust." Marla made sure those weren't left out.

"As you say." Patroclus made more notes, then looked up. "There were two publishers for the same work?"

Marla laughed. "Oh, yes. Remember, in the up-time, this was over two hundred and fifty years old. Handel and his family were no longer around to care. There were probably more publishers than that who printed this work. These were just the publishers of the copies in Grantville."

The printer thought about that, then shrugged. "As you say. My other question is, exactly what was the name of the composer? The full score and the cover and title page of the vocal parts book say Handel, but the introduction to the vocal parts book says Händel. Those are two very different words in German." Patroclus jotted them on a blank space on the sheet, but Franz had definitely heard the difference.

"Umm." Marla put her finger to her lips for a long moment. "I read something about that. Oh, yeah . . . if I remember correctly, Händel is the correct name, but he changed it to Handel after he settled in England. Seems like the English kept forgetting to include the umlaut when they printed his name, and outside of the royal family most of the English didn't know how to pronounce it. I guess he gave up fighting it. Made a virtue out of necessity, maybe."

"So, how should we do it now?"

"He was German, right? We're in Germany, right?" Both men nodded. "Then it's Händel." Patroclus penciled more notes on the title page. "Something small we can do right the second time around."

And with that, they began reviewing the music pages.

* * *

Lady Beth looked down at the class schedule she and Marla had just finished creating. "Okay, so you're going to teach one class of choir for now, one class of senior theory and one class of junior theory, all scheduled before noon. Casey will take the other two classes of junior theory. Hopefully by the time the enrollment grows enough to stretch those classes past the limits, we'll have some answers back from Grantville about someone taking us up on our job offers. I got some names from Wendell and sent some telegrams off right away."

Marla started gathering her notes. Lady Beth took advantage of the break in the conversation to change the subject. "Have you started your Latin yet?"

" *Amo, amas, amat.*" When their laughter was done, Marla looked to Lady Beth. "One last thing . . . I've already been approached by families wanting private music lessons for their daughters. What's the school's policy going to be on that?"

Lady Beth leaned back in her chair, ran her hands through her hair—catching the pencil as she dislodged it from behind her ear—and sighed. "The school doesn't have a policy, because I haven't given it much thought. What do you suggest?"

"You can either count it as an elective within the curriculum, charge the fees and pay me, or you can let me arrange things directly with the families and they can pay me."

"Hmm . . . I think for now let's have them connect directly with you. As time goes by, we can incorporate that into the formal curriculum if we want or need to."

"Fair enough," Marla replied. She started to stand, only to settle again when Lady Beth raised a hand to stop her.

"Are you planning to give the lessons at the school?"

"Yes."

"Hmm . . ." Lady Beth hummed a lot when she was thinking. "That means you'll be using school facilities, maybe school supplies, school piano. I think the school needs some slight compensation."

Marla looked a bit wary. "I might agree to that. How much are you thinking of?"

"Twenty-five percent."

Wariness gave way to another frown. "Nope. Too much. I might go five."

"Twenty."

"Seven."

"Fifteen."

"Nine."

"Twelve."

"Ten, and no more, or I'll teach them out of my house." Marla's tone was rock solid.

Lady Beth smiled. "You always were the most stubborn girl I knew. All right, agreed on ten percent, based on your receiving the payments from the families. How many of the girls will you take?"

"I can give an hour a day per week. Figuring a half hour lesson, which is all that most of these girls would have the stamina for, that's ten girls. However, if you want to let our agreement stand as a model, Master Andrea could take quite a few more, maybe up to twenty a week."

Lady Beth whistled. "You don't plan by halves, do you, my dear?"

"I told you my goal—I want women in music, and I want it in this generation. This is where I'm going to start."

"Agreed. And if we're going to allow adjunct private music lessons, we really ought to offer more than voice. What do you recommend?"

"There's no reason why the same model wouldn't work for all the music tutors. I could take a mix of voice and piano, maybe modern flute as well. Hermann Katzberg could teach piano, harpsichord, and possibly the lap harp. I'm sure that Franz could provide a list of men from the orchestra who would teach the various strings." She quirked her mouth sadly. "I wish we had someone to teach guitar."

Lady Beth let the silence grow for a moment. It was obvious that Marla still missed her brother Paul. "If you'd ask Franz, I'd appreciate it," she said at length.

Marla took a deep breath and nodded. Once again she gathered her things and this time she stood. Lady Beth stood as well, holding out her hand.

"I'll see you Monday morning, and we'll get you started." Marla shook hands with her, and started for the door. "And Marla . . ." The younger woman looked back over her shoulder. "I'm really glad you're going to be working with us."

An expression of pleasure crossed Marla's face.

"Thanks, Lady Beth. I'm really glad to be here."

## *October, 1634*

"Marla!"

On her way out of the Duchess Elisabeth Sofie Secondary School for Girls, focused on her afternoon schedule, Marla Linder at first didn't react when she heard her name called. When it did register, she turned and waited for the woman who was approaching her.

"Hi, Amber. What are you doing here?"

Amber Higham stopped beside Marla and looked up at her. "I had several items of business in Magdeburg, so I got a substitute teacher for my classes and made the trip."

"So what have you accomplished so far?

"I took a look at the plans for the new opera house to see if I could see any problems from a performing point of view."

Marla grinned. "Yeah, that's exciting. I can't wait for that to be done. They promised some time next year." She laughed for a moment. "Notice me not holding my breath, though. I remember when the builders ran so long with the addition to the high school my freshman year. So, what else?"

"I just sat in on a discussion between Abbess Dorothea and Lady Beth. The Abbess let it be known she is pleased with the progress the school is making."

"That should make Lady Beth feel good. How long are you going to be in town?"

"I leave tomorrow—I have to be back for homecoming and stuff."

"Ah, yes. Can't miss that."

Amber cocked her head. "So, how are you doing? I hear you're pretty busy these days."

The two women turned and started toward the door.

"Busy . . . that's too mild a word, I think." Marla snorted. "I thought I had a pretty good idea of what this school stuff would be like, what kind of demands it would make. I mean, I had assisted with children's choir at church, even taught it some. I had worked with Mr. Wendell as a student conductor, so I thought I had some idea of how to prepare for that. I had the training to be a teacher after the Ring fell. And I walked that bunch of hard-headed Germans through the history of up-time music last year." The two women shared a smile at that, since the "hard-headed Germans" were Marla's husband Franz and several of their best friends. "But having three sets of preparation to do, plus teach the lessons, plus work on my own repertoire, has turned out to require more time than I thought it would. I've got to spend more time on the Reinecke piece, or I'll never be ready to play it next year."

"Is that the *Sonata "Undine"* that Heinrich mentioned?"

"Aha! The truth comes out. You came to see Master Schütz." Marla smirked at Amber, who wrinkled her nose back at the younger woman. "Yeah, that's the one." Marla opened the door, and they stepped out into the brisk autumn air. "I only have the music to it because my flute teacher had lent me his copy just before the Ring fell. I heard him play it once, and just absolutely fell in love with it. But it is *so* hard. I've been practicing for months, and still haven't got the first movement right."

Amber shivered, wrapping her coat around herself. "I think I've heard it done. As I recall, it sounded like a bear. Can you learn it in time?"

"I will do my dead-level best. If I can't play it, it won't be because of lack of trying." Marla tried to calm her doubts with outspoken assurance.

"Then you will succeed." Amber's matter-of-fact acceptance gave Marla a lift. "So, how do you like teaching?"

Marla smiled in a grand way as the two women started down the steps. "Oh, I love it, even with the demands on my time. I've got over fifty girls in the choir now, and it's so much fun. They're still learning to read music and to follow my lead as a conductor, but they're making real progress. We're working on music for a Christmas concert."

"That's good," Amber responded. "How are you voicing them?"

"Soprano and alto, for now. After the first of the year, I'll go to soprano I and II and alto. And my poor alsos, as well."

"Alsos?"

Marla could hear Amber's eyebrows lifting, even though she wasn't looking at her as they walked along.

"Yes, the girls who can't sing soprano or alto. They just sing also. I have one girl that seems to be a hopeless monotone, and two, no, three who haven't learned how to sing what they hear." She shuddered. "It's actually worse when they're almost on pitch than when they're not. At least when they're wandering they might accidentally stumble on a harmony."

Amber reached over and patted her on the arm.

"I'm sure you'll do fine, my dear."

"I'll have them for several more years, so maybe I'll get through to them before they leave."

They stopped at the door to Amber's carriage.

"Can I give you a ride anywhere?"

Marla pushed her sleeve up to look at the man's wristwatch strapped to her arm. "Well, actually, I'm running a bit late. If you could drop me by the Academy's building, I'd appreciate it. I really don't want to hear Master Andrea being sarcastic about my being late—again."

"Heavens, we wouldn't want that." The two women shared a smile. "Let's go, then."

It only took a moment to settle in their seats and start the carriage rolling. Marla was enjoying being out of the wind when Amber said, "I meant to tell you, I really enjoyed the performance of Master Giacomo's *Lament for a Fallen Eagle* the other night. I think his new arrangement of it is even more powerful than the original that you did last year."

"Mmm." Marla closed her eyes and smiled dreamily. "Oh, yes." She opened her eyes again and looked at Amber. "Mind you, I'll always have a fondness for the original solo version, since that was basically written for me. However, having the full orchestra accompaniment and getting to sing with Andrea . . . that was as close to heaven as I've been since the day I got married."

"I suspect Master Giacomo was pleased as well."

Marla laughed. "He was like a kid taken to an ice cream shop and told he could have whatever he wanted. I've never seen a grown man almost giddy, before." She laughed again. "It was really funny during rehearsals. He kept trying to be serious, but then the smiles and chortles would leak out."

The carriage ran over a particularly large bump, which stopped the conversation for a moment.

"So," Amber started again, "I hear you're working on *Messiah.* What's your progress?"

"Good. Our printers, the Zopffs, have finished printing the vocal parts books that we require. They've passed them to Mappe the binder, who's finished binding Franz's copy of the score and should finish binding the choir copies next week. Then he'll start binding the presentation copies of the score and part book."

"That's very good. Maybe Mary's music account will stop hemorrhaging silver after that." Amber smiled at Marla's stricken expression, reaching across to pat her arm again. "That's one of the things that Lady Beth and I needed to talk about. It's not that bad, dear. And your idea of having the nobility bid on the autographed copies of the first edition has fed a lot of silver back to us."

The carriage pulled to a stop. Marla exited, then leaned back through the door. "Forgot to tell you. Andrea's pretty much done with the vocal auditions. We start rehearsing as soon as the vocal parts books are ready."

"Now there's cause for a hallelujah."

* * *

Marla opened the door of the house that was the temporary quarters of the Royal Academy of Music, Franz standing behind her. This admitted Friederich Mappe and his journeyman, followed by Patroclus Zopff, all of whose arms were filled with bundles of books.

"We have arrived, Frau Marla," announced the binder, "with the last of the parts books."

"Great! Bring them over here, please." She supervised the placing of the bundles on a side table, then picked one of the books up to examine it. Pages were flipped through, printing was examined randomly, paper binding was tested. The book passed muster with flying colors, and she placed it back in the bundle.

"Good job, both of you. Thank you for a job well done." They shared a moment or two of additional conversation, then the binders excused themselves, leaving Patroclus behind.

"Herr Franz, Frau Marla," Patroclus began, "we have not been so busy working on your order that we have not heard rumors of new printing machines." He raised an eyebrow.

"So have I," Marla replied. "But those rumors are all I know. I suggest you drop in at the Freedom Arches." Patroclus looked surprised. "Hey, those folks will know everything there is to know about what's happening in and coming out of Grantville. If they don't have one to show you, they'll be able to tell you who to contact."

"Hmmph." Patroclus did not look particularly pleased with that recommendation.

"Is there a problem with that?"

"My younger brother, Telemachus, spends every free moment at the Arches, to the neglect of his work."

"Telemachus," Franz mused. "He is the tall youth who was working the press the last time I was in your shop?"

"The same. And when he does come in from his visits, after turning an unhearing ear to our father's remonstrations he will yammer on about what great work the CoC is doing and how important the new printing devices are, all the while making the most elementary mistakes in setting type. I was almost forced to bar him from working on your commissions altogether." The printer shook his head. "He is my father's despair and our family's burden."

"I would say pray for patience," Marla said, "but scripture says that patience comes from trials. I won't wish that on you."

"Thank you. My poor father reads the wisdom of Solomon daily, but finds little that encourages him."

Marla was about to continue her sympathy when a thought struck her. "Patroclus . . . about the new printing devices . . ." He looked to her with interest. "Your brother is not wrong about those. You might talk to Lady Beth Haygood at the school. She said something about purchasing a mimeograph machine for the school. If that's true, she can tell you who to talk to."

"True." Patroclus nodded with a faraway look in his eye. After a moment, his gaze focused on Marla again. "My father and I, we have decided to print another one thousand full scores and five thousand part books."

"Wow." Marla was impressed. "So you're going to go for it, huh?"

"To quote Caesar, 'The die is cast.' Or it will be as soon as we start printing."

"So, what made you decide to commit to this?" Franz asked.

"The timing." Patroclus pulled at his beard with ink-stained fingers. "The next Leipzig book fair will be Easter of next year. By then, the account of your performance will have swept Europe. I will go. Mappe will bind some copies for us, and we will sell either bound copies or unbound signatures." He grinned suddenly, rubbing his hands together. "We will sell many copies, and many printers will want to become our friends." They returned his smile.

Marla expression changed as a thought crossed her mind. "A moment, please, Patroclus." She turned, dug a book out of her portfolio and thrust it in his hands. "This is the next thing the Grantville Music Trust wants you to publish."

Patroclus stared at a garish lavender binding with an unusual font splayed across the front cover. Marla watched as he deciphered the text and sounded out the words.

" *Elementary Harmony*. Second edition. Robert W. Ottman." He opened the cover and flipped through the pages. "A treatise of some sort, I take it?"

"Exactly," Marla responded. "This is the distillation of musical art from the up-times. I—we—expect this

book to be even more influential than *Messiah* . You want to set this up and start printing lots of copies. Take it to your Leipzig fair. You'll sell a *lot* of copies of this one."

"One wonders," the printer closed the book, "since this volume is entitled *Elementary Harmony* , if there is a companion volume devoted to, shall we say, advanced topics?" He looked sidelong at Marla.

"Of course there is," she laughed. "And next year we'll ask you to print it. But we want this one to set the stage and tempt people to buy it. It will make an even bigger splash."

"Indeed." Marla didn't miss the glitter in Patroclus' eye. "We shall endeavor to, ah, splash with fervor." They shared a moment of laughter.

Patroclus stopped smiling. "Umm." He was obviously hesitant about whatever it was he wanted to say, but worked himself up to speaking. "About Eurydice . . ."

"Your sister," Marla prompted.

"Yes." The printer started to pull at his beard again. "Is she . . . you have selected her . . . my father . . ."

Marla started to smile again. "Your father is concerned about the propriety of your sister singing in the community choir for *Messiah* ."

"Yes." Patroclus sagged in obvious relief that he hadn't offended one of their best recent customers.

"You tell your father that Gerde Drechsler is also singing in the choir."

The printer's eyes widened. "The daughter of the goldsmith?" A very well-to-do and influential man in Magdeburg, Herr Drechsler was.

"Yep. You think that will make your father a little more accepting?"

"I believe so."

"Of course, I can talk to him, if you think it would help."

"Oh, no, Frau Marla, that will not be necessary," Patroclus hurried to say.

Marla bit back a grin.

* * *

The fuse was lit the next evening.

Franz followed Marla and Master Andrea into the room where the choir would rehearse, his precious new copy of the full score of Händel's master work under his arm. He took a seat to one side as Andrea called everyone to order.

"Attention, everyone!" Andrea's voice cut through the clamor rather well, Franz noted, without becoming shrill. "Please sort yourselves out . . . sopranos to my left, then altos, tenors and basses."

There was the sound of shuffling feet as places were adjusted. The noise level dropped to whispers after

everyone found their group.

"Welcome. As you know, I am Andrea Abati, one of the two vocal leaders for this work. And this, as most of you know, is Frau Marla Linder, the other vocal leader."

Franz watched as Marla stepped forward.

"Right. Call me Marla. We're all here to do the first performance of a masterwork of a great up-time composer. You have been chosen as the best singers available at this time and place. You will work very very hard. All of us will. You will learn notes, you will learn to pronounce English clearly, you will sing and rehearse until you are ready to drop from exhaustion. We all will. But make no mistake about it—we will do our very best." The expressions on some of the faces that Franz could see were mixed. Some were smiling in anticipation. Some were confused. A few were frowning. "And when we are done, you will have the satisfaction of knowing that you have participated in something truly historic. In years to come, you will be able to brag to your children and grandchildren that you sang in the first performance of *Messiah.* "

A hand went up in the midst of the group of tenors.

"Frau Marla?"

"Yes?"

"When will we perform this?"

"The week after Christmas."

"Then why are we starting so early? I mean, it is a long work, but even something like this would only get maybe three weeks rehearsal time in the Elector's court."

Franz saw Marla start to respond, but she stopped when Master Andrea looked at her and raised his eyebrows. She nodded, and the Italian master faced the questioner. "And what type of performance was produced from that rehearsal?" His cool soprano voice was straight toned; no sarcasm was to be found, which surprised Franz somewhat. Andrea possessed a tongue that could be razor sharp at times. "Was it perfect? Was it powerful? Or was it only acceptable?"

There was a moment of silence, before the other man was heard to say, "Acceptable."

"This I have observed from watching Herr Sylwester work with the orchestra." Andrea bowed slightly in Franz's direction. "Every performance benefits from as much rehearsal as possible. Our goal is not to make acceptable music. Our goal is to make great music. To make great music requires great commitment. We call you to that now."

"What he said," Marla added when Andrea turned to her. "Now, we are going to hand out the part books. You will be responsible for their care and protection, and for having them here at rehearsals." She looked at them from under lowered eyebrows. "And heaven help you if you lose or mangle your copy. As much as these cost, I will *not* be happy." Although Marla bared her teeth in what appeared to be a grin, Franz didn't see anyone smiling back at her. It appeared the singers had assessed her attitude and were taking her seriously. That was a good thing in this venue . . . conducive to continued good health and longevity of life.

The next few minutes were occupied by numbering books and assigning them to singers. At length Marla placed the assignment sheet in her portfolio, then turned to where the singers were assembled. Franz watched as she scanned them.

The forty-eight singers were arranged in their sections as Master Andrea had directed them initially. Franz smiled a little—the mixture of boys and women in the sopranos and altos would probably generate some little comment. He remembered Andrea saying that he would accept a pig for the chorus if it could sing to his satisfaction. Well, apparently a pig had not tried out, but there were three boys in the upper parts, as well as a woman standing with the tenors, trying to ignore the sidelong glances she was getting from the men.

"Master Abati tells me that you all can read music to some degree. I know that the style of the notes will be somewhat strange to you, but I promise it will not take long for you to get comfortable with them.

