

Grantville Gazette

Volume 12

Eric Flint

&

Grantville Gazette Staff

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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 advanced 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

The Anaconda Project,
Episode One
Written by Eric Flint

Chapter 1. The Map

"This is absurd," said Morris Roth, as forcefully as he could. He had a bad feeling that wasn't very forceful at all, given that he was wearing an absurd costume—he thought it was absurd, anyway, although it was just standard seventeenth century courtier's clothing. The entire situation was absurd.

A bit desperately, he repeated the statement. "This is absurd." After a couple of seconds, he remembered to add: "Your Majesty."

Fortunately, Wallenstein seemed to be in one of his whimsical moods, where the same possible slight that might have angered him at another time merely seemed to be a source of amusement. General Pappenheim—damn his black soul to whatever hideous afterlife there might be even if Morris didn't believe in hell in the first place—was grinning outright.

"Ah, Morris. So modest!" Pappenheim's scarred face was distorted still further as the grin widened. "How can you claim such a complete absence of heroic qualities? You! The Don at the Bridge!"

Morris glared at him. "It was just a job that needed doing, that's all. So I did it. But what sort of lunatic—ah . . ."

Calling the King of Bohemia a "lunatic" to his face was probably not wise. Morris was nimble-witted enough even under the circumstances to veer in midstream. So to speak.

"—what sort of misguided and misadvised person would confuse me with a blasted general? Your Majesty, General Pappenheim, I am *ajeweler*."

"What sort of person?" asked Wallenstein, chuckling softly. "A lunatic, perhaps. The same sort of lunatic who recently proclaimed himself King of Bohemia despite—yes, I will say it myself—a claim to the throne that is so threadbare it would shame a pauper. But who cares? Since I am also the same lunatic who won the second Battle of the White Mountain."

They were in the small salon in the palace that Wallenstein favored for intimate meetings. He planted his hands on the armrest of his rather modest chair and levered himself erect.

"Levered" was the correct term, too. Wallenstein's health, always delicate, had been getting worse of late. Morris knew from private remarks by Wallenstein's up-time nurse Edith Wild that she was increasingly worried about it. Some of the new king of Bohemia's frailty was due to the rigors of his military life. But some of it wasn't. Wallenstein, unfortunately, was superstitious and still placed great faith in the advice of his new astrologers—including their advice on his diet. Morris had once heard Edith mutter that she was *this close*—a thumb and fingertip indicated perhaps an eighth of an inch—to getting her revolver and gunning down the astrologers.

It was not an inconceivable thought, actually. Edith was quite ferocious, in her own way, as she'd proved when she'd shot dead the assassination team sent to murder Wallenstein a few months earlier. The reason Wallenstein had "new" astrologers was because they'd replaced some of the old ones who'd been implicated in the plot.

"A jeweler," Morris repeated. Even to his ears, the words sounded like a whine.

Pappenheim waved his hand airily. "And what of it? Every great general began his life as something else. Even a baker, perhaps."

Morris glared at him again. "'Began his life.' I am in my fifties, for the love of God."

"Don Morris, enough," said Wallenstein firmly. "Your reluctance to assume the post of general in my army simply reinforces my conviction that I have made the right decision."

"Why, Your Majesty?" demanded Morris, just as firmly. One of Wallenstein's saving graces was that the man didn't object to subordinates challenging him, up to a point, provided they were polite about it. "My military experience is limited to that of an enlisted soldier in the American army of another universe. What we called a 'grunt'—with exactly the connotations you'd expect from the term. To make things worse, I wasn't even in a combat unit. I was essentially a quartermaster's clerk, that's all, keeping military supply records."

Smiling, Wallenstein looked at Pappenheim. For his part, Bohemia's top general still had the same wolf-like grin on his face.

"Limited to that? Oh, surely not, Don Morris," said Pappenheim cheerily. "You forget the Battle of the Bridge. Which you led—not even you will deny that much—and which has since entered the legends of the Jews all across eastern Europe."