"I will be directing the choir rehearsals, and Master Abati will be working with the soloists. Those of you who are interested in singing solos should speak to him after tonight's rehearsal."

Marla looked around again. "Right. Let's get to it, then. Open your books to page 16. We will begin with the chorus 'And the Glory of the Lord.'"

Franz already had his full score open to that selection—page 19, in his book—and had his pencil and paper ready to take notes. He had already faithfully copied the penciled notes from Marcus' original score to his; all the little instructions about who to cue for an entrance and when, comments about tempo and dynamics, even the circles around some of the printed musical directions. Having done that, he was now ready to begin developing his own additions to those notes from watching Marla work with the choir. Once the singers began working with the orchestra, they would be following him, not her, so they needed to see the same approach.

True to her word, Marla worked them hard, first taking each vocal section through their notes several times with Hermann Katzberg playing their parts on the harpsichord. Toward the end of the evening, she finally had them try it all together at a tempo rather slower than the *Allegro* called for in the music. Even so, Franz could see widened eyes among some of the singers as they began to feel how this chorus should sound with the contrapuntal entries passing back and forth, leading up to moments of true chorale structure, then returning to the counterpoint. The grand *forte* choral entrance of "And the glory, the glory of the Lord" in the middle of the piece was so together, so strong, that the hairs on the back of Franz's neck stirred. And no sooner had those hairs settled down than they started standing again as the lower voices thundered "For the mouth of the Lord, the mouth of the Lord . . ." and were joined by the higher voices in the *fortissimo* "Hath spoken it."

Their eyes were glued to Marla, who held them there with her hands for a long moment. Finally she dropped her hands, to the sound of sighs and breath whooshing out of lungs as the singers released their tension. Franz relaxed along with them

"Good job, folks. That's a good start. We've got a fair amount of work to do on it before it will be ready, but that's not bad at all for one night's rehearsal. We will see you in two night's time." The others began stirring around, only to stand still as Marla spoke one more time. "And remember, you don't own those books. You really don't want to know how upset I can get if you lose one."

Franz watched Marla wave at Patroclus, come to walk his sister home, then turned away as the singers picked up coats and headed for the exit. The four of them—Marla, Franz, Andrea and Hermann—walked around, blowing out lamps and snuffing candles. Franz could see that evening

rehearsals could get a bit expensive. When he voiced that thought, Andrea replied with, "Three of our singers are students in Marla's academy."

"Not mine," she interjected. "That's Lady Beth's school."

"Very well, the redoubtable Frau Lady Beth Haygood's academy, then. And several of the men work during the day. Dietrich, for example, works as a weaver. So we must accommodate them."

"Dietrich?" Franz asked, intrigued by the tone of Andrea's voice.

"Dietrich Fischer . . . the man in whom I may have discovered the voice that can do Iago."

Franz and Marla rolled their eyes at each other. Once the ground had been broken several weeks ago for the Royal and Imperial Opera House—more familiarly known as "Mary's Opera House", because Mary Simpson had done the initial planning and raised the commitments for the funding—Andrea's obsession for a staging of Verdi's *Otello* had become, well, obsessive. He had managed to convince those who had a say in the matter that it would be the premiere work for the hall. Now he was searching for voices, and in the process was at times driving his friends to the brink of uncontrollable urges to commit mayhem.

"Dietrich Fischer—the big hulking guy on the right?"

"The very one."

"He is that good?" Hermann asked.

Andrea shook his head. "No. He is at the moment very little more than raw talent that has learned to make a note or two. But he could become that good." He gave a slow smile. "And I will see to it that he does so."

Franz looked to Marla and Hermann. They all shrugged in a unanimous show of commiseration for the soon-to-be-harried Dietrich.

* * *

Franz looked up from his conversation with Matthaüs Amsel as Isaac Fremdling entered the orchestra rehearsal room. Seeing Isaac brought a smile to Franz's face. Isaac was second only to Matthaüs as a violinist, which meant that Franz had included him as part of the orchestra draft for *Messiah.* He opened his mouth to greet his friend, but closed it as Isaac's expression and lack of instrument registered.

"Where is your violin?" Matthaüs asked the question that was foremost in Franz's mind.

"At home," Isaac answered. "Franz, I will not be able to play for you in this work."

Matthaüs started to expostulate, but ceased when Franz held up his hand. "Why not?" was his simple response.

"Franz, who am I?"

"Isaac, one of my very best friends." Franz wondered where this was going.

"And?" Isaac was looking at Franz with expectation.

"One of the finest musicians that it has been my very great pleasure to know, hear and play with."

"And?"

The light finally dawned in Franz's mind.

"You are your father's son."

"A Jew, not to put too fine a point on it."

Franz nodded slowly.

"I cannot play or sing in this work. I am sorry." And from the expression on his face, Isaac was indeed regretful. He looked to say something else, but shrugged instead and looked to Franz with a bit of nervousness in his expression.

Franz stood for a moment, then held out his hand for Isaac to grasp. "As you will, my friend. There will be other music to play. Until then."

Isaac wrung Franz's hand strongly, opened his mouth as if to speak, then shrugged again. He touched a hand to his forehead, then turned and left.

Franz and Matthaüs stared after him. After a moment, Matthaüs stirred.

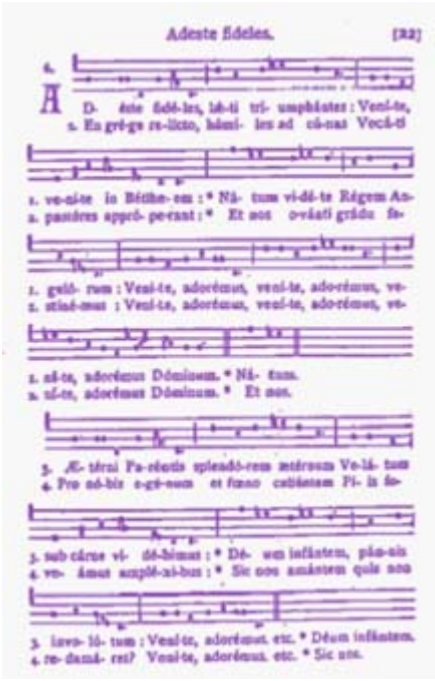
"Will you let him return later?"

"Of course." Franz stared at his other friend.

"Many of the other musicians will mutter and criticize him and you."

"They have not the right." Matthaüs started to object, but Franz held his hand up again. "You know his story. I know you do, for I told it to you." Matthaüs nodded, remembering the story of a son declared dead. Remembered, too, how he had shivered when he heard it. "Until the others have paid the kind of price Isaac paid for his music, they have not the right to complain or criticize." Franz quirked his mouth. "And besides, religious toleration is the rule now, remember. Isaac has the courage to stand by his convictions. We should have the courage to respect that."

* * *




Marla looked out at her girls. "Right. Now that you can read music reasonably well, the Duchess Elisabeth Sofie Secondary School for Girls choir is going to have a Christmas concert." *That* started a buzz in the ranks. "You're going to learn a lot of new songs, and you'll like most of them." She pulled a sheaf of paper out of her portfolio. Here's the first one."

The next few moments were taken up by the whisper and crinkle of paper being passed. Here and there a giggle punctuated the process.

"Take good care of those pages." Marla hid a grin as she noticed the girls rubbing at the ink on the paper and sniffing it. She'd always hated mimeographed stuff when she was in school, but now that she was on the other side of the teacher's desk she was ever so thankful that Lady Beth had managed to score one of the precious new machines. It had arrived just in time to speed up the music preparation for the choir process quite a bit, and right now she needed every edge she could get. Her already maxed-out schedule was now officially over the line into insanity, what with conducting the *Messiah* choir rehearsals four nights a week.

One of the girls held up a hand.

"Yes, Albreda?"

"This song is in Latin, Frau Linder."

"Yes, it is. And it won't be the last song you see in Latin, either. For that matter, we'll learn songs in French and Spanish for this concert, as well."

"But I'm not very good at Latin, and I don't know French or Spanish at all!" Albreda was looking a little panicked. Marla remembered that she was one of the scholarship girls. Her father was a mere accounting clerk for one of the master weavers, and she probably hadn't been exposed to other languages much.

"Ah, but you are taking Latin," Marla responded. "So that will help. And for those of you taking French or Spanish, singing songs in those languages will help you learn them. It won't be hard. Promise."

Albreda settled down somewhat, although her eyes were still a bit wide.

"Okay, everyone sing the melody this time through." Marla played an introduction on the piano, nodding where she wanted them to begin. The voices were unsure at first, but after a couple of beats they all came in.

" *Adeste fideles*
*Laeti triumphantes*
Venite, venite in Bethlehem . . ."

* * *

Franz looked to Ralf and Emil. "You are the lead trumpeters. Do you want to play this with the new instruments or the old? I care not, so long as you can play it in the right key."

The two men looked to each other for a long moment. Ralf, the older of the two, finally shrugged. "Let us try it with the new. If need be we can revert to the old valve-less horns, but I would rather have the valves and tuning slides."

"Then get ready, if you will."

The two musicians walked back to their seats. The rest of the orchestra ceased their conversations almost immediately, waiting expectantly. Franz waited until Ralf and Emil were seated and had their instruments in their laps before he stepped onto the podium.

"Section 12, if you please." He waited for pages to finish turning, until he could see everyone's eyes. Once he had their attention, he raised his hands. Instruments were raised to the ready at that signal. The tip of his baton gave very small movements as he counted, "Two, three, four . . ."

The broad downbeat of the *Andante con moto* beginning of "For Unto Us a Child is Born" sounded, and Franz led them onward.

* * *

"No, no, no!" Marla stopped the chorus with a jerk. For a moment, she looked around for something to throw, but by the time she found a pencil her self-control had reasserted itself. "That's not right. It's got to

be lighter than that." She searched for an example until a mental light came on.

"How many of you folks saw *A Falcon Falls* when the ballet company staged that three months ago?"

Most of the almost fifty *Messiah* chorus members raised their hands.

"Good. You know what you sound like?" Heads shook across the front of the choir. "You sound like those clog dancing soldiers, all heavy feet and no bounce." That got a bit of a laugh.

"You remember how the ballet dancers danced, how they seemed to just barely touch the floor. That's how you must sing right here. You must dance this line, dance it lightly. There will be a time later to be strong, but right here . . . dance it with your voice." Faces showed comprehension, which encouraged Marla. She raised her hands. "From the beginning."

She gave the downbeat for Hermann on the piano, and on the second off-beat the sopranos entered, as lightly as ever she could have wished.

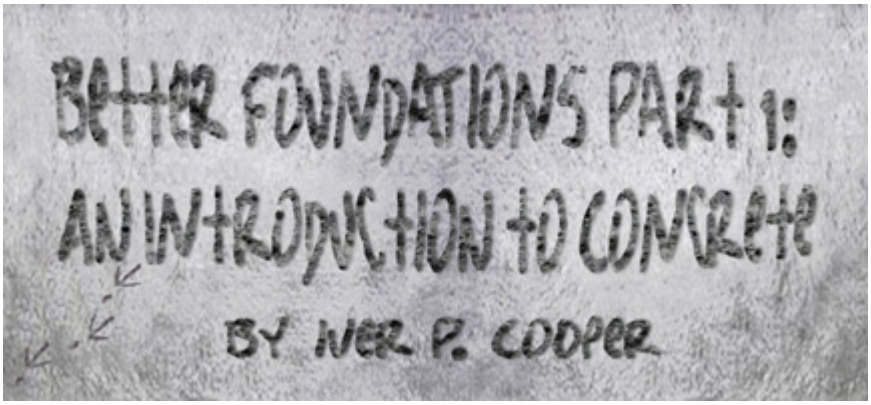
*"And He shall purify,*
*And He shall purify . . ."*

"Yes!" She surrendered herself to the flow of the piece.

* * *

# Better Foundations, Part 1: An Introduction to Concrete

## Written by Iver P. Cooper




Concrete—"Liquid Stone"—has made possible many innovations in architecture. Yet concrete is no Space Age *wunderkind* ; it has its roots in antiquity. Concrete, albeit of a kind inferior to the modern product, was used by the Romans in the construction of the Pantheon, which has endured since the time of the Emperor Hadrian.

While the Roman concrete structures endured, concrete technology languished after the fall of Rome. The seventeenth century is still the Dark Ages so far as concrete is concerned. But the up-timers will bring about a "Concrete Renaissance" in short order.

## *What Is Concrete?*

Concrete is a composite material, made by combining an aggregate (a hard particulate material) and a cement (a matrix forming material) with enough water to cause the cement to set and bind the aggregate together. The binding is the result of the chemical reaction of the cement with the water. The aggregate is a combination of fine aggregate (sand) and coarse aggregate (e.g., gravel).

Mortar is a paste-like mixture of sand, a binder (e.g., cement) and water. It doesn't contain coarse aggregate, but of course the mortar is used to bind together cut stones or bricks, and to fill in gaps between them. Those stones and bricks are much larger than the coarse aggregate of concrete.

## *Concrete and Cement in Canon*

We know that when Grantville made its involuntary journey into seventeenth century Germany, some concrete construction came along for the ride. Mark Huston's "Gearhead" ( *Grantville Gazette*, Volume9) mentions "a pair of concrete bridges." There is a concrete floor in the building which Chad Jenkins has converted to a shop for washboard manufacture, see Rittgers, "Von Grantville" ( *Grantville Gazette*, Volume7). There is also a concrete floor at the farm where Harmon Manning suffered his ultimately fatal fall, see Ewing, "An Invisible War" ( *Grantville Gazette*, Volume 2). Pam Miller has a concrete porch, see Vance, "Protected Species" ( *Grantville Gazette*, Volume13). The high school has a concrete "awning" over the entrance, see Flint, *1632* , Chapter 11. And there is at least a concrete slab in the Grantville city jail, see Weber, "The Company Men" ( *Grantville Gazette*, Volume2).

Concrete was used in the displaced West Virginia mine featured in Mark Huston's "Twenty-eight Men" ( *Grantville Gazette*, Volume10), in a wall separating the working and non-working sections of the mine. The wall was built out of concrete blocks, and thus, even if the wall was assembled after the Ring of Fire, the blocks themselves may have been cast up-time.

Since the Ring of Fire, there has been some new concrete work. Sometime before March 1632, Delia Higgins sold the remaining dolls in her collection, and used the proceeds for two projects. The first was building a warehouse. Her intent was to build a concrete warehouse, a "work of art", with "the best combination of up-time and down-time construction techniques possible." Gorg Huff, "Other People's Money" ( *Grantville Gazette*, Volume 3)(timeframe March-October 1632). What she got was, "if not exactly a work of art," a structure which "was functional, and very large." It was built with "fairly standard down-time construction techniques, with concrete pillars added for support."

In the process of trying to persuade the high school chemistry teacher, Alexandra Selluci, to help with the warehouse project, Delia got talked into becoming the "sugar grandma" for the Grantville High Tech Center's "brand new concrete research program, complete with structural engineering courses where the teachers were half a chapter ahead of the students, or sometimes half a chapter behind." In Delia's opinion, "the kids that had gone into concrete were phenomenal. They were about four to one down-timer to up-timer, about average for the high school. They wanted to build things. Great big things, dams, skyscrapers, and roads, and were willing to work at it."

Later in OPM, Delia reveals that she saw the warehouse as a stepping stone to a grander project, the Higgins Hotel. "The concrete program at the school was developing a group of young people who could make structural concrete, and form it into structures that would support tremendous weight. Hiring Michel Kappel was done both to get a down-time builder familiar with up-time building techniques, and as favor for Karl Schmidt. Claus Maurer was a master builder with more experience than Herr Kappel, but again, part of the reason for hiring him was to get him familiar with the available up-time tech. It wasn't her fault that they had fought with each other and with the teachers at the tech center and Carl over at Kelly Construction. Besides, materials were so expensive that the cheapest halfway decent material was quarried granite from the ring wall."

By December, 1631, the high schoolers are working on "some sort of concrete project," and mortar is available. See Huff and Goodlett, "Birdie's Village" ( *1634: The Ram Rebellion*). In Cooper, "Stretching Out, Part One: Second Starts" ( *Grantville Gazette*, Volume11), there is a passing reference to an equally mysterious "concrete project" which is apparently looking for venture capital in July 1633.

By July, 1633, the conservatory at the new hospital has "cement paths" (people often confuse cement and concrete, cement is a *component* of concrete). See Ewing, "An Invisible War" ( *Grantville Gazette* , Volume2). I can't help but wonder whether the hospital itself, a three story building completed a year earlier, is of concrete construction.

The Higgins Hotel is at least partially built as of summer 1633, see Cooper, "Stretching Out Part 1" ( *Grantville Gazette*, Volume 11) and "The Chase" ( *Ring of Fire II*), but the stories don't say whether it used concrete.

Somewhat inconsistently, in the Friends' "Burgers, Fries, and Beer" ( *Grantville Gazette*, Volume7), set in January 1634, Julio Sanabria wonders where he would get the cement, fire clay, and lime he needs in order to put his masonry tools to use. You can't make concrete without cement, and concrete was already being made.

The Grid lists a concrete company, started by William Roberts and his brother Ronald Chapman. Roberts is a managerial type and Chapman worked "for a company in Fairmont as a foreman of a team that built pre-fab metal buildings." The relationship of this company to the high school concrete research lab is unclear. It is possible that the company existed only on paper.

## *Concrete and Cement Knowhow*

Grantville is in do-it-yourselfer territory. There are also going to be a fair number of "how-to" manuals (some even read by their owners), as well as homeowners with hands-on experience making (and repairing, especially those who didn't read the manuals) concrete flatwork (floors, driveways, patios, porches, walkways), foundations, walls and even outdoor furniture. But no pink concrete flamingos, I hope.

In addition, Grantville had at least two general contractors before the RoF, Happy Acres and Home Center (Grid). I doubt that either of them has built a skyscraper, and there isn't much concrete construction in Mannington, but chances are reasonable that they have employees who have worked with concrete.

There were also construction technology courses offered at the Marion County Technical Center. I have no idea which courses were offered in 1999-2000, but the current catalog includes "Basic Masonry and Landscaping," "Foundations and Framing," "Fundamentals of Building Construction," "Masonry and Plumbing," and "Construction Systems."

The up-timers with college engineering degrees are most likely to have attended either West Virginia University or Fairmont State. WVU offers a degree in civil engineering, with undergraduate elective courses in Civil Engineering Materials (CE310), Concrete and Aggregates (CE412), Construction Methods (CE413), Construction Engineering (CE414), Advanced Concrete Materials (CE416), and Reinforced Concrete Design (CE 462). While there is no guarantee that any particular civil engineer in Grantville has taken any of these courses, it is certainly possible.

In any event, there are going to be up-timers who know how to estimate how much concrete is needed for a job, prepare the forms to receive the concrete, put down the steel reinforcements, monitor the pour, and cure the concrete. A smaller number (those who didn't just use ready-mix) will know how to proportion concrete, that is, decide the proper ratios of cement, aggregates and water.

What is less certain is that the up-timers will know, firsthand, how to make cement. Cement is usually bought ready-made and even a building contractor needn't have firsthand knowledge of cement manufacture. If any up-timers do, it is probably because they worked in a cement plant outside Grantville. An EPA ranking of Portland cement plants, by size, listed Capitol Cement, in Martinsburg, in 29th place. That was the only West Virginia listing. (EPA) However, I have found a 1976 reference to the Marquette Cement Manufacturing Co. plant near Fairmont (PSC).

* * *

Grantville, according to canon, has pretty much every encyclopedia you can imagine. "Not just the great one, the 1911 *Britannica* , which they guarded so carefully, but all of them—the later *Britannica* editions, the *World Book* and *Americana* , *Columbia* , and *Funk and Wagnalls* , old and new, large and small." (Flint and DeMarce, *1635: The Bavarian Crisis* , Chap. 5). My understanding is that the public library has the *Encyclopedia Americana* , and both the modern and the 1911 editions of the *Encyclopedia Britannica* . The high school has the *World Book* , and the junior high, the *Collier's* . There's also a nearly complete ninth edition of the *Britannica* , and, I suspect, several CDROM-based encyclopedias, most likely *Compton's* and *Encarta* . Besides having articles on concrete and cement, these encyclopedias have related tidbits scattered across their many volumes, which a sufficiently diligent researcher can uncover.

Grantville is modeled on Mannington, West Virginia, and I have checked the high school and public library holdings for more specific works. North Marion High School has the Time-Life *Masonry* (1977). It and the public library have Kicklighter's *Modern Masonry: Brick, Block, Stone* (1977).

There may also be other relevant books. For example, the high school has Trachtenberg's *Brooklyn Bridge: Fact and Symbol*(1979), and Stevens'

*Dam: An American Adventure*, and concrete was used in their construction.

There is no easy way of determining what books might be in private (home and work) libraries, or at the Voc-Ed Center. Bear in mind that any engineer almost certainly has kept all of his or her college engineering textbooks. Even a retired engineer would hesitate to part with them.

There is also a documented relationship between the North Marion High School of Mannington, WV and LaFarge, an Ohio cement company. LaFarge gave the high school a $300,000 atomic absorption spectrophotometer in 1997 (Zeller). Surely the student research projects developed using the AAS would have included ones dealing with cement. And perhaps the school got some cement technology texts along with the AAS.

## *Down-timers' Cement and Concrete Technology*

Previously, I said that Roman concrete was inferior to modern concrete, and I should explain why. First, it had a compressive strength of only 2800-3000 psi (RomanConcrete.com; Spratt), comparable to the "low end" of the strength range of modern concrete. Secondly, it was not reinforced.

Many sources state that concrete technology was "lost" in the Middle Ages. But I very deliberately used the term "languished" in the introduction. The Normans used concrete in the construction of parts of Reading Abbey (1130), the White Tower of London, and other structures. (Davidovits, May, Ferguson). But Ferguson comments that "concrete in the hands of the Normans was a total failure," and lists a dozen Norman concrete towers which fell down.

Mukerji asserts that the Roman formula for "hydraulic cement" (that is, one which hardens in contact with water) wasn't lost, but rather remained "tacit knowledge" among masons and military engineers, at least in limited areas, so that it was known in, e.g., seventeenth century France. Idorn (38) says that use of hydraulic cement was monopolized by the authorities; e.g., Christian IV of Denmark imported trass (from Dutch merchants) for making hydraulic mortars for his palaces and castles.

In 1568, the French architect Philibrt de L'Orme taught preparing a mortar from burnt quicklime, river sand, pebbles and water, with the pebbles being "of all sizes." (Jackson 23).

A crude form of concrete was apparently used as ballast between the frames in the galleon *Nuestra Senora de Atocha*(1620)(Crisman).

## *The Advantages of Concrete*

Concrete competes as a building material with steel, wood, and brick, and as a road pavement with asphalt. Concrete has numerous advantages as a structural material.

*On-site Fabricability*. The 1911 *Encyclopedia Britannica* (1911EB) says that concrete has "the immense advantage over natural stone that it can be easily molded while wet to any desired shape or size." It has similar advantages over steel and wood. Steel can be cast only at a high temperature and wood not at all. Steel can be bent but only through persistent application of great force, and wood can be bent only gingerly and slowly, to avoid breakage.

*Convenience*. "Its constituents can be obtained in almost any part of the world, and its manufacture is extremely simple." (1911EB).

*Compressive strength*. Like natural stone, it possesses great resistance to compression; its compressive strength is usually 4,000-15,000 pounds per square inch (psi), or higher, of cross-sectional area. (Levy/Down, 279). (In 2000, concrete with a strength of 8,000 psi or higher was considered "high strength"; Nilson 50.) The compressive strength of wood, parallel to the grain, is comparable, perhaps 6,000-7,500 psi, but perpendicular to the grain, wood is much weaker, perhaps 450-1050 (Green). As for natural stones, granites and marbles are stronger (up to 30,000 psi), and soft limestone weaker (700 psi)(Cowan 105).

*Strength-to-Cost*. The figure-of-merit (two-thirds power of strength, divided by cost per unit volume) is 80 for concrete, 60 reinforced concrete, 80 wood, 45 brick and stone and only 21 steel (Ashby 100).

*Stiffness-to-Cost*. The figure of merit (half power of Young's modulus of elasticity divided by unit cost) is 40 for concrete, 20 reinforced concrete and brick, 15 wood and stone, and only 3 steel.

*Stiffness-to-Weight*. For columns which fail by buckling, the figure of merit is the half power of Young's modulus, divided by the density. Steel is 59, but concrete is almost as good, 49 (Gordon 321). So by making the columns just a little thicker, you can use reinforced concrete instead of steel, saving perhaps 99% in steel consumption.

*Fire resistance*. Concrete itself is non-combustible, and has a thermal conductivity about 5% that of steel (PCA). However, it should be noted that with reinforced concrete, the reinforcing steel becomes ductile at high temperature, and since it presumably is there to provide tensile strength, the result may, ultimately, be structural failure.

*Biological and chemical resistance*. Wood rots, and is attacked by termites (or, at sea, teredo worms). Steel corrodes. Concrete isn't vulnerable to these threats, but it can be attacked by acids, sulfates and chlorides (from deicing salts). Special concretes are used for construction in the vicinity of high-sulfate soil (or groundwater). And of course the reinforcement in reinforced concrete can corrode if corrosive agents can reach it.

*Temperature stability*. A concrete wall or floor will absorb heat during the day and re-radiate it at night. That's true of any material, but concrete has a greater "thermal mass" than wood (HousingZone). (An interesting variation is a panel with a lightweight thermal insulating material sandwiched between layers of concrete.)

*Soundproofing*. The airborne sound insulation of a concrete first floor is 9-22 dB higher than that of a timber floor ("Going Up").

## *Disadvantages of Concrete*

*Low Tensile strength*. Unfortunately, concrete's tensile strength (resistance to being pulled apart) is only about 10% of its compressive strength (Twelvetrees 41); Gordon (44) quotes a value of 600 psi (whereas commercial mild steel is 60,000 and high tensile engineering steel is 225,000). Because plain (unreinforced) concrete is strong in compression and weak in tension, it can be used in columns, arches and domes, but not in beams (horizontal structural members).

*Low Compressive Strength-to-Weight Ratio*. If we divide the compressive strength by the density (~2), we get values of about 2000-7500 psi/unit weight for unreinforced concrete. For steel, despite its greater density (~7.5), we get values of 4800-8000 (Twelvetrees 31).

*Flexural strength*. Concrete is not good at resisting failure from bending; its flexural strength is perhaps 12-20% compressive strength. (Cadman).

*Brittleness*. Concrete is also brittle, that is, once cracked it is easily fractured. The "fracture toughness" of concrete is 0.2-1.4, compared to 0.7-0.8 for soda lime glass and 50 for steel (Matt Gordon).

*Shrinkage and Expansion*. Freshly laid concrete shrinks as a result of the chemical reactions between its ingredients, the evaporation of water from the concrete, and the rising of air voids to its surface. Once hardened, concrete expands and shrinks in response to changes in temperature and moisture levels. Of course, all these dimensional changes stress the concrete, perhaps causing cracks.

Fortunately, if concrete is reinforced with a material, like steel, which is strong in tension, and ductile, it becomes an all-purpose structural material.

# *CONCRETE COMPOSITION*

We start by reviewing the ingredients of concrete: cement, aggregate and water. Cement itself is a complex material. Once we know what goes into both concrete and cement, we can consider how concrete is mixed, laid, cured and tested.

## *Cement*

Cement, in essence, is a binding agent. It can be used in mortar or in concrete. Cements are traditionally classified as being either *hydraulic* (those which, at least after setting, are resistant to water) or *non-hydraulic* (those which must be kept dry). The term "hydraulic" also has come to imply that when first mixed with water to make concrete, the cement reacts chemically with the water, forming hydrates which help bind the aggregate. (These hydrates are themselves insoluble in water, thus conferring the water resistance.)

The *pozzolanic cements* result from the mixture of a source of calcium (usually lime) and a source of silica (possibly also containing alumina). The lime is derived by heating chalk or limestone (calcium carbonate); the process is called calcination. The lime may be either the highly reactive quicklime (calcium oxide) or the somewhat less reactive slaked (hydrated) lime (calcium hydroxide), the latter being obtained by reacting quicklime with water.

*Portland cements* likewise are derived from a mixture of calcium- and silica-rich materials, but this mixture is subjected to a further calcination at a high temperature.

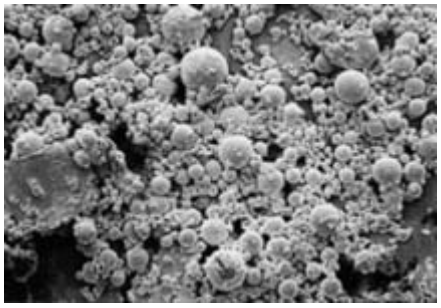
The *natural cements* are prepared from a source material which naturally contains both lime and silica. Hence, no mixing step is needed. Like Portland cements, it is calcinated, but at a lower temperature than that typical in Portland cement production. (Eckel, 151).

*High-alumina cements* are made from limestone and low-silica bauxite; they were invented in 1908.

In the twentieth century, the commercially dominant hydraulic cement was "Portland cement." However, we will first discuss the older pozzolanic cements.

# *Pozzolanic Cements*

A *pozzolan* is a source of silica (silicon dioxide) which can react with lime to form a cement. A material can contain silica but not be useful as a pozzolan. For example, most sands contain silica, yet are unreactive. Moore says that this is because they have a tightly bound structure which frustrates the reaction. (Sands are used in concrete, but as aggregate.)



The ancient Roman cement, which is pozzolanic in nature, is described in Marcus Vitruvius Pollio's *De Architectura* , Book II. This classic text became available to Europeans, in Latin, Italian and German printed translations, in the fifteenth and sixteenth centuries. There is also Sir Henry Wotton's *The Elements of Architecture* (1624), which is derived from Vitruvius.

The first known post-Roman use of a pozzolanic cement was in Italy. The Venetians used the "black lime of Abetone" in the fifteenth century, and the Roman pozzolana was used by Fra Giocondo in the mortar of the pier of the Pont de Notre Dame in Paris (1499). (Giocondo published an edition of Vitruvius in 1511.)

Vitruvius refers to "rubble work," with stones mortared together. In chapters 4-5, Vitruvius says that one may mix sand (a silica source) with lime to make mortar. He recommends use of three parts sand to one of lime when the sand is from a pit, and a two to one ratio if the sand is from sea or river. According to Moore, Vitruvius' "pit sand" is actually volcanic ash, specifically, *pozzolana* .

*Pozzolana*. The eponymous *pozzolana* is a volcanic ash discovered at Pozzoli, near Vesuvius, but also

found elsewhere in Italy (including near Rome). The 1911 Encyclopedia Britannica article on "cements" gives compositions for both Neapolitan (27.8% soluble silica, 5.68% lime) and Roman (32.64%; 4.06%) "Pozzuolana."

Vitruvius, in chapter 6, says: "There is a species of sand which, naturally, possesses extraordinary qualities. It is found about Baiae and the territory in the neighborhood of Mount Vesuvius; if mixed with lime and rubble, it hardens as well under water as in ordinary buildings." This "sand" is obviously a pozzolanic ash. Herring points out that this pozzolan could react with lime because it was already calcined by the volcano.

*Santorin earth*. This is really a volcanic tuff, which blankets the Greek island of Santorini (Thera). It is about 64% silica and 3.5% lime (USBM). It was used in ancient Greek mortar (Lea 3) and, millenia later, it was still exported for use in making pozzolanic cement (1911EB "Santorin").

*Pottery shards*were ground up, in antiquity, to produce a pozzolan. Pottery is made by heating (calcinating) clay, and clay is rich in silicate minerals. Brick could be recycled in a similar way. Vitruvius says that if mortar is made from river or sea sand, it is improved by addition of one-third part of ground potsherds.

A modern clay-derived pozzolan is *metakaolin* . It is obtained by calcinating the clay mineral kaolinite, an aluminosilicate clay mineral. Metakaolin is one of the most reactive pozzolans.

*Pumice*is a very light, highly porous igneous rock, with a silica content of 60-75%. In 1911, pumice was chiefly obtained for commercial use from the Lipari Islands north of eastern Sicily, and especially from Monte Pelato and Monte Chirica. The Lipari Islands have exported pumice since antiquity, and Canneto is the center of the pumice trade.

*Trass*, a Germanic pozzolan, is a tuff (rock derived from volcanic ash) found in the Eifel, a volcanic region of Germany lying between the Rhine and Moselle rivers (1911EB). The article on "Trass" specifically mentions the Brohl and Nette valleys, and the town of Andernach. Eckel (635) says that trass occurs along the Rhine, from Koln to Coblenz, and that the towns of Brohl, Kruft, Plaidt and Andernach near Coblenz are significant players in the trass industry. 1911EB characterizes it as 19% soluble, 50% insoluble silica. It is lacking in lime so it is less reactive than *pozzolana* . Nonetheless, the Romans recognized its resemblance to the Vesuvian material.

(Johnson, 387). In 1837, trass sold for $5.225 per cubic meter, whereas common sand cost $0.85. (Treussart 90).

Extinct volcanoes can also be found in the Vogelsberg (west of Fulda), the Roehn (east of Fulda), the Lausitz (north of Dresden), and in the Eschwege at the Werra, east of Kassel. (MB).

*Kieselguhr*(diatomaceous earth, diatomite), which is derived from the silica skeletons of fossil diatoms, is over 80% silica. In 1911, it was not an economical material for cement making, because it was in demand as an absorbent for the nitroglycerin in dynamite. The 1911EB mentions deposits of diatomite in Richmond, Virginia, in Aberdeenshire (between Logie Coldstone and Dinnet), in Wales (Llyn Arenig Bach), and on Skye. It is in fact found in Germany (e.g., Obrehole) , but I don't know whether it was a known substance (e.g., for filtering beer) insofar as the down-timers are concerned.

*Ground granulated blast furnace slag*(GGBFS) is a product of steelmaking (1911EB). Slag cements were first used in 1774, in mortar (Prusinski).

While USE Steel in Grantville will no doubt be happy to sell its slag, King warns that the slag "requires a fair amount of processing to become a useful pozzolan." GGBFS is produced by rapidly quenching (cooling) molten iron blast furnace slag by immersing it in water or blowing air over it, in a "granulator," and then grinding it. The GGBFS is then combined with lime to make slag cement. (It should be noted that slag, processed differently, can be used to make an aggregate.)

*Coal fly ash*. When coal is burnt, it leaves behind both bottom ash and fly ash, the latter being the particles which are carried up into the smokestack. Fly ash was first used in a pozzolanic cement in the construction of the Hoover Dam (1929).

The silica content of the fly ash is dependent on the type of coal; 20-60% for bituminous, 40-60% for sub-bituminous, and 15-45% for lignite. The ash also contains lime; 1-12% for bituminous; 5-30% for sub-bituminous, and 15-40% for lignite. Fly ash is classified as being either Type C (calcium-rich) or Type F (calcium-poor). The type C ash is more reactive than the type F ash, and is even self-cementing. ("Fly Ash," Wikipedia).

Fly ash particles have diameters of 1-100 microns. The particles with sizes under 10 microns are the most pozzolanically active, and ASTM limits the concentration of particles larger than 45 microns to 38%. The particle size distribution varies depending on the coal deposit and also on the plant design and operating parameters.

By way of a bonus, since fly ash particles are almost perfect spheres, they act like microscopic ball bearings, improving the workability and pumpability of the concrete in which they are used (Copeland).

Grantville has a coal-burning power plant which may already be equipped with devices for filtering out fly ash to minimize air pollution. By the beginning of *1634: The Baltic War*, there is a coal gas plant in Magdeburg. They are connected by rail and water, and the fly ash can therefore be shipped to any point along the line which is convenient for cement and concrete manufacture.

How much the up-timers know about this utility of fly ash? It is not mentioned in 1911EB. The *Encyclopedia Americana* notes that it can be removed from the smokestack gas by electrostatic precipitators ("Power, Electric") but doesn't mention its significance for cement-making.

On the other hand, the Allegheny Power Company (which presumably owns the Grantville power plant) reported to the SEC that its subsidiaries sold 131,000 tons of fly ash (and 168,000 tons of bottom ash) in 1996, and that the uses of the ash included "cement replacement."

So I am sure that at least the power plant manager, Bill Porter, knows about this possibility.

Talmy, USP 5521132 gives the composition of the fly ash from the Rivesville Power Plant, which was the model for the Grantville plant. It is 58.79% silica, 27.91% alumina, 8.41% iron oxide, and only 1.20% lime. Its LOI (loss on ignition),a measure of the unburnt carbon on the particles, is 28.3%. That's high, so it will have to be burnt off. ASTM C618 requires that the LOI be no more than 6% (King 5).

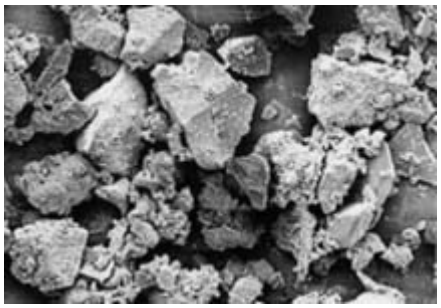
*Rice husk ash*. Traditionally, rice was milled just to remove the chaff (outer husk), leaving brown rice. The brown rice may be further milled to remove the bran (inner husk), leaving white rice. If the husks are burnt, about 20% of the husk weight remains as ash, and this ash is about 95% silica, and constitutes a highly reactive pozzolan (Allen, King). The difficulty in preparing the ash is burning the husk at a temperature low enough so that the silica doesn't form inactive crystals while burning it long enough to ensure that all the cellulose is consumed.

Americans don't think of rice as a European crop, but it was brought to Spain and Portugal by the Moors ("Rice," Wikipedia), and has been grown in Italy at least since the fifteenth century. Lombardy was the first major Italian producing region. By 1644, there was rice production in the Veneto, and in the nineteenth century canal construction made it possible to grow rice in the Piedmont. (Seed). Rice can also be grown in France and Greece.