Morris grit his teeth. "I said. It was just a job that needed to be done, and—"

"Enough, Morris," repeated Wallenstein.

Morris fell silent. The fact that the King of Bohemia had dropped the honorific "Don"—which was an informal term, but significant nonetheless—made clear that he considered the argument at an end. Whether Morris liked it or not, his new post as a general in the Bohemian army was a done deal.

"Follow me," said Wallenstein, heading toward one of the doors in the small chamber. Even though Wallenstein was only fifty years old, he moved like a man twenty years older. It was rather painful to watch.

After following Wallenstein and Pappenheim through the door, Morris found himself in a chamber in the palace he'd never seen before. The chamber, also a small one, was completely dominated by a large table in the center of the room. The table itself was dominated by huge maps that covered almost its entire surface.

Once Morris was close enough to see the map on the very top of the pile, he had to restrain himself from hissing.

So. Here it was. He'd heard rumors of the thing, but never seen it.

The map had no legend, but the title of it was plain enough even if invisible. *The Future Empire of Wallenstein the Great*, would do quite nicely.

Wallenstein and Pappenheim said nothing, for a while, giving Morris the time to study the map.

His first impression never changed. The map could also have been titled *How Little Bohemia Became an Anaconda*.

Indeed, the "Bohemia" that the top map projected into the future did look like a constrictor, albeit a fat one. On the west, serving for the serpent's head, lay Bohemia, Moravia and Silesia. Then, came a neck to the east, in the form a new province that Wallenstein had labeled "Slovakia." Presumably, he'd picked the name from one of the future history books he'd acquired. Which was all fine and dandy, except that in the here and now there was no country called "Slovakia." What there was in its place was the region of the Austrian empire known as the northern part of "Royal Hungary," the rump of Hungary that had been left to it by the Ottoman Turks after their victory over the Kingdom of Hungary at the Battle of Mohács in 1526.

So. War with Austria. Check.

Of course, that was pretty much a given, with Wallenstein not only a rebel from Austria but allied to the USE. Hostilities between the USE and Austria had died down lately, since Gustav Adolf was preoccupied with his war against the League of Ostend. But nobody much doubted that they would flare up again, unless he lost the war against the alliance of France, Spain, England and Denmark. Assuming he won, everyone with any political knowledge and sense at all knew that Gustav Adolf would turn his attention to Saxony and Brandenburg, and the Austrians were sure to weigh in on the opposite side.

Still, rebelling against Austria and establishing an independent Bohemia was one thing. Continuing on to seize territory from the Austrians that had never been under Bohemian authority was something else again.

It got worse. Or better, Morris supposed, depending on how you looked at it. He had to remind himself that, after all, this *was* the ultimate reason he'd come to Prague and decided to throw in with Wallenstein. The worst massacre that would ever fall upon Europe's Jewish population prior to the Holocaust was "due to happen" in fifteen years, in the Chmielnicki Pogrom of 1648, unless something was done to upset the applecart.

Morris had finally decided that the best chance for upsetting that applecart—a very intractable applecart, given the complex social and economic factors involved—was to ally with Wallenstein and rely on him to be the battering ram.

He still thought that was the best alternative. What he hadn't figured on was that Wallenstein would return him the favor and propose to make *Morris* the battering ram.

But he'd leave that aside, for the moment. He went back to studying the map.

East of "Slovakia," the proposed new Greater Bohemia starting getting a lot fatter, like an anaconda that had just swallowed a pig. The big new belly of the new empire would consist of most of the region that was today usually called Lesser Poland, a huge territory which comprised the southern half of the Polish-Lithuanian Commonwealth. In the future history Morris came from, most of that would eventually become part of Ukrainia.

War with Poland. Check.

Well . . . Being honest, Morris knew that was pretty much a given also, if he was to have any hope of forestalling the Chmielnicki Pogrom. The noble magnates who dominated the political life of

the Poland-Lithuanian Commonwealth were bound to be hostile to any project which removed the corrosive social tensions in Lesser Poland. Much of their wealth and power came from those tensions.