*Silica fume*. Once the semiconductor industry is reestablished, there will be the possibility of using *silica fume*(0.1 micron silica particles, a byproduct of silicon production) as a high-activity pozzolan. Silica fume is expensive and difficult to work with, so it will probably be relegated to the same niche market it enjoys now (concrete with compressive strength exceeding 15,000 psi and with high chloride resistance). (King 7; SFA).

## *Portland Cement*

"Portland cement" was patented by Joseph Aspdin in 1824, and improved by his son William in 1843. Aspdin's cement was made by heating together finely ground limestone and clay. He cooled the resulting "clinker" and pulverized it. This powder could be stored until it was ready to be activated by addition of water.



The Aspdins used too low a temperature (probably lower than 1400 deg. C) to achieve a true Portland cement. (Blezard 8). (EB11 specifies a "clinkering" temperature of 1500 deg. C (2732 deg. F) which is in accord with modern practice.)

There is a good description of the modern American cement-making process in "Cement," *Encyclopedia Americana* . Sources of lime (e.g., limestone, chalk, marl, marble, shells), and of silica (sand, sandstone, clay, slag, ash) and alumina (clay, shale, bauxite) are quarried and crushed, then mixed together and ground up some more. The grinding can be done wet (that is, in a water slurry) or dry. Wet grinding yields a more homogeneous blend, but the powder has to stay in the kiln longer. (Camp)

This "rawmix" flows into a continuously operated, inclined, rotating kiln. EA says that this is typically 300-400 feet long, inclined at one half inch to the foot, and rotated at 30-90 revolutions per hour. The kiln is hottest at the discharge end.

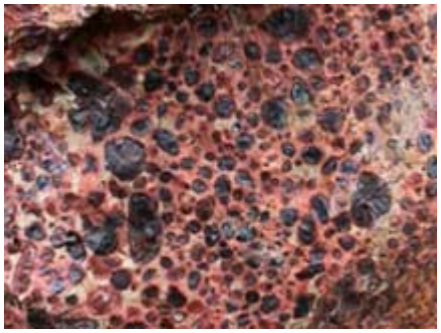
The material takes 2-4 hours to pass through the kiln, and reaches a temperature of 2600-2800 deg. F. First water is driven out, and then the carbonates decompose into oxides. Ultimately, some of the material liquefies, and the lime (calcium oxide) reacts with the silica to form calcium silicates, notably dicalcium silicate (belite) and tricalcium silicate (alite).

Shale and clay often have a high aluminum and iron content. Alumina (aluminum oxide) serves as a flux, that is, it reduces the melting point so that more of the charge is liquefied at the peak kiln processing temperature. Thanks to the flux, liquid appears at about 2400 deg. F, but even at the peak temperature,

only 20-30% of the charge is in the liquid phase. When the charge is cooled, the alumina is converted into tricalcium aluminate.

The EA "Concrete" article explains that tricalcium aluminate "produces a very high heat of hydration" and "has poor durability because it reacts with sulfate alkalis found in soil and water." Overly high aluminate levels may be reduced by adding iron ore to the kiln.

Iron oxides also act as fluxes, and they react with aluminate to form tetracalcium aluminoferrate. This iron compound is responsible for the grey color of the cement; if cement is made from low-iron materials, it will be white in color. On the other hand, the iron improves the resistance of the concrete to sulfate water.



Tricalcium aluminate forms because a source (e.g., bauxite) of aluminum oxide (alumina) is added to the kiln when making Portland cement. It is provided to reduce the melting point of the composition so it is liquid at the peak kiln processing temperature, thereby favoring formation of alite and belite. Unfortunately, it has undesirable properties, Like tricalcium aluminate, the tetracalcium aluminoferrate acts as a flux.

The product of the calcination reaction in the kiln are black hard nodules with diameters of one-quarter to one inch diameter, called "clinker" because they make a clinking noise in the kiln. These are mixed with 4-5% gypsum (hydrous calcium sulfate). EA states that the purpose of the gypsum is to slow down the "setting" of cement, since otherwise a Portland cement concrete mix might set, and become unworkable, before pouring was complete.

On average, every thousand tons of cement requires roughly 1511 tons of various oxides (1315 tons calcium oxide, 71 tons silica, 108 tons alumina, 17 tons ferric oxide), and 53 tons gypsum. (Van Oss 22). To get those oxides probably means processing up to twice the weight in raw rock.

## *Vertical Kiln Development*

Of course, the post-RoF cement industry is going to begin more humbly than with the monster rotary kilns described in EA. The first cement kilns were intermittent, vertical kilns. Such kilns are "old" technology, already used in pottery, lime and brick making, and so there will be a rapid adaptation.

The simplest kiln design is a pit kiln, in which the fire is allowed to burn downward. Unfortunately, most of the heat is wasted, because it escapes upward.

An improved design is a simple shaft kiln; this involved digging a horizontal tunnel into the side of a hill, and a vertical shaft down to meet it. An arch of limestone is built at the junction. The rawmix is piled on top of the arch, and the fuel goes below it ("separated feed"). The fuel is lit and the fire burns upward. (Lazell 24-30; Eckel 409-19).

In both pit and shaft kilns, earth acts as the insulator. The dome kiln is the free-standing equivalent, made of brick or perhaps brick-lined metal. The interior was egg- or bottle-shaped, with the top portion serving as a chimney. The arch was replaced with a grating, and the fuel (preferably coke, but sometimes firewood) and rawmix was piled above the grating in many alternating layers ("mixed feed"). A typical dome kiln was 15-20 feet high and perhaps six feet in diameter.

Normal operation was discontinuous. The kiln would be loaded with perhaps 50 tons slurry and 12 tons coke. It will take two days to fire up, two or three days to burn through, and additional time for cooling down, drawing out the clinker, and reloading the kiln. Dome kilns produced perhaps thirty tons clinker per batch, and one batch per week (EB11). According to Eckel, production is 0.5-1 ton clinker per cubic meter of burning space, and 23-30 pounds of fuel are needed per 100 pounds clinker.

Intermittent operation is wasteful of energy, since the kiln must be cooled down and then reheated for the next batch. But the new arrangement made it theoretically possible to operate the shaft or dome kiln continuously. One worker could (cautiously) collect clinker which has fallen through the grating, while another added new layers at the top. We then have a "running kiln."

In practice, the clinker tended to hang up, forcing a cool-down (Redgrave 158). Also, it was difficult to maintain a consistent burn in running lime kilns (Johnson) and I suspect that the same problem would have carried over to cement kilns. Lipowitz (32) said in 1868, "many attempts to establish a kiln on the perpetual system have been devised, but hitherto the desideratum of a perfectly unexceptionable running kiln is still unattained."

Chamber kilns were adapted from brickworks, and the basic concept was that excess heat from one chamber was transferred to another. They thus achieved a substantial fuel savings. Chamber kilns are an old technology, but they reached their pinnacle in 1858, when Hoffman invented the "continuous" chamber (ring) kiln, briefly described by EB11.

The first vertical kilns capable of sustained operation appeared in the 1880s. These were larger than dome kilns (the Coplay Cement Company's nine Schofer kilns, operated in Delaware 1893-1904, were ninety feet tall), with separate drawing, burning and loading floors for the workers, and multiple ports and chutes through which to regulate the supply of rawmix and fuel. They probably had better linings, too. However, my sources are maddeningly vague about just how they avoided the problems of the old "running" dome kilns.

The new kilns differed in terms of where exactly the fuel and rawmix were added, the fuel used (coke or small coal), and where the interior narrowed and widened. EB11 diagrams the Dietzsch type, in which the shaft is staggered to create a horizontal ledge to which the fuel was added. A pair was usually built back-to-back. The upper vertical shaft contains the unburnt rawmix and the lower shaft is the burning zone.

EB11 also mentions the Schneider kiln, which had a single vertical path. The Schofer (Aalborg) kiln was similar. Eckel says it produced 10-15 tons clinker daily, consuming 280 pounds coal per ton product.

## *Rotary Kiln Development*

It took roughly ten years (1885-1895) to achieve a truly practical rotary kiln. There were "many practical difficulties" and "an immense amount of expensive experimenting" (Sabin 23; ER Chap. 20; Brown 39-42; Redgrave 167-176).

One problem with the early rotary kilns is that they were simply too short, Ransome's being twenty-six feet long and Navarro's, forty feet. Consequently, there was a lot of underburnt clinker, and also much heat was wasted. While our heroes will know that the modern rotary kilns are hundreds of feet long, without foreknowledge of the problems of the pioneers, the first post-RoF rotary kilns are likely to be short prototypes, of underwhelming performance.

Secondly, there were various problems with the kiln lining, both spalling of the lining and balling of clinker upon it .

And finally there were the issues of finding the right fuel and minimizing fuel consumption. The first fuel experimented with was gas. Next came a "jet of burning petroleum," because it allowed precise control of the temperature of the kiln. Indeed, a chemist asserted at the time that the "rotary kiln can be successfully operated only in localities where crude oil is abundant and cheap." (Prentice) However, in most places oil was expensive, and the rotary kiln didn't really catch on until it was adapted (1895) to use blown pulverized coal.

The great advantages of the rotary kiln, once perfected, were its low labor cost (20-30% that of continuous shaft kilns) and high production rate (over double) (ER 188). Its bugbear was fuel consumption.

For several decades, the standard dry-process kiln was sixty feet long and six feet diameter, and the wet-process cousin could be up to eighty feet. The dry-process kiln produced 160-180 barrels (each 376 pounds) of clinker daily, consuming 110-150 pounds coal per barrel. (Eckel 424; Sabin says 175-250 barrels for 95-120 pounds coal/barrel.) The wet process was even more wasteful of fuel (ER 17).

It took Edison from 1899 to 1902 (Vanderbilt) to build the first "long" (150 foot) kiln, despite his study of the "short" kiln technology. The Edison kiln tube, nine feet in diameter, was made from ten-foot sections of cast iron, bolted together. It was suspended on fifteen rollers, rotated by an electric motor, and there were ten thousand bearings, lubricated with an automatic oiling system. The kiln had a pitch of eighteen inches and powdered coal was forced in by pressurized air to create a forty foot combustion zone at the lower end. Only two men were needed per shift.

Edison shocked the industry by producing 350-375 barrels daily, while consuming only 65 pounds coal per barrel (Eckel 424). Edison ultimately increased production to 1100 barrels/day (Vanderbilt 185). The "light bulbs came on," and by 1918 there were kilns over 200 feet long.

In the standard sixty footer, the combustion zone, in which clinker was formed, was near the lower end, and about ten feet long, and the heated gases which rose from it had only the upper forty feet in which to decompose the rawmix. Much of the heat of the gases was wasted, and the processing path was so short that the rock still retained much of its carbon dioxide, releasing it when it reached the combustion zone. (Dyer)

By increasing the length, the cylinder could be fed faster, tilted more steeply and rotated more quickly, and still burn the stone properly, without the produced carbon dioxide interfering with the combustion. Eckel (429) estimates that the output (barrels/day) will be between one-eight and one-twelfth of the product of the length (feet) and the square of the internal diameter (feet) at the discharge end.

In re-inventing the rotary kiln, our heroes will need to solve problems relating to forming the giant metal cylinder, developing a proper lining (early 20c usage was alumina brick), providing the mechanisms for

turning the cylinder, and assuring proper heating.

## *Comparison*

| Kiln | Daily Production (barrels) | Coal (pounds/barrel) | US Labor Cost (Cents 1900) |
|---|---|---|---|
| *Dome* | 30 | 80-120 | E:30-50 |
| *Hoffman (per chamber)* | 25 | 60-80 | |
| *Dietsch, Schofer* | 50-75 | 60-80 | 12-14 |
| *Rotary, wet 60'* | 80-120 | 140-200 | 2.5-4 |
| *wet 110'* | 130-200 | 100-140 | |
| *dry 60'* | 175-250<br>E: 160-225 | 95-120<br>E:95-150 | |
| *dry 110'* | 300-500 | 75-100 | |
| (Sabin 25; E:Eckel 411, 424) | | | (ER 188) |

In general, the fuel-efficient vertical kilns long remained popular in Europe, where labor was cheap and fuel was expensive. In America, where the reverse was true, by 1900, the rotary kiln accounted for 90% of production.

## *Grinding*

The clinker is ground down, to a very fine powder. How fine? EB11 says, enough so most passes through 0.005 inch sieve holes. In modern practice, to an average of ten microns, which makes baby's talcum powder seem coarse in comparison. Cement plants will need to be able to measure particle size in order to ensure a consistently high quality product.

Grinding of clinker was done originally with millstones (EB11). However, by the late nineteenth century, ball mills were available. In a ball mill, the material to be ground enters one end of a rotating cylinder, and leaves at the other. The cylinder contains balls made of a hard material, such as steel, rock or ceramic, and the clinker is ground down by friction and impact. The mill can be powered by animals, wind, water or electricity.

Cement powder must be kept dry until use since cement reacts with water ("sets"). Cement also gradually loses strength when stored.

## *Types*

There were five basic types of Portland cement in use in 2000:

- **•Type I: General purpose.**
- **•Type II: Moderate sulfate resistance.**
- **•Type III: High early strength (gains strength faster than type I, which allows earlier removal of the forms which the concrete is poured into. According to Arnold 32, type III cures about twice as fast as Type I)**
- **•Type IV: Low heat of hydration (for use in massive structures, like dams, where it is difficult for the heat to escape because of a low surface-to-volume ratio)**
- **•Type V: High sulfate resistance.**

There were also "air-entrained" variants of types I-III (IA-IIIA) so you could say that there are actually eight basic types.

Domestic production in 2000 was over 90% types I/II, with the balance split primarily between types III and V. Type IV was less than 1% of production. (USGS).

Type III is used mostly for precast concrete manufacture (so the molds can be reused more quickly) and for emergency repairs. Commercially, types IV and IV have been largely superseded by Portland-pozzolan blended cements (see below). What that all means is that, as a practical matter, the up-timers probably have experience only with types I and II.

The typical chemical composition of the five types of Portland cement is given in the Encyclopedia Americana "Cement" article. The chart lists the proportions of tricalcium silicate, dicalcium silicate, tricalcium aluminate, tetracalcium aluminoferrate, calcium sulfate, magnesium oxide, and free calcium oxide for each. EA notes that it isn't desirable for free calcium oxide to exceed 2-3%.

While this may make it seem that the chemical composition is critical, the ASTM specifications are "not very strict since cements with different chemical compounds can have similar physical behavior" (Camp). But Camp also says that "high quality cements require adequate and uniform raw materials." How do we reconcile these two statements?

What it comes down to is that the physical properties of the cement (and corresponding concrete) have to be predictable (so that, say, the concrete in the third floor is just as strong as the concrete in the lower floors). So once you determine that a particular combination of raw cement-making materials makes a physically desirable cement, you want to make sure that all of the cement produced will continue to manifest those desirable properties.

It is also worth noting that both chemical and physical properties of Portland cement have changed over the years, with post-1930 cements being more finely ground and containing more belite than older cements. The concrete made with post-1930 cements strengthens more quickly (so construction is faster) but is less durable (Mehta).

## *Quality Control*

The quarried stone can vary from day to day in its content of the various oxides. Quality control—measuring the chemical composition of the stone and the clinker, and adjusting the proportions of limestone, clay etc. appropriately—began in the 1870s (Blezard 17).

In modern practice, the chemical composition of the rawmix is tightly controlled—within 0.1% or better! This accuracy is achieved by hourly X-ray fluorescence or, every three minutes, gamma neutron activation analysis. ("Portland Cement," Wikipedia).

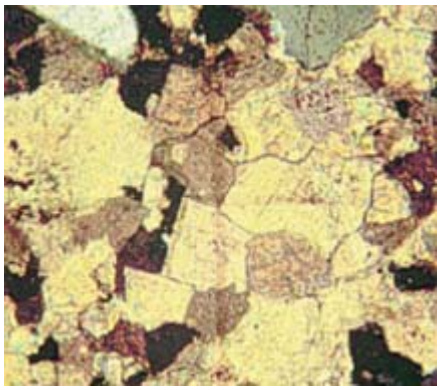
Obviously, we are not going to achieve that kind of control in the early post-RoF period. Nor is such control critical, as long as one periodically tests the efficacy of the cement. After all, nineteenth century rawmix certainly wasn't monitored by X-ray fluorescence. EB11 says that "the silica may range from 19 to 27%, the alumina and ferric oxide jointly from 7 to 14%, the lime from 60 to 67%."

I would imagine that there would be an attempt to perform daily chemical analyses on the rawmix, and that these analyses would be correlated with tests of the cement emerging at the other end of the kiln. The latter will include both chemical tests (see below for the desired constituents of different types of cement) and physical ones, i.e., using the cement to make a concrete and then testing the concrete for strength. In addition, there would probably be at least daily chemical testing on the raw materials (e.g., limestone). Even this crude quality control is going to be new to the seventeenth century.

Grantville chemists will have to dredge up their old quantitative chemical analysis course textbooks and figure out how to assay for silica, alumina, iron oxide, lime, magnesia, etc. (Waterbury, Appendix III). Once they have an oxide analysis, the proportions of the four main reaction products can be predicted using what is called the Bogue calculation. Classical chemical analysis can require hours or even a few days to complete (Blezard 22), so adjustments will be sluggish by modern standards.

## *Natural Cement*

So-called "natural cement" is a cement, similar to Portland cement, which was produced by calcination of a naturally occurring mixture of lime and clay, such as the "dolostone" (magnesium-rich limestone) of Rosendale, New York. It was used to make concrete for the Brooklyn Bridge and Grand Central station in New York City. EA "Cement" distinguishes between "hydraulic limes" (with a silica-alumina content of 10-20%) and "natural cements" (20-35%).



1911EB acknowledges the existence of natural-cement deposits near Chittenango, in Madison County, New York, as well as in Kentucky (Louisville), Indiana (Clark county), Illinois, Oregon (Rogue river), Pennsylvania (Williamsport, Lycoming County). EA mentions Rosendale and Fayettesville, NY.

Natural cements do occur in Europe, notably in Belgium (Tournai district) and England (septarian nodules found in southern England) (Eckel1905, 214-8). However, this will have to be discovered the hard way.

According to EA, natural cements can be made by processing the rock in "small, upright, wood-burning kilns . . . fired for about a week", and then grinding the resulting "clinker" between millstones, using waterpower. Firing temperatures are similar to those of lime kilns (1000-1200°F) (ER 21).

In any event, users of "natural cement" were at the mercy of nature; they had to be content with the particular mixture of lime and clay which the formation produced, whether it gave the cement and concrete the correct characteristics or not. The clinker must be sorted, and the under and over burnt material tossed away. Losses will probably be on the order of 25%. (Reid 9). The strength of natural cement is perhaps half that of Portland cement (Mills 41).

## *High Alumina Cement*

This is made by heating a mixture of limestone and aluminum ore (bauxite). According to EA "Cement," it's resistant to sulfates and chlorides, and it hardens faster than Portland cement (and hence is useful for emergency road repair). Hot, moist conditions can cause it to suffer a catastrophic change in its microstructure—which is why the Europeans ban its use in structural concrete (Camp 6).

For sources of bauxite, see Cooper, "Aluminum: Will O' The Wisp?" ( *Grantville Gazette*, Volume8).

## *Blended Cement*

In the twentieth century, this referred to a combination of Portland cement with a pozzolanic cement. EB11 says that adding trass can increase strength.

Blended cements were first used in underground and underwater structures because they imparted increased durability. Later, they were used in massive concrete works because of their reduced heat evolution (compare type IV Portland cement) and in weather-exposed concrete to reduce expansion (and cracking) as a result of the alkali-aggregate reaction. Ultimately, they came into general use. (Lea 424-5).

In general, the blended cements have a lower short-term (28 day) strength and a higher long-term (1-5 years) strength. (Lea 436, 473).

## *Aggregates*

The aggregates form about 60-80% of the concrete (Ahrens 17). You may think of the aggregates are the "bones" of concrete, and the cement as the "sinews." Most of the weight of concrete, and also most of the structural strength, is attributable to the aggregate.

A concrete mix will usually include both fine (under one-quarter inch) and coarse aggregates. The maximum size for the aggregate is usually an inch or two. (Roman concrete used much larger pieces, see Cowan 120.) The purpose of the fine aggregate is to fill in the spaces between the larger chunks, and it's usually sand. (Arnold 27)

The proper shape of the aggregate pieces is going to be a matter of study and debate. EB11 "Concrete" teaches that "spherical pebbles are to be avoided," and that the grains of sand should be of "an angular shape." However, modern concrete technologists are of the opinion that "the ideal aggregate would be spherical and smooth." (Camp, Chap. 6).

In the nineteenth century, aggregates were haphazardly collected from the pit or crusher. (Bauer 54). But ideally, the coarse aggregate is not a single size but rather exhibits a spectrum of sizes. An example of a desired grading curve, Fuller's "ideal curve" (1907) specifies that the fraction of aggregate smaller than a particular size is the square root of the ratio of that size to the maximum size of the aggregate.

Use of a well-graded aggregate permits more economical use of cement, but this is balanced somewhat by the greater amount of work which may be involved in achieving that degree of grading for the available aggregate. A sieve analysis is used to determine whether the aggregate approximates the desired grading curve.

Normal density aggregates include crushed limestone, sand, river gravel, and crushed recycled concrete. The density of concrete made from such aggregates would be perhaps 150 pounds/cubic foot.

Low density aggregates might be expanded clay, shale, slate, slag, or crushed recycled brick. They bring concrete density down to 100-130 pounds/cubic foot (Ahrens 23).

Very low density aggregates include expanded mica, vermiculite, perlite, pumice, and glass or ceramic spheres. Concrete density can be as low as 20 pounds/cubic foot, which is lighter than water. The concretes used in the annual "concrete boat" races make considerable use of these aggregates.

*Sand and gravel*. Sand and gravel may be deposited by glaciers, water, or wind. In general, wind deposits (dunes and loess) are not useful in concrete-making.

If you look at a map of Europe during the last ice age, you can see that the terminus of the continental glacier was along a gentle NE to SW curve, falling a little north of Hamburg and Dresden. In southern Germany, there are likely to be deposits left by alpine glaciers. However, since these glaciers were advancing during the seventeenth century (remember the Little Ice Age), I am not sure that they will be accessible.

Water deposits can be left by rivers or the sea, and in general river sand is more useful. The problem with sea sand is that it encrusted with sea salts. Twentieth century facilities can desalinate sea sand but this isn't likely to be a practical option for our protagonists.

You can find river sand (or gravel), not only in the beds and banks of existing waterways, but also in ancient channels. In the mountains, gravel may be found in alluvial fans.

Julio Sanabria may have exaggerated a bit when he assumed that "sand is everywhere," but there shouldn't be a problem finding some sand in the vicinity of Grantville and Magdeburg.

*Crushed stone*. In the United States (1989), the preferred rocks for crushing are, in descending order, limestone, then granite, traprock, dolomite, sandstone/quartz/quartzite, and marble, and finally volcanic cinder/scoria, slate, and marl (USGS). Quarrying is likely to occur where the rock outcrops or at least the soil overburden is thin. It might also be done as a byproduct of roadbuilding.

The choice of stone is dictated by a combination of its engineering properties, availability and cost. The rocks vary in mechanical strength, density, durability, chemical stability, surface characteristics, content of

undesirable impurities, and the suitability of the shape of the crushed fragments (Waddell 2.6-.19).

*Air-cooled blast furnace slag*. This can be obtained wherever pig iron is produced. Slag concrete is actually stronger than that made from gravel.(Ramachandran).

*Bottom Ash*. This is similar to fly ash, but unfortunately higher in alkalis and sulfates. Ramachandran suggests that it be used as a lightweight aggregate in concrete block production.

*Red Mud*. This is a waste product of the production of alumina from bauxite. It can be formed into balls and then fired, like clay pottery, to produce an aggregate. A fairly high temperature (1260-1310 deg. C) is required to melt it.

*Sawdust*. Sawdust can be used as an aggregate (as in "woodcrete"), but sawdust concrete has reduced strength and, if the sawdust content is high, is flammable. The best wood sources are spruce and Norway pine. (Ramachandran).

*Waste glass*. Glass refuse can be used as a lightweight aggregate, but it reduces strength, and also renders the concrete susceptible to certain chemical attacks.

## *Water*

The key is to use water which doesn't contain significant levels of impurities that adversely alter the properties of the concrete. For example, seawater has a high content of dissolved salts, including sulfates and chlorides, which can cause a variety of problems.

According to EA "Concrete," if the water is good enough to drink, it is good enough to make concrete. However, drinkable water isn't strictly necessary.

In the seventeenth century, water quality cannot be taken for granted. The ASTM standard method of deciding whether water is acceptable for concrete mixing is "if the setting time does not differ by more than 30 minutes and the strength is not reduced by more than 20% when compared with a sample [made] using distilled water." (Camp).

In cold weather, it can be advantageous to use hot water, thereby speeding up the setting of the concrete (Arnold 32).

## *Admixtures (Additives)*

The Romans experimented with animal fat, milk and blood as additives (UIUC).

*Air*. It is possible to entrain air into concrete, either when mixing the concrete, or by use of an air-entrained cement. Why is this good, when concrete layers are taught a variety of techniques to prevent voids? The difference is that these "good" air bubbles are small (one to three thousandth of an inch), numerous (400-600 billion per cubic yard), and well-distributed. The air content may be 3-7%, rather than the usual 1-2%.

Air-entrained concrete is more resistant to freeze-thaw cycles. In ordinary concrete, when temperatures drop below freezing, the residual water expands, and stresses the concrete, possibly cracking it. But in air-entrained concrete, all those air spaces can compress if the concrete nearby is stressed. Air-entrained concrete is also more workable. The mix must be adjusted to avoid loss of compressive strength.

Air-entrainment was developed in the 1930s. It is achieved by adding a surfactant to the concrete. The conventional air-entrainment agents include "Vinsol resin" (the "petroleum-hydrocarbon, insoluble fraction of a coal-tar, hydrocarbon extract of pine wood") and "Darex-AEA ("a triethanolamine salt of a sulfonated hydrocarbon")(Bauer 47). Vinsol resin is mentioned in the CRC Handbook of Mechanical Engineering, a reference book reasonably likely to have been in Grantville.

No doubt people will think about using ordinary household detergents, but use of the wrong one could reduce strength and not achieve the desired effect. So any candidate surfactant has to be tested for its effect on the concrete (CCN).

*Accelerants*. Agents, e.g., calcium chloride (CRC), can be added to reduce the setting time.

*Retardants*. Other agents, e.g. sugar ( CRC), can be used to cause the concrete to set more slowly. They are typically used during hot weather.

*Water-reducers*. These reduce the amount of water needed for the mix to have the desired level of workability. Decreasing the water:cement ratio increases strength.

*Superplasticizers*are "second-generation" water-reducers; they were introduced in the 1980s. They include sulfonated melamine (or napthalene) formaldehyde condensates and ligonsulfonates (CRC).

*Pigments*. You can imagine an early architect telling a client, "you can have any color concrete wall you like, as long as it's grey." In the late twentieth century we had the choices of blue (cobalt oxide), brown (iron oxide), buff (another iron oxide), green (chromium oxide), and red (yet other iron oxide). Pigments can be expensive, and tend to weaken concrete, so they are used sparingly. (Chen 30).

## *Lightweight Concrete*

Plain concrete weights 150-160 pounds/cubic foot. Lightweight concrete weighs 35-120 pounds/cubic foot. There are two basic methods of lightening concrete. Either you use a lightweight aggregate (see above), or you add a foaming agent (e.g. aluminum powder) to put gas bubbles into the concrete. In our time, concrete using a lightweight aggregate costs 30-50% more than ordinary concrete. (Merrill).

Structural lightweight concrete, made with expanded shale or clay aggregate, has a strength of 2,500-6,000 psi. It was used in constructing the 52 story One Shell Plaza in Houston. Intermediate lightweight concrete, made with pumice, scoria or herculite aggregate, has a strength of 1000-2500 psi. Extra-lightweight concrete, made with perlite, vermiculite and polystyrene bead aggregate, has a strength of only 100-1000 psi. (Ali).

*Pumice and scoria*are considered volcanic glass. Concrete made with them weighs 90-100 pounds/cubic foot. (Lewel).

*Perlite*is a volcanic rock which expands dramatically when heated, somewhat like popped popcorn. Encyclopedia Americana says that it is found in New Mexico, Greece, Hungary and Italy. Concrete made with expanded perlite weights 35-75 pounds/cubic foot.

*Vermiculite*is a clayey mineral (think "kitty litter") which, in the crude state, has a density about twice that of water. When heated, it "expands explosively," perhaps 20-30 fold. *Encyclopedia Americana* notes that it is mined in Montana (near Libby), North Carolina, South Carolina and Wyoming. It is

doubtful that any up-time information is available on where it can be found in Europe. Concrete made with expanded vermiculite weights 35-75 pounds/cubic foot.

## *Heavyweight Concrete*

High density aggregates, such as barite, limonite, magnetite and steel balls, have been used to increase the strength of a concrete structure, especially fortifications.

## *Reinforced Concrete*

*Steel*. Reinforcement of concrete was proposed by Joseph-Louis Lambot in 1848. Reinforcing concrete with steel means that you take advantages of the strengths of both materials. The steel provides tensile strength, while the concrete provides compressive strength and also protects the steel from the environment. It can be provided in the form of individual bars, welded wire fabric, and cable (strands twisted together).

The steel is placed where it will carry the tensile loads of the structure. This is possible only because the concrete adheres to the steel, so tensions are transferred from one material to the other. The force of adhesion is dependent on the surface area of the reinforcing bar ("rebar") , and the bar must be long enough so that the strength of the bond is greater than the strength of the bar itself.

Most materials expand when it is hot and contract when it is cold. The dimensional change with temperature is measured by the "coefficient of expansion." If the coefficients for steel and concrete were dissimilar, then changes in temperature would disrupt the adhesion needed for the composite material to behave as a single unit. However, they are in fact quite similar, Twelvetrees (47) giving values of 0.0000066 and 0.0000055, per degree Fahrenheit, respectively. Still, a change of temperature will cause some stress; the steel bears it better because it is about 100 times as elastic as concrete.

Besides resisting tensile stress, the rebar also helps distribute strain throughout the concrete, and hence reduces the chance of rupture at a point of concentration.

Obviously, our ability to use steel-reinforced concrete is dependent to some degree on steel production. However, it is equally clear that it is more economical of our precious steel production capacity to build with steel-reinforced concrete than with steel alone. For a reinforced concrete beam, if the relative cross-sectional area of the rebar was 1% ("Reinforced Concrete," Wikipedia), the rebar might add just 3.6% to the weight of the beam. That 1% corresponds to 132 pounds of steel of per cubic yard concrete. (Taylor 536).

During the first decade post-RoF, I expect that reinforcement practice will be similar to that of the early twentieth century. Figure 50-200 pounds of steel reinforcement per cubic yard of concrete, depending on

the use. (Taylor, 14-32).

The advantages of reinforcement aren't limited to poured concrete. Precast blocks usually have two or three vertical holes; steel bars may be placed through the holes for increased strength.

*Prestressed concrete*. This is a variation on ordinary reinforced concrete. The idea is that a tensile stress applied to steel tendons generates a compressive stress in the surrounding concrete. The tendons are placed so that the compressive force offsets tensile forces which are imposed on the concrete by the overall structure in service. In other words, prestressing permits the concrete to match its strength (resistance to compression) against what would otherwise be a foe to which it is especially vulnerable (a tensile structural load). (Waddell, Chap. 41). Prestressed concrete is used to make the floors of many high-rise buildings.

In pre-tensioning, the "tendons" are tensed in a "stressing bed" by hydraulic jacks. The ends are anchored by reinforced concrete or structural steel abutments which extend deep into the ground. The concrete is poured into the bed and, once it cures to a desired compressive strength, the tendons are cut loose at the ends, which causes the transfer of the stress from the steel to the concrete ("detensioning"). Typically, pre-tensioning is done when the concrete members are manufactured in a central casting yard for transport to building sites.

In post-tensioning, the concrete is cast so that it contains ducts (by using thin-walled steel forms), and, once the concrete has gained sufficient strength, the "tendons" are run through the ducts and tensed and grouted. Post-tensioning is more likely to be carried out on-site.

It is fairly common for prestressed concrete to also be precast.

*Cast or Wrought Iron*. Traditional cast iron has a tensile strength of 10,000-20,000 psi, and wrought iron, 20,000-40,000 psi (Gordon 44). While inferior to steel in strength, and quicker to rust, they can be used in reinforcements if steel supplies are inadequate.

*Non-Ferrous Metals*. The common ones (copper, zinc, brass, bronze, aluminum) won't work. While their strength is at least equal to that of cast iron, their coefficient of thermal expansion is significantly higher than that of concrete. There's also the problem of corrosion by caustic alkalis in the concrete. Tin has a good coefficient, but is weaker than cast iron.

*Wood Reinforced Concrete*. Mass production of steel was unknown in the seventeenth century prior to the Ring of Fire. Hence, the steel industry in the early post-RoF years has a lot of catching up to do in order to be on par with what it was in the mid-nineteenth century, when steel-reinforced concrete was invented. This led me to wonder whether one might, as an expedient, use large wooden beams in place of steel bars as reinforcements for the less demanding concrete structures. While the tensile strength of wood is inferior to that of iron, it is still far superior to that of concrete—at least if the tensile forces act along the grain of the wood.

That said, it doesn't seem likely that wooden rebar (as opposed to wood fibers, see below) is practical. With regard to posts, Radford (154) said "no form of wooden reinforcement, either on the surface or within the post, can be recommended. If on the surface, the wood will decay; and if a wooden core is used, it will in all probability swell by the absorption of moisture, and crack the post." So the problem of moisture must be addressed by applying some kind of waterproof coating to the wood.

Another issue is whether the concrete will adhere to the wood, which is critical for the transfer of tensile stress from the concrete to the reinforcement. Cobleigh says, " A wooden reinforcement in the center of a

concrete fence post is worse than useless. It does not make a bond with the concrete, and thus weakens, instead of strengthens, the post. Of course, the same is true of wooden reinforcement of any concrete work."

Finally, there is the issue of whether the wood and concrete would expand or contract the same amount if the temperature changed. From what I can tell, the coefficient of thermal expansion of wood is about half that of concrete (Luebkeman).

Bamboo can be used as rebar, but it isn't bound well by cement, and the bamboo must be treated so that water absorption doesn't become a problem. (Swamy, 141, 157).

*Fiber Reinforced Concrete*. "And Pharaoh commanded the same day the taskmasters of the people, and their officers, saying, 'Ye shall no more give the people straw to make brick, as heretofore: let them go and gather straw for themselves." (Exodus 5:6). Clearly, fibers have been used to reinforce brittle materials since antiquity. For example, straw and horsehair were baked into mud bricks (Mohr 113). Cement and concrete have been reinforced with a variety of fibers, including steel, wood, asbestos, glass, textile, plastic, and carbon.

Fibers tend to be used in two different ways. First, they can be directly incorporated into the cement of conventionally reinforced concrete to reduce local cracking. Secondly, they can be incorporated into a matrix of some kind, and the resulting composite fabricated into rebar used in lieu of steel reinforcement, to increase tensile strength (while adding less weight).

Direct incorporation of glass or hemp fibers can actually reduce tensile strength (Materschlager). Steel fibers do increase tensile strength by 30-40%, and flexural strength (resistance to first cracking) by 50-150% (Frank). Of course, the tensile strength of unreinforced concrete is abyssmal, so 30-40% isn't much of an improvement.

In the case of direct incorporation, it is critical that the cement adhere to the fibers, or the fibers create weak spots. It may be possible to overcome adhesion problems with suitable coatings.

Straw was used to reinforce bricks in ancient Mesopotamia. The Finns added *asbestos* fibers to clay pots as early as 2500 BC. They were added to cement in 1898, but given the health concerns with asbestos, this history isn't likely to be repeated in the new time line.

*Steel*fiber reinforcement has been studied since the 1950s. Steel fibers are usually 0.5-2.5 inches long, and are added at a concentration of 0.25-2% by volume. (R&T).

*Plastic*(acrylic, nylon, polyester, polypropylene, rayon) fibers are also popular, but of course to make plastics, we need a variety of reagents and organic chemical feedstocks. So plastic fibers are going to be a relatively late introduction to the new time line concrete industry.

*Wood*fibers are the subject of current experimentation. They are added to cement shingles to increase ductility. Cement shingles have advantages in areas susceptible to wildfires. (Muhollem). Wood fibers have also been used in fiber-cement sidings (Mohr).

There are other *natural fibers* , too. The vegetable fibers include bast (flax, hemp, jute, kenaf, akwara, bamboo), leaf (sisal, henequen, pineapple, banana, elephant grass), and seed or fruit fibers (cotton, kapok, coconut husk "coir"). There are also animal fibers like wool. Obviously, the tropical fibers aren't going to be readily available in seventeenth century Germany, at least at a low enough cost.

Direct incorporation of *glass* fibers is possible only if alkali-resistant glass is used; ordinary glass fibers don't tolerate the highly alkaline environment of concrete.

Combination of fibers of different lengths or compositions can have synergistic effects (Banthia).

## *Composite Rebar-Reinforced Concrete*

It is possible to fabricate rebar out of a composite material, a fiber-reinforced plastic ("FRP"). The purpose of the plastic matrix is to protect the fiber from abrasion and chemical attack, and to transfer loads to it. Hence it has to be able to bind to both the cement and the fiber.

The properties of FRPs are strongly influenced by the length, diameter, arrangement and composition of the fibers, and the composition of the matrix.

*Matrix.* The FRP has to be readily fabricatable into rods, which means the plastic (resin) is usually either thermosetting or thermoplastic (which can be recast). It is desirable that the rods be bendable on-site. The resins in commercial use are synthetic; the thermosets include polyester, epoxy, and phenolics, and the thermoplastics, polycarbonate, polysulfone, and polphenylene oxide. In order to explore these possibilities, we first have to reconstruct the plastics industry to the point at which we have fine control over the mechanical and chemical properties of the plastic.

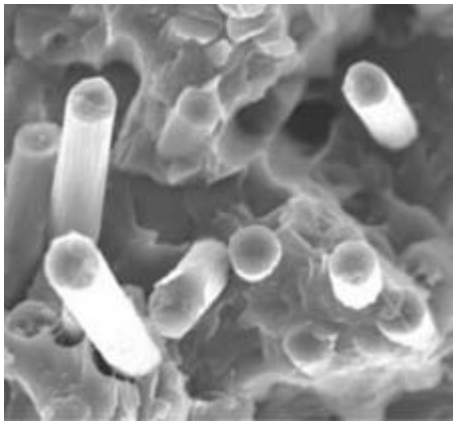
There are a number of natural resins which might be tested as potential matrixes. But Humphreys warns that natural resins "generally lack the processing and performance characteristics sought after in a matrix resin." (For desired characteristics of matrix resins, see Hale 49.)

Casein, a milk protein, can be precipitated from milk with heat and acid, and hardened with formaldehyde to make a semi-synthetic plastic. According to canon, it was made by the winter of 1631-32 (see Offord, "Bootstrapping," *Grantville Gazette* , Volume11, and DeMarce, "Songs and Ballads," *Grantville Gazette* , Volume14). It is probably too soft, and too vulnerable to water absorption and biological degradation to be a good FRP matrix.

Most of the research I have seen on natural resins has focused on their combination with natural fibers to make a biodegradable material. Biodegradability is great for bottles, but not what one wants in a skyscraper, bridge or dam.

* * *

Glass ("GFRP") and Carbon ("CFRP") composite rebars are commercially available nowadays. There is some information about glass and carbon fibers available in the *Encyclopedia Americana*.



*Glass Fibers.* A glass fiber-reinforced plastic ("GFRP") is often called, somewhat misleadingly, "fiberglass". The latter term actually refers to the "bundle" (cloth, tape, etc.) of glass fibers used to make the GFRP.

A GFRP rod has a higher tensile strength than one made of steel, and it is lightweight and corrosion-resistant. However, its mechanical properties are different enough from those of steel (they vary by direction, and it isn't as stiff) that direct substitution of GFRP bars for steel bars is not possible. (CPPI).

Glass fibers are intriguing, because there is a down-time glass industry—we aren't starting from scratch. Coarse glass fibers have been used for decoration since antiquity (Cooper, "In Vitro Veritas" ( *Grantville Gazette*, Volume 5), and they are mentioned in Antonio Neri's *L'Arte Vetraria* (Florence, 1612).

When glass is drawn into a fiber, it deforms, wiping out most of the weakening surface defects. The tensile strength of *glass* fibers with a diameter of 1/2000th inch is perhaps ten times that of bulk glass, and comparable to high tensile engineering steel. Glass fibers of those dimensions were first drawn by Griffith in 1920.

However, he was just testing the strength of individual fibers, not trying to produce them en masse. To make glass fibers (preferably, 5-20 micron diameter) on a commercial scale, we need to be able to produce a homogeneous glass (to control viscosity during drawing, and so the final product will have consistent mechanical properties), and we need glass drawing machinery which can reliably produce fibers of the correct dimensions. The *Encyclopedia Americana* "Fiberglass" article says to draw the glass through a platinum orifice plate, but platinum is not available immediately after RoF (it was considered a "waste" metal).

Moreover, the new fibers tend to stick to (and weaken) each other. Hence you also need to integrate, into the drawing operation, treatment of the fiber with a protective film (and in turn we need to identify a suitable chemical for that purpose). (Gordon, 74-76, 183-4). And once we have the glass fibers, we still have to find the right matrix.

I would have expected it to take some years to solve these problems. However, canon (Huff and Goodlett, "The Monster," *Grantville Gazette* , Volume 12) says that sometime between June and November 1633, "fiberglass" is available, albeit at a high price. Georg Markgraf 's second airplane, the "Jupiter," has an GFRP skin "made of a composite of fiberglass and resin." Perhaps the "fiberglass" was

hand-drawn?

Unlike the composite rebars discussed here, Georg's aircraft body doesn't have to have a lot of strength. It is "semi-monocoque" construction, meaning only part of the stress is borne by the body itself.

*Carbon Fibers.* Alternatively, it is possible to *carbonize* certain artificial and natural fibers. The first carbon fibers were made, by Edison (1879), from cotton or bamboo, for use as incandescent light bulb filaments. They were "extremely brittle" (Lee, II147).

High-performance carbon fibers were first made commercially available in 1959, at a price of over $500/pound (Jacobs 544). The usual starting materials were polacrylonitrile or rayon. Of course, we have to make these synthetic fibers before we can carbonize them.

The most interesting potential source for carbon fibers is pitch, which can be derived from oil or coal. Fibers can be pulled, like taffy, from the pitch, and these carbonized. In fact, if a high enough temperature is used, they can be converted to a particular form of carbon, graphite, with especially desirable properties (ACS; U. Kentucky).

Bear in mind that carbon fibers were leading-edge materials even in 2000 (Hegde; ACS), so even entertaining the notion of carbon fiber-reinforcement is going to give some readers apoplexy. But at least there is no doubt that the raw materials are available. The trick is going to be working out the manufacturing technology.

Hale 47 quotes 1998 fiber prices per pound as follows: E-glass ($1), S-glass ($5), aramid (e.g., Kevlar®) ($15-50), standard graphite ($17-35), high strength ($40), high stiffness ($65), and ultra-high stiffness ($275-650).

***

The great advantage of FRPs over steel is their high ratio of tensile strength to weight. This is especially important for vehicles, many parts of which can be made completely out of composites.

Unfortunately, FRPs suffer from a relatively high price and relatively low stiffness. Even with today's production technology, these composites are much more expensive than steel ($3-4/pound for GFRP, and more for CFRP, compared to $0.32 for epoxy-coated steel. (Purdue).

In part, the high prices are because GFRPs and CFRPs are still produced in relatively low volumes (MIT). Arguably, they will have a better chance in the new time line, because steel itself is a specialty product in the seventeenth century. On the other hand, steel will probably be needed for the very machinery used to manufacture GFRPs and CFRPs. And the availability of concrete as a building material should reduce the demand for wood, which could in turn bring down the price of iron and steel (because in 1630, charcoal was over three-quarters of the cost of smelting iron; Sass, 162).

Moreover, civil engineers need a material which not only has high tensile strength, but which is also stiff. GFRPs are quite inferior to steel in terms of stiffness, and CFRPs can only be made stiff with substantial difficulty and expense. CFRPs also fail at a lower strain than steel. (Humphreys).

Hence, I think it may be more than a decade before we see substantial building use of GFRPs or CFRPs. However, their weight advantages are of particular moment to the aircraft industry, and that industry is likely to fund research which will eventually benefit builders, too.

## *Macro-Defect Free Cement*

It doubtful that anyone in Grantville will know about it, and even less likely that they will know how to make it, but in the 1980s it was shown that one could essentially eliminate pores by use of the combination of a Portland (calcium silicate) or better, a calcium aluminate cement, a water-soluble polymer (e.g. polyvinyl alcohol-acetate copolymer), water and glycerine. Compressive and flexural strength increase ten-fold, toughness more so, and stiffness doubles. (Ghosh, 352-3).

## *Concrete-Related Materials*

*Ferrocement*. This material is similar to reinforced concrete, but there is no coarse aggregate in the concrete (so it is really reinforced mortar), and the reinforcement is closely spaced layers of small-diameter wire mesh and bars. The wire was originally steel, but other materials (e.g., bamboo) have been used. (Haussler; Robles-Austriaco). A crude form, with a single mesh layer, was invented by Lambot in 1855 (Jackson 28). Experimentation revealed that the weight of steel should be about 27 to 37 pounds per cubic foot.

*"Micro-Reinforced Concrete"* has been touted for blast resistance (Hoffman; Hauser; Chusid; Excendinc). From what I can tell, it is just ferrocement "on steroids"—supplemental cementitious materials, superplasticizers used to reduce the water-cement ratio, etc. I suspect there has also been some optimization of the mesh.

*Seacrete*. This was a highly experimental, concrete-like material as of the time of writing. Calcium carbonate, from seawater, is electrodeposited on a wire mesh which carries the necessary electrical current (Hibbert, USP 4246075). Seacrete is potentially as strong as concrete. There are a few catches. One is to get high strength, you have to use low currents so the rate of deposit is slow—you have to grow seacrete for a year or more to get a strength of 8000 psi. Another is that all the electricity needed is expensive (see "Seacrete," Wikipedia). And third, there is no moving Seacrete, you grow it where you want the wall (or whatever) to be. So its use is likely to be limited to underwater or coastal structures.

*Pykrete*. This is a composite material made of 14% sawdust (or wood pulp) and 86% water. It is frozen to produce a concrete-like material. In World War II, there was a proposal to use it to make aircraft carriers (Project Habbakuk). A sixty foot experimental structure was constructed and floated at Patricia Lake, Alberta.

*Concrete Cloth*. This is a recent (2003) development, a dry concrete mix-impregnated fabric, usually bonded to the outer surface of an inflatable plastic (PVC). The theory is that the plastic is inflated, the concrete is hydrated, and the concrete cloth hardens into a dome shape, for use as an emergency shelter. (ConcreteCanvas)

*Polymer concrete*. A concrete-like material in which part or all of the cement is replaced with a polymer (e.g., polyester or vinyl ester resin, or latex). The polymer inhibits water absorption. It is often used for emergency repairs because it can obtain useable strength in minutes. Unfortunately, the polymer is expensive (and not immediately available post-RoF).

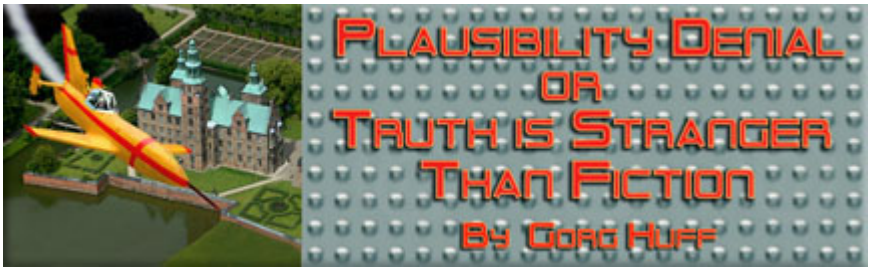
* * *

In Part II of this article, I will explain how concrete is produced, laid and tested, and what sort of structures it could be used to build.

**To be continued in *Grantville Gazette* , Volume 20**

# Plausibility Denial or Truth is Stranger Than Fiction

## Written by Gorg Huff




## *Predictions and Reality*

Some years ago the barflies who frequent the 1632 Tech Manual, after much debate, came up with the number of computers in Mannington, West Virginia. Which was also the number of computers in Grantville. At the most recent 1632 con, we discovered that that estimate was off. As of the year 2000, there were more computers in Mannington than we thought.

Based in large part on library usage, we estimated the number of books in Mannington. Then we found out about a couple of large private libraries. Turns out there are more books in Mannington than we thought.

Estimates were made about the amount of heavy machinery. There was more heavy construction equipment than we thought.

Estimates were made about the precision with which the down-timers could produce products by hand. When checks were made about what they had actually done it turned out that: The down-timers were capable of more precision than we thought.

Is anyone starting to notice a pattern here? I haven't been involved in 1632 Tech from the beginning, but I have been around for a while. And one thing has shown itself to be amazingly consistent throughout:

every learned estimate that has been checked against the facts on the ground—at least all those that I'm aware of—have been off, and all in the same direction. That direction is "less." Less equipment, less knowledge, less craftsmanship, less everything. Up-timer, down-timer, it doesn't matter. It's still always "less."

## *Thought Experiment*

Let's take a break for a bit and try a thought experiment. To do this experiment, go to your local movie rental place and rent *The African Queen* . Now comes the hard part. Watch the movie, but try not to be distracted by the story or the excellent acting of Bogart and Hepburn. Instead, I want you to pay fairly close attention to the boat, and especially the little steam engine it uses for propulsion. Pause the tape, take notes, try to remember everything you've learned about steam engines from grade school on. Then, sit down and, using the movie and what you remember, try to design a small steam engine of comparable power.

Some of you will be able to do this, some won't. If one of ten of you can do so, then steam-powered barges on the Elbe and the lower Saale rivers will become fairly common, fairly quickly. Perhaps as important, small steam mills and shops will come into use in the towns around Grantville, to run things like lathes and small mills.

Now, in your minds eye, consult with some down-time craftsmen. Show them your drawings, tell them about how it's important that the steam be contained in the piston or pistons, then released at the right point in the stroke. Ask your pretend down-timer how he would go about making the pistons and cylinders, the rods, the valves, the crankshaft, and so on. Talk it over with friends from work, get their opinion. The percentage of those who can design a steam engine, compared to those that can't, goes up as errors get caught and concepts get added. One person doesn't have to be able to do it. Five, or six, or a dozen—each knowing different parts of how to do it—can get together and work it out.

Now, do the same thing with airframes, internal combustion engines, suspension systems, and so on. I think you'll be surprised at how often you come up with something that will actually work. It might not work really well, but it'll be an airplane that will fly or a suspension system that's better than they had on the stagecoaches of the old West. It has been said that all technology goes through three phases:

1 - Simple invention that doesn't work really well, like the first steam engine or the first screw on a ship.

2 - Gradual improvement and increasing complexity, like better carburetors, improved ignition systems, timing controls, gearing. In the case of screws/propellers improved tuning for speed, to avoid cavitation, reduce drag and a direct the greatest amount of water rearward. Here the increasing complexity is not in the screws themselves so much as in the design of the screws.

3 - Abandoning an invention for the next. Going from paddle wheels to screws is a good example of this

one. Because even a pretty cruddy screw/propeller has one vast improvement over the best possible paddlewheel. Weight. Screws, even the most perfectly designed, are not nearly as efficient as a paddlewheel in direct terms. However, a paddlewheel weighs so much more than a screw that the improved performance is not worth the excess weight. Not even if it's a pretty crappy screw.

## *Cost Versus Benefit*

In the simplest terms, the value of any product can be measured as the sum of material cost and production cost. The benefit in terms of industrial equipment can be measured in reduction of production cost. So the questions facing any person thinking of investing their time and money in a new production device are:

Will it work?

How much will it benefit us if it does?

In determining—well, guessing about—the answers to those two questions. the potential investor of the seventeenth century had to consider how much they were spending to produce the final product without the innovations. In the seventeenth century, before the Ring of Fire, that involved a couple of very basic problems for people who were considering, or willing to consider, investing in new production techniques. The first of those problems was, to great extent, that they did not really have a means of accurately measuring how much it cost them to make stuff without the new technique. And labor costs were dirt cheap. Together, those factors meant that they were buying a very expensive pig in a poke.

It is mentioned in 1632 that businesses are cropping up all over the place within only months of the Ring of Fire. By September of 1631, you cannot hire people without offering stock options, at least in the opinion of one of the people starting up the chemical plant. So why is that?

Not having so many people shooting at them might have had something to do with it. So did improved roads that meant that goods could be shipped by the wagon load rather than by mule load. The machines and electrical power that the up-timers brought with them must also have been a big help, both in making the production of production machines much cheaper and in facilitating the transport of goods.

However, to my mind the most important change was one of information. The question "will it work" changed to "can we make it work." And the answers, in general, became much more positive.

Cheap labor becomes less of a factor when you add in the amount of time labor takes. The craftsmen of the seventeenth century were often very skilled. They could produce products of exact measurements and fine quality, but doing so with the tools they had before the Ring of Fire took an incredible amount of time. And they had to be paid, at least a little bit, for all that time. If one semiskilled laborer and a machine could make the same number of products in a day as five highly skilled master craftsmen in a

week, the savings are considerable, even when you include the cost of the machine. And with the spreadsheets and amortization calculations available, the estimations of those savings became a lot more solid.

How much time in inventing is spent inventing? What part of the years from first try to successful commercial production is spent actually figuring out how to make a product work? How much time does the inventor spend on the day job? How much time in interesting backers in the concept? More importantly, how much time is spent failing to interest backers in a particular product? In the sixteenth, seventeenth and eighteenth centuries, the amount of time spent on that last factor was measured in decades—and sometimes centuries. In large part, this was because the skills needed to invent something are not necessarily the same as the skills necessary to make a go of the company that will produce the product. And it can be really hard to tell whether a product failed because it just wasn't commercially viable or because the inventor was a lousy business person. Absent evidence to the contrary, the general assumption in the Early Modern period was that the product wasn't viable.

## *The Wietze Oil Fields*

Did they drill for oil or mine oil? Who cares? The reason I don't care is because, whatever they did in our time line, it probably wasn't what Quentin Underwood did in the 1632 time line. Mr. Underwood had access to up-time equipment used for drilling water wells, parts fabricated in the up-timer shops, and certain preconceived notions about how you get oil out of the ground. Once he got to Wietze, he would have learned that the locals had been mining the oil sands and using the tar to pave the local roads and as a patent medicine. It is fairly unlikely that Quentin would have forbidden the local down-timers from continuing their mining operation. In fact, he probably started buying oil sands from them. He would also have started drilling oil wells, because that's the way you get oil out of the ground up-time. After consulting the closest thing the up-timers had to a geologist and the down-timers, he would have had a pretty decent idea of where to drill. He might well have drilled a couple of dry holes. If he was unlucky, he'd have drilled five or six dry holes. This is not by any means a disaster, it's more along the lines of an irritation. Sooner or later, and not much later, he was going to hit oil. The precise details about how all this happened would probably make a really good Gazette story. But it doesn't really matter that much in terms of the larger story arc.

What does matter in terms of the larger story arc, is the simple fact that there's oil at Wietze. Quite a lot of oil, certainly enough to run every machine brought back by the Ring of Fire. Plus all the machines that can be built in the USE until the mid-sixteen forties. It also matters that there is lots of oil in lots of places around the world. Places that are at least generally known. They know where to look.

## *Other nations will be slower . . . but not that much*

Why hasn't Africa become an industrial power house? What about South America? There are, of course, any number of factors, many of them political, but one of them will tend to swamp the rest. Competition. By the mid-twentieth century, large and powerful industrial complexes had been established. To establish an auto factory in Uganda, you would need to make it impractical for the auto manufacturers in the US, Europe and Japan to sell to you and, at the same time, provide enough market to support mass production. The countries you're competing with already have the factories to make the car parts and the cars they build. Their heavy initial investment is already made, and paid for by their sales in other places.

That is not the case in Grantville, the SoTF, or the USE. It will take decades before they can even approach market saturation. Build a sewing machine factory, fine, great. But you're not going to make enough machines to get more than a small percentage of the market. So, six months later—two years at the outside—someone in another part of the USE or in France, Britain, Poland—or all of the above—will start a sewing machine factory. Start a typewriter factory: same thing. Drill an oil well: same thing. Most of the "how to" is in the library and preventing industrial espionage for the little bit left falls somewhere between impractical and impossible. But even if you pass a miracle and manage it, that won't keep your competitors from figuring out the missing bits on their own. Besides, what do you care? You have more customers than you can feed as it is.

An almost effective alternative to the hog-in-the-manger attitude of "We must keep it all" is the notion of franchises. Where the first, or one of the first, to do something makes up a set-up kit which they either sell outright or offer for a percentage of the new business. I say "almost effective" because it still won't keep people from going out on their own to do the same thing. It will just mean that the easiest route to successfully making widgets is to buy the widget franchise package. It's not a new idea or one that the up-timers can fail to be aware of, not with the ubiquitous McDonalds and Pizza Hut franchises. It might seem a bit strange to apply it to manufacturing shoes or sanitary products, but the down-timers were already doing something fairly similar with the spinsters working as jobbers for the cloth makers.

## *And what does this mean?*

1632 Europe is an open market with lots of consumers and room for lots of people getting filthy rich by making lots of new products and old products faster and cheaper. So what does all this have to do with writing stories in the 1632 universe? Well, a couple of things.

One: it's not that important whether or not there is a book telling precisely how to make widget X. If there is, great. But even if there ain't, you can still probably make it a lot faster than it happened in our time line because, if for no other reason, it's going to be a lot easier to find investors. You may not find quite the same way to make it as they did in our time line, in fact you probably won't. You'll skip steps that were needed in our time line which can be replaced by something that wasn't available in 1816 or

whenever the widget you're after was first produced. You'll have to find workarounds for stuff that didn't come back with the Ring of Fire or came back incomplete. You don't actually need a blueprint of a Fresno scraper or a life-size model of the Hindenburg. You can build a Grantville scraper or a lighter-than-air crane support without them. It doesn't hurt to have them, but it doesn't kill your story if you don't.

Two: you don't need up-timers. Like the books, they are convenient but not really necessary. Señor Carlos De Vega in Portugal can—and often should—be your hero, perhaps loyal to the Spanish crown or perhaps seeking an independent Portugal. In either case, working to make himself richer and the world a better place at the same time. Or Lue Chin, who just this morning got hold of a packet of plans from Grantville on how to make a Jacquard loom and realized that with it he can weave complex designs in to his silks and sell them to Japan for twice what he could before. Assuming that whoever is Emperor this week doesn't have him executed for western corruption or steal the factory for taxes.

By now it's out there, folks. The crate load of lamps and bottles are cascading down the hill and genies are popping up like weeds in a poorly tended garden. Air conditioners in Mexico? Sure, why not. After all, by now someone has gone though the books and magazines in Grantville, put together a cheat sheet and published it. It doesn't matter whether the design comes from the 1911 Encyclopedia Britannica, from one of the air conditioners in Grantville, or from down-time experimentation that was given just a few clues. What matters is that Chechiwa, the maid of the Spanish noble that owns the air conditioner, gets a chance to examine it and figure out that with a bit more work it could be used to freeze things and keep them fresh.

So go forth and write stories, tell tall, really tall, tales. Don't worry too much whether the book you read that told you how to build a can opener was in Grantville. By now, it doesn't matter that much. There's a good chance some of those busy researchers at the National Library have put together fairly decent specs and they are being published in German and Latin all over the USE. Don't try to have a Huey sitting in a forgotten valley in Grantville. Have your character build himself a rocket-powered air plane.

And be a bit cautious about telling your fellow barflies they can't build X because the vital bit didn't come though the Ring of Fire. A lot more stuff came though than was noticed at first glance. And even if the vital bit didn't make it through, there is probably a workaround.

Go find it.


* * *

# Wingless Wonders

## Written by Kevin H. Evans


Lighter-than-air technology is a lot like the game Go. It is easy to learn, but very hard to master. Many countries tried the technology, but only a few managed to master it. By far the largest number of rigid airships were built by Germany. On the other hand, the United States was the country which built the most non-rigid airships. Both countries expended large amounts of resources and effort in perfecting the technology. Other countries, in an effort to keep pace in the lighter-than-air race, created airships that were both technologically inferior and poorly operated. Many of these efforts represent some of the worst accidents in lighter-than-air history.

This technology, although considered by many to be obsolete, is actually quite useful and is coming back into use in modern technology. The following article is mostly about what we would need to do to use this technology in the post-Ring of Fire time frame.

## *Glossary*

Normally I put the definition list at the end of the article, but I have seen such a large variation in terminology, that I want to put the list up front.

***Dirigible*** – any aircraft that is controllable as it flies through the air. ***Rigid Airship -*** any aircraft that has a framework inside the skin which provides shape and support for the aircraft. ***Non-rigid Airship -*** an aircraft that depends on pressurization to maintain it's shape. ***Semi-rigid Airship -*** an aircraft that has a keel and framework in the ends to support the load and provide shape to the airship. ***Balloon -*** a non-powered aircraft that depends on lifting gas to make it fly. ***Aerostat -*** any aircraft that depends on lift generated by an internal gas. ***Ballonet -*** an internal balloon used to provide pressure and shape to a non rigid airship. ***Gas cell -*** a container to hold lifting gas in a rigid airship. ***Lift -*** the force that holds the aircraft in the air. ***Drag -*** the force that impedes the aircraft as it moves through the air. ***Thrust -*** the force that propels the aircraft through the air. ***Control surface -*** devices that allow changes in attitude of the aircraft. ***Density -*** the weight of a gas as measured in pounds per cubic inch. ***Gross weight -*** the total weight of the aircraft including cargo and crew.

## *Tech Work-Arounds*

Certainly many of the currently used materials and techniques are not available post-ROF and so work-arounds need to be developed for those items. Further, some items are very expensive and a cheaper item needs to be developed to use it its place. Throughout the text suitable workarounds will be mentioned where possible.

## *How Lift Works*

Lift can be generated dynamically, as in a heaver-than-air aircraft, by moving the aircraft through the air. Indeed many modern aircraft when un-powered, have the flight characteristics of a brick, and depend on a continuous application of thrust to keep the craft in the air.

Lift can also be generated statically, as in aerostats, by using a lifting gas. This gas provides lift by displacing the atmosphere, which is denser and heavy, causing the container of lighter gas to float on top of the thicker air. The lighter the gas, the more it can lift. How much a gas will lift will be described later on.

## *Captive Balloons*

These are balloons that are attached to the ground with an anchor. Such balloons are useful as observation platforms, entertainment devices, advertising, and as a "skyhook" for use as a crane. Captive balloons used as observation points have the advantage of allowing a communication wire to be attached

to the tether, making telegraph or voice communications possible.

Balloons can be used for entertainment (rides) or advertising icons. Both are effective as a result of their size, eye catching colors, position overhead, and sense of fantastic unreality.

Balloon cranes have been used in to modern times as efficient transportation devices. One of the biggest advantages is the ability to transport bulky items (like logs or large stone blocks) across distances without the need for cutting roads or obtaining access through congested urban areas. This transport is achieved via the use of a cable affixed to a mast or hill top and using a traveling block and tackle mounted on a pulley. The use of a sufficiently large balloon allows lifts of weights in the tens of tons.

## *Free Balloons*

This is the category of balloons that are inflated and released. Such balloons are subject to the wind and go where the wind pushes them. This does not mean that they are uncontrolled or un-guidable. They can be flown to locations by picking the wind layer going in the direction desired.

Free balloons can not "tack" like a ship because they have no counter-drag. A ship has the water it floats through to provide drag or resistance. This drag acts as a modification to the thrust of the wind allowing progress against the wind. Balloons are so large that the size of the envelope makes any secondary sail drag streamer or other passive device irrelevant. The closest a free balloon comes to tacking is when a pilot can balance the balloon on the interface between two wind layers and go in a third direction. This maneuver requires great skill and the existence suitable wind layers.

## *Airships*

What we know as airships are aerostats that have the ability to be guided to a desired point regardless of the direction of the wind. The ability to guide an airship depends on the addition of thrust and control surfaces to the airship. This thrust is generally provided by propellers powered by engines attached to the airship. Also of note is the need for the airship to have a means of maintaining its shape. Moving a large object through the air faster than the air is moving causes stress on the object, and as the stress increases the object distorts in shape causing increased drag and unstable movement. Shape distortion can be severe enough to cause the venting of the lifting gasses and loss of lift.

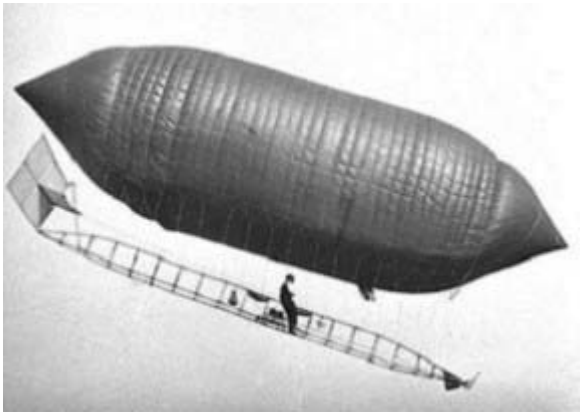
## *Rigid Airships*

Airships that have a system of internal stiffening are known as Rigid Airships. The internal structure provides shape to the airship and support for its equipment. Normally the frame is covered by a skin which is hardened by a "dope" that colors the skin and increases the skin's durability. Lifting gasses are contained in gas cells which are attached to the frame. Power plants, holds, cabins, control cars, and control surfaces are also attached to the frame. This class of airship also tends to be larger as the weight of the frame increases the dead weight which in turn makes the size needed to lift the gross weight larger.

## *Semi-rigid Airships*

These airships are much like their rigid cousins. That is, they have a keel to support equipment. Often this includes a nose-cone frame to resist the forces created by forward movement and a tail cone to support the control surfaces. A semi-rigid design saves much of the weight attached to a rigid design but can make non inflated storage complicated. Semi-rigid designs often include elements of non-rigid designs, notably ballonets to aid in maintaining the shape of the envelope.

## *Non-rigid Airships*



In a non-rigid airship, the skin is the gas-containing device. Shape of the skin is maintained by the use of a ballonet. A ballonet is a cell within the skin that is pressurized to create induced pressure on the skin and so maintain the shape of the airship. It is usually only about five percent of the total envelope capacity, and is only necessary to maintain the desired shape of the airship. It is notable that the ballonet is normally filled with air pumped in from the outside of the skin and thus can be regulated without loss of the lifting gasses. Equipment is usually mounted on the control car, which is hung from a cantenary curtain attached to the top inside of the skin.

## *Other Classes of Airship*

In our time line, near the end of the airship age, (in the 1940s and 50s) developers were experimenting with airships called metal-clads. Metal-clads were airships that had a skin composed of aluminum and had elements of rigid and non-rigid design. The greatest advantage was that the metal skin almost completely stopped leakage of the lifting gasses. The best known of these was the US ZMC-2 called the "Tin Bubble." The Tin Bubble was perhaps the most successful of the U.S. Navy's airships. This airship was so reliable that it used up two sets of engines before it was retired from service.

In addition were classes where a significant portion of the lift was provided by the shape of the airship, and acted much like more standard aircraft.

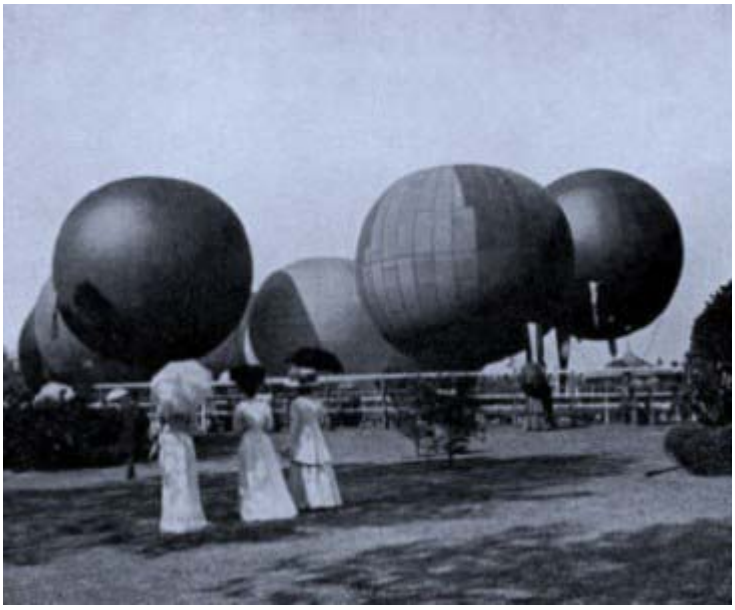
# *Lifting Gasses*

Flight in LTA ( lighter than air) is a result of static lift. That is lift that exists whether the aircraft is moving or not. This lift is generated by the difference in weight of the contained gas compared to the atmospheric gas the aircraft is immersed in. By and large there are three gasses in use for lift and a few more gasses that can work but are marginal in application. In our time line, we use hydrogen, helium, and hot air as lifting gasses. Some commercial city gasses such as natural gas and ammonia are also lighter than air and have been used as lifting gasses. But they are not a lot lighter than air and require a much larger volume to be effective. Of the big three, hydrogen is the lightest and provides the most lift, approximately 66 lb per 1000 cubic feet. Helium will lift around 44 lb per 1000 cubic feet . And hot air will lift around 20 lb per 1000 cubic feet.

Each of these gasses have advantages and disadvantages. Hydrogen will burn, helium is extremely hard to find, and lift from hot air varies depends on the air pressure, temperature and humidity present during its use. On the other hand, hydrogen can lift a lot, helium is non-flammable, and hot air is easy to get and can be used with minimal crews and facilities. For example, to lift one ton hydrogen needs 30,304 cubic feet of gas, with a sphere of 39 feet in diameter. Helium needs a sphere 44 feet in diameter with a volume of 45,454.4 cubic feet. Hot air varies (18-24 lb per 1000 cubic feet) but for design purposes is centered at 20 lb per 1000 cubic feet. This results in a sphere of 57 feet in diameter with a volume of 100,000 cubic feet.

Of the lifting gasses now used, helium is right out for the Ring of Fire. The only known source of helium in usable quantities is a set of gas wells in the western half of the North American continent. Both the location and the technology needed will make this gas impractical.

This leaves hydrogen and hot air as usable alternatives. Hydrogen will lift 30% more than helium and is much easier to get. Hot air will lift just less than half of helium, but is even more simple to get. The disadvantages are that hydrogen burns with great enthusiasm, and hot air needs the frequent application of heat to keep its lift.



Hydrogen has had a bad reputation since the 1930s, but has become much more favored in the last ten or so years. Much of the reputation was due to a number of accidents caused by an imperfect understanding of the gas and electricity. New practices and designs have significantly lowered the hazards

of hydrogen. Long distance gas balloon racing has switched more and more to hydrogen due to it's substantially lower cost and greater lifting capacity.

Most important among the new practices for hydrogen use is that the aircraft must be a single entity in relation to conducting electricity. This oneness of structure prevents arcing from one section to another section of the aircraft and denies any ambient hydrogen an ignition source. Also the envelope must be adequately vented so as to allow any leakage of gas to immediately exit the aircraft. And finally the gas cells must be frequently emptied and refilled with pure hydrogen, as oxygen has a tendency to migrate in to the gas cell, creating what is called a rotten cell. That is a cell that is easily combustible due to the availability of oxygen in the mix.

Hot air has a lower lifting capacity and requires an aircraft of roughly three times the size for an equivalent amount of lift. Also significant allowance must be made for fuel to maintain the heat in the air, this fuel is in addition to the fuel for used for motive power if any. Currently in our timeline, fuel requirements have been going down with the use of redesigned materials. A standard hot air balloon usually gets about an hour and a half of flight time from twenty gallons of fuel. New materials have allowed as much as thirty hours of flight from the same amount of fuel. Surprisingly the biggest modification has been a multiple layer approach that reduces the heat transfer out of the envelope. Hot air also has another great advantage, because the typical balloon or airship is non-rigid it stores in a much smaller space and can be handled and crewed by significantly smaller numbers of people.

## *Power Plants*

Many types of aerostats need power plants. Airships need them to move through the air and hot air balloons need them to heat the air inside to provide lift. A power plant should be light. That is, they need to have a good power-to-weight ratio and should be dependable. Traditionally, diesel and gasoline have been the fuels of choice, but kerosene and propane have also been used. Due to the ability of an airship to provide static lift, lower horsepower engines are usable. Lower horsepower engines provide economy in fuel and cost of the engines. Additionally, other types of power plants have been used, with steam and hot air (Carnot cycle) engines being the most common. The lifting gas used also affects the power plant, with the power being mounted inside the envelope when using nonflammable gasses (allowing easy engine maintenance) and mounting the plants outboard when flammable gasses are used. Power plants for hot air balloons are the burners used to heat the air inside the balloon. Such burners normally provide 2 to 6 million BTUs to the air inside the envelope depending on the size of the air mass to be heated.

Modern airships are powered by a variety of means, most commonly the internal combustion engine. Such engines are in limited supply in the immediately post-ROF world, but will become more common as knowledge and tooling spread out from Grantville. Many internal combustion engines need tight tolerances and advanced lubricants, however there are large numbers of engines possible at a lower technical expertise.

In 1900 the "gnome rotary" (an engine where the cylinder block spun and the pistons were attached to the frame) was invented. This engine was a single valve (per cylinder) with the fuel fed from the center crankshaft along with the lubrication, all of which was exhausted from the cylinder each rotation of the block. This is the engine that made all early airplanes possible. Their major disadvantage was that they were a single-pass lubrication. That is, the oil is used once, and ejected from the engine. This oil was castor oil, and the engine moved in a constant cloud of oil vapor.

By the way, this accounts for the drinking tradition of fighter pilots. Since the pilot was bathed in a cloud of castor oil, they ingested large amounts of it. In an effort to absorb some kind of food value that was not "cleansed away" by the qualities of castor oil, they took in vast quantities of wine and beer as the alcohol metabolized quickly, before the colonic took everything else away. At least, that was the excuse. If this sort of engine is used in an airship, since it would be mounted below or behind the cabin, airship pilots would be "beyond" this sort of problem.

In 1903 the Wright brothers made their engine in a bicycle shop. This was a standard internal combustion engine of four cylinders using the Otto cycle. Such engines are not high compression, efficient, or even very powerful. But they work, dependably and every time (mostly). Further, such engines can be made with low tolerances and primitive machine tools.

Steam power is also an option. A steam generator (a flash boiler), a light weight engine, and a condensing coil can be made well within the weight limits available.

Last, a Carnot cycle engine removes even the need for water as a working fluid, but does so at a need for much higher tolerances. So much so that the internal combustion engine, with it's low tolerances claimed the position of first choice among engines, and so received almost all the research and development in our culture.

## *Envelope Construction*

Envelopes are constructed from materials that are impervious or resistant to passage of the lifting gas. Of note is that the rigid frame airship has gas-containing cells inside the frame with a cloth covering over the frame that provides a smooth surface to the outside environment.

Traditionally the great airships of the 1930s used a material called goldbeaters skin to form the gas-containing area. Goldbeaters skin is made from the lining of an ox stomach and had the dual properties of being impervious to hydrogen gas and of making gas-tight seals when the edges are properly treated and placed together. The problem with this material is that the total amount of "skin" per oxen is very small (not much larger than a sheet of paper), and thus needs a lot of dead oxen, with over

200,000 used for a ship like the Hindenburg.

Currently most airships use a layered fabric made from cloth treated with latex or Mylar. Mylar is also used solo as a gas-containing material in some airships. Gas balloons are made from treated nylon, because the lifting gas is vented in flight as part of the control process. Hot air balloons are normally made from treated rip stop nylon. It is important to note that the use of the nylon imposes a maximum usable temperature, as too much heat will melt the envelope.

Physically the envelopes are normally made from a set of segments called gores. The gores are sewn together using "French seams" which are double sewn and leave no loose ends. Additionally some seams may have a load-bearing tape or wire enclosed to provide strength to the envelope and give places where the load can be attached.

The best envelope ever constructed was that of the ZMC-2, a semi-rigid airship called by its crew the "Tin Bubble." This envelope was a three layer sandwich of aluminum that allowed gas leakage only at the valves and outlasted two sets of engines. Alas, large quantities of aluminum are probably out of reach for the near- and mid-future in the 1630s.

By far, the largest number of envelopes were made from latex-impregnated fabric. Over 150 such aircraft envelopes were made for the US Navy alone. Nylon, polyester, and rayon are also popular materials for envelopes. Of all of these, the cotton and latex fabric is the most feasible for the ROF. Cotton cloth is available in large quantities from India, and latex is found in usable quantities in a number of common plants notably dandelions, ragweed, and milkweed. And so the manufacture of this fabric is possible in the post ROF time line.

## *Structure*

The material of choice for airships is aluminum. As previously mentioned, aluminum will not be available in large quantities for some time. Rigid airships will need something else. A substitute, actually used by the German navy in World War I, was wood. Split and laminated spruce is light, strong, and provides many of the properties of aluminum. The downfall of wood is its slightly greater weight by volume for the same strength, and its tendency to absorb moisture. Moisture makes the wood heavy and can cause degradation of the lamination in the frame. One of the cures is to coat the frame in varnish. This excludes the moisture but adds to the overall weight.

## *Applications*

Aerostats have both civil and military uses. Almost any conceivable activity can be customized for either use. At first glance the military would seem to be a higher priority, but commercial uses may greatly outstrip military uses in value.

The most immediate use would be transportation. Properly constructed, an airship can move large cargos to remote areas with little or no infrastructure on the receiving end. An airship of 1.5 million cubic feet (440' X 70') would carry 50 tons gross weight. Assuming fifteen tons of vehicle and crew, that gives thirty-five tons of cargo delivered anywhere.

Power requirements for an airship are significantly lower than aircraft of the same capacity due to static lift of the gas. Handling and storage can be greatly simplified with proper terminal design and vectored thrust engines (Mount them on pivots to allow maneuvering against the wind.)

Militarily this would allow the delivery of high priority cargos to the battlefield. Commercially, an airship could pick up a cargo from the factory and deliver it directly to the customer, even position the cargo in the case of a large item like a generator rotor for a large hydraulic plant. A company, "Cargolifter" had built a prototype and had obtained terminal facilities to begin operations in 2002. It lost funding in the stock market crash of that year, and so never built beyond the prototype.

The ability of an airship to hang in one spot makes it an unsurpassed observation platform. Combined with a radio, and a telescope, airships can provide search and rescue, survey, and battlefield reconnaissance. Tether balloons also have great utility as an observation platform and gave significant advantages to the forces using them in the American Civil War. Convoys escorted by blimps used by the US Navy suffered no losses to submarines in WWII due primarily to the airship's ability to maintain station on the convoy and look directly down into the water for the submarines. Also the Navy had a number of rigid airships that were used as scouting elements for the fleet allowing a very large area to be surveyed in combat conditions. These airships were also aircraft carriers and could launch and recover aircraft while in flight to further expand their coverage.

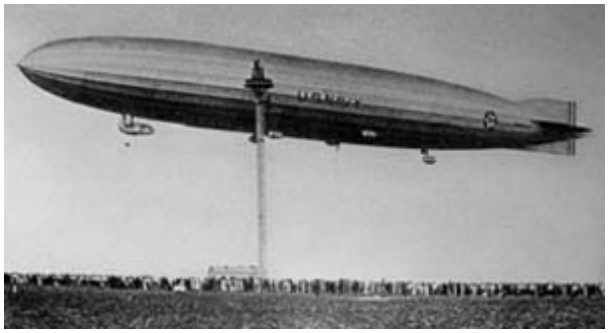
Another use is to lift really large loads with a minimal infrastructure. "Sky Cranes" were used in the logging industry to reduce the need for cutting roads and make transportation fast and easy. Tethered balloons can lift and position large loads in crowded urban environments. Militarily, a cargo lifting balloon can speed cargo load-on in forward areas without the need for heavy cranes or large scale ground stabilization for lifts and loaders.

The last area that I will mention is recreation, including passenger transport. The *Graf Zeppelin* (LZ127) logged more than a million miles of passenger transport. All these miles were without accident and using hydrogen as a lifting medium. The *Graf* also made the first non-stop flight across the Pacific in 1929. In the 20's and 30's numerous point-to-point air routes were in use as fast luxury travel in Germany. While the *Queen Elizabeth* could make twenty knots, the *Graf* averaged eighty. So an Atlantic crossing would take the ship an average of twelve days. The airship could make the trip in three. The most common run for *Graf Zeppelin* was Berlin to Buenos Aires nonstop. It was not until after World War II that any commercial airplane could attempt the same trip.

## *Weather*

Another item that needs to be specifically covered is the handling of the airship in rough weather conditions. Like fixed-wing aircraft, airships have conditions where they cannot fly. High wind conditions, and thunderheads are the two biggest killers of airships. In a high wind, that is 60 miles an hour or more,

airships have great difficulty in flying against the wind. One early proto-type aerostat was scheduled for a trip into Germany, but was delayed several days, because no progress can be made against the wind. While this was not fatal for the airship, it did cause the airship to have a delay in its service.



The other big weather problem are extreme thunderstorms. The *Shenandoah* , an airship flown by the U.S. Army, was lost when its captain decided to fly through a line squall of thunderheads. This resulted in the airship being broken into three pieces and the death of over half of the crew. However, these weather conditions also affect fixed-wing aircraft in very much the same manner. Even at our level of technology, the weather still is king. Therefore an airship needs special facilities to keep it safe from the weather when not in use.

This is usually a hangar large enough to contain the whole airship and strong enough to resist any wind that hits it. An alternative to a hangar, is to have a tower with a pivot connector that hooks to the bow of the airship, and a track that circles the tower, so that the back of the airship can be connected to a cart that runs on the track. This allows the airship to change its orientation much like a weathervane so that wind resistance is minimized. Certainly the most important means of safe flight in bad weather is knowing when not to fly.

## *Sample Aerostats*

In describing sample aerostats the following criteria will be used:

Purpose, gross lift, weight, useful lift, cubic capacity, shape, dimensions, speed, power plant, lifting gas used, and rough cost.

First a small thermal airship.

This is a recreation and sport aircraft designed for local use buy a hobbyist.

The cubic capacity is 150,000 feet.

The gross lift is 3000 lb @ 20 lb per 1000 cubic feet.

The weight of the airship is roughly 1500 lb (600 lb envelope, 400 lb basket, 500 lb fuel and power plant).

The airship is an ellipsoid (cigar shaped).

The airship is roughly 160 feet long by 40 feet in diameter.

In still air the airship can attain 30 mph.

The airship is powered by two 40 hp air-cooled engines with ducted fan propellers.

Lift is provided by hot air created by burners internal to the envelope.

The rough cost is 80,000 to 95,000 $USE primarily due to the cost of the fabric.

This airship is a recreational vehicle for a hobbyist. The design is based around the thermal airships in current use in our time line for competition and light advertising. It is a pressurized envelope with internal burners. Pressure in the envelope is maintained by a fan forcing air in to the envelope and controlled by a pressure relief valve in the nose. Landing and emergency venting of the envelope is by means of "parachute" valve in the top front of the envelope. This allows the venting of hot air for rapid descent or emergency deflation on landing if needed.

The construction is basically non-rigid, with the load of the "car" carried on cantenary wires from the crown of the envelope. Control surfaces are mounted on the car, and consist of an inverted "V" tail placed in the slipstream of the engines.

Operation of the control surfaces is by means of cables between a yoke in the pilot's position and the tail planes. The engines are mounted on the rear sides of the car and can be pivoted 270 degrees for climb and dive. Control of the engines is also by cables and include speed and pivot position. Instrumentation includes an altimeter, a vertical sink indicator, fuel gauge, an internal temperature readout for the envelope, and a sight ring for estimating speed.

A flight would proceed as follows. With the car and envelope unloaded from storage, the car would be oriented with the long dimension of the envelope parallel to the wind (bow upwind). The envelope would be spread out in preparation for the cold inflate. The bow line is attached to an anchor strong enough to hold the airship against any wind present.

The envelope pressure valve is tested, the burners are mounted to the car outside of the envelope (which is displaced to the side for the test) and hooked up to the propane supply tanks. The burners are then test fired for a preflight check. After the burners cool they are mounted inside the envelope and the envelope is sealed.

Cold inflation is by the fan used to maintain pressure in the envelope. Unlike a hot air balloon, the cold inflation causes the envelope to fill and stand above the car even without the hot air. During cold inflation the control surfaces and engine tilt are operated to insure that they are functioning. Once cold inflation is complete, the burner pilot-lights are lit and the burners are operated to put hot air in the envelope. The crown vent is checked to insure that the control rope is free and functioning.

As the lift increases, crew and passengers are boarded. The engines are started and run through their power range then set to idle. The burners are run until positive lift is achieved. The engines are run up until the bow rope is slack, then the anchor is cast off and some tilt is given to the engines to lift off.

During flight attention is focused on maintaining level flight via the VSI and burner control. The pilot also maintains the desired course. Maximum recommended altitude is 18,000 feet. There are serious oxygen issues over 15,000 feet. Typical endurances for this type of airship is two and a half to three hours. Recommended flight times should not exceed two hours, allowing a reserve of air time for emergencies.

Landing is begun by approaching the desired landing site from downwind, and flying against the wind up

to the landing site. The airship loses altitude by allowing the air in the envelope to cool, venting air, and engine tilt as needed. The ground crew captures the bow rope and attaches it to the anchor. The air is allowed to cool (or is vented) until negative buoyancy is achieved. Any ground operations are carried out such as ground crew holding lines, or maneuvering the basket. Also, more fuel and passengers or cargo could be loaded, and so start another flight.

Shut down of the airship requires that the burners are extinguished, and allowed to cool. Then the pressure fan is stopped, and the crown vent is opened. The tanks are removed and the envelope is rolled up and placed in the car, and the airship is placed in storage.

Next, a rigid cargo airship

This is a medium-sized ridge airship primarily used to transport cargo.

Gross lift is 50 tons (100,000 lb)

The airship weighs about 15 tons (with fuel and crew)

Useful lift is around 35 tons.

The envelope holds 1,500,000 cubic feet.

The airship is an ellipsoid (cigar shaped) with external control car, control surfaces, and engines.

The envelope is about 440 feet long and 70 feet in diameter, cargo is slung below the keel.

As equipped the airship can travel 65-70 mph at full power.

Power is provided by six nine-cylinder steam engines, with 300 hp generated when running at full speed. (2200 rpm, 400 psi). Engines are rotary, with bash valve steam admission, composed of nine single-acting pistons each. Exhausted steam is recovered and condensed. Steam is made by mono-tube "flash" boilers, with a boiler, condenser, and engine all housed in each "pod."

Lifting gas is hydrogen, with an average lift of 66 lb per 1000 cubic feet. This is a SWAG but cost should be in the neighborhood of 1.5 to 3 million $USE.

This airship is a cargo hauler. The airship has a frame with a skin on the outside and gas cells inside for

lift. Control car engines and cargo are mounted outside the envelope. The cargo is carried in a container slung below the keel of the airship below the center of gravity. Further the container should be standardized to also fit truck and railcars, making it a true intermodal system. (Note that anything that can be balanced and slung could also be carried.) All the engine pods are powering ducted fans, and are mounted so as to be rotated for vectored thrust, allowing the airship to be "parked" while loading and unloading the container or cargo.

Such airships could pick up and deliver cargo almost anywhere. When not in use more elaborate basing systems are needed. Best is enclosed hanger space, allowing the airship to be stored in "flight," or filled with lifting gasses. Next best is a central tower with a ring of track around it, this allows the airship to be docked to the tower by the nose and rotate around the tower in accordance with the wind. The ring track allows the rear of the airship to be tethered to a rail car, allowing control of the whole airship on the ground.

Air crew would include enough bridge crew to stand twenty four hour watches, (Helm and watch officer x 3) and a chief engineer, and enough engine crew to stand watch on each engine pod, (1+(6*3)), and a cargo officer. This gives a crew of at least 15.

Off duty crew are accommodated inside the envelope at the keel of the airship. Since the gas cells of this ship are smaller than the skin of the ship, there is sufficient room for crew quarters a small living space. It would be not much more than a space to sling hammocks when not on duty. Food preparation would be without flame, so would probably be cold prepared foods in flight. While this ship is capable of longer flights, it would be most used for one or two day trips.

Such an airship should also have enough fuel for ten days cruise, giving a sustained cruise of 12,000 miles at fifty mph. Such a speed would allow easy one day trips to any part of Europe. A typical day would be, at the main base, fuel and preflight, load ballast, launch, fly to intermodal yard and pick up outbound container, (20,000 lb of cane crushing widgets, and 40,000lb of mixed cargo), drop ballast, fly to Amsterdam intermodal yard, drop container, pick up 60,000 lb container of new world Rum, return to Magdeburg intermodal yard, drop cargo, pick up ballast, return to base, moor to handling equipment, move to hanger, rinse and repeat. Bulk cargos could make lots of money. In 1657, England averaged 400 ships a year, with 150 tons of cargo each, just of sugar.

Last, a sky crane.

The aerostat is a tethered balloon, used as a construction crane.

Balloon gross lift is four tons. (8,000 lb)

The weight of the flying tackle (balloon, lift harness, ropes and pulleys, etc) is 3,000.

Max free lift is 5,000 lb , working lift is 4,000 lb.

Cubic capacity of the aerostat is just under 121,300 cubic feet. (hydrogen at 66 lb per 1000 cubic feet)

The aerostat is a sphere, roughly 28.7 feet in diameter. 2588 square feet surface area.

Aerostat is tethered, no power plant or on board crew.

This aerostat is a stationary lifting device. It's purpose is to pick up heavy things and put them, precisely,

in an exact spot. The envelope is constructed of sealed cloth inside a net. The net supports the "flying tackle" that is, ropes, pulleys, and control systems. The balloon is tethered to the ground by three adjustable anchor ropes.

In use, the balloon would first be topped with off with gas for the day's work. The control tackle (the three tether ropes) are let out until the balloon is above the first load of the day. The flying tackle is attached to the load, and the control tackle is let out until the balloon is above the desired unloading position. The maneuvering of the balloon is by means of the three control tackles. The flying tackle is then let out until the load is in position. The load is removed from the flying tackle, and the balloon is repositioned for the next load.

System cost is the envelope and the tackles. The envelope is 2588 square feet of fabric, and the netting. The four tackles are a set of blocks and rope each strong enough to hold the max load (16,000 lb allowing safety factor). Total cost should be close to 150,000 $USE.

## *The Grantville Connection*

In Grantville, purpose-built lifting and recreational aerostats will come in to existence as soon as the need is perceived. Some members of the community have prior experience with sport ballooning, and others may have a historic interest. Lifting balloons may be especially attractive when high-capacity cranes are found to be difficult to build, with movement of the crane systems being another large concern. Information sources to be found in Grantville are encyclopedias and personal libraries of the sport ballooning enthusiasts in town. Most notably, the *Encyclopedia Americana* , and the *Encyclopedia Britannica* . While the articles are not highly detailed, they do give enough information to get lighter-than-air technology started. The biggest factor in lighter-than-air development will be that the people know it is possible and will try stuff until they make it work.

The biggest concern however will be overcoming the "it's not modern enough" bias built in to the up-timer mentality. In our time line, airship travel was abandoned just as really efficient airships entered the market. This abandonment has been attributed to the dangers of flammable lifting gasses, but is probably more due to the outbreak of World War II.

Post war, the facilities and technologies created during the war lead the aviation industry in a different direction. Airplanes were available from army surplus, air bases were located around the world, and we had gotten used to the idea of large airplanes with internal combustion engines. With such momentum, research and development of airships did not recommence until the 1980s.

## *The Rest of the World*

Airships will be very attractive to down-time political units. Static lift provides flight with much lower horsepower demands. Also, airships give a limited technology plant a lot of "bang for its buck" when large numbers of complex engines are difficult or impossible to make. Large lifters will allow comparable cargo amounts to be shifted, and will allow the "We fly too" for the polity. As with many other concepts, just the knowledge that it is possible will spur development.

In regard to those hostile to Grantville or the USE, having something that flies will allow them to gain some equality on the field of conflict. The benefits from scouting alone make any kind of aerial vehicle well worth the effort. This is not exclusively limited to powered airships. Tethered balloons with some type of signaling apparatus, either a wired teletype, or even signal flags, can be invaluable on the battlefield. Having timely pertinent information as to what is really going on and can be an enormous force

multiplier. Said information can be the difference between winning or losing the battle especially in this time period.

Another use that may be of interest to the world is to have a small airship as part of the equipment of a naval warship. The small airship is not intended to do any combat, but it is to be used as a scout to increase the amount of area that the warship can see and therefore control. Having such a scout will allow fewer numbers of ships to control larger amounts of space, thus making each ship much more flexible in allowing the use of fewer ships for the same amount of work.

## *Conclusion*

Lighter-than-air vehicles will have a window of utility where they can be the best alternative for a developing aeronautical program, especially outside the Ring of Fire. As has been stated, lighter than air vehicles will allow nations who are developing new technology, to maximize the amount of aerial capacity for the material they expend in their flight programs. Well-developed airships will be able to carry more weight sooner than comparable aircraft, especially as ground facilities will have to be developed for those aircraft. Nevertheless, heavier-than-air aircraft will dominate where air speed is more important than capacity. To say it another way, if you want to go in comfort take an airship but, if you want to get there right now take the plane.

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**THE END**