From there, the map got rather vague. The northern boundary of Wallenstein's proposed empire followed the Dnieper river from its headwaters near Lublin, taking in Pinsk as well as Kiev. The southern boundary was less distinct, being indicated by a shaded area rather than clear borders, although it generally seemed to follow the line of the Carpathians and the Dnepr river. Morris suspected that Wallenstein wanted, if possible, to avoid any outright clashes with the Ottoman Empire. He'd take what he could, but stop short of challenging the Turks directly.

Marked in faint pencil lines further east was what amounted to a long tail that stretched into the southern regions of what Morris thought of as "Russia," although in the seventeenth century the area—this was true of much of Lesser Poland, as well—was very much a borderland thinly inhabited by a wide mix of peoples.

So. War with Russia and the Cossacks. Check. Tatars too, mostly likely.

Morris let out a slow breath. Maybe war with the Muscovites and Tatars could be avoided. As for the Cossacks . . .

Mentally, he shrugged his shoulders. Morris had as much sympathy for the Cossacks as any late twentieth century Jew with a good knowledge of history.

Zilch.

Fuck 'em and the horses they rode in on. The same bastards who led the Chmielnicki pogrom—and then served the Tsars as their iron fist in the pogroms at Kiev and Kishinev.

Wallenstein and Pappenheim still weren't saying anything. Morris leaned back a little and started scrutinizing the map again, west to east.

The plan was . . . shrewd. Very shrewd, the more he studied the map.

Morris didn't know exactly where the ethnic and religious lines lay in the here and now. Not everywhere, for sure and certain. But he knew enough to realize that what Wallenstein proposed to do was to gut the soft underbellies of every one of Bohemia's neighbors.

Silesia, in this era, was not yet really part of Poland, as it would become in later centuries in the universe Morris had come from. Its population was an ethnic mix, drawn from many sources—most whom were Protestants, not Catholics. And Wallenstein already started as the Prince of Sagan, one of Silesia's provinces.

Despite the name, "Royal Hungary" in the seventeenth century was mostly a Slavic area, especially in the north, ruled by the Magyars but with no real attachment to Hungary. Morris wouldn't be at all surprised if most of its inhabitants would view a Bohemian conquest as something in the way of a liberation. They certainly weren't likely to rally to the side of their Austrian and Hungarian overlords.

Moving still further east, the same was true again. "Lesser Poland" had little in the way of a Polish population—and that consisted mostly of Polish noblemen grinding under their Ruthenian serfs. As for the Ruthenians themselves, the name was not even one that they'd originated, but a Latin label that had been slapped onto them by western European scholars. In a future time, most of them would eventually

become Ukrainians. But, in this day and age, they were a mix of mostly Slavic immigrants—with a large minority of Jews living here and there among them.

Most of the Jews lived in the larger towns and were engaged in a wide range of mercantile and even manufacturing activities. The Polish-Lithuanian Commonwealth did not maintain in practice the same tight restrictions on Jewish activity that most realms in Europe did. Unfortunately, a number of them had also moved out into rural areas.

"Unfortunately," from Morris' viewpoint, because these Jews did not spread into the countryside as farmers. Instead, they spread as rent-collectors and overseers of the large landed estates maintained by mostly-absentee Polish magnates. They were universally hated by the Ruthenian peasantry—who, in the nature of things, did not make any fine distinctions between the small class of Jews who oppressed them and the great majority of the Jewish populations in the towns who were simply going about their business.

Wallenstein's shrewdness was evident wherever Morris looked on the map. He proposed to seize Lvov, for instance, but did not propose to take Krakow. Looked at from one angle, that was a little silly. At the end of the year 1633, the population of Krakow was also mostly non-Polish. Wallenstein could even advance a threadbare claim to the city, since it had once been under the authority of the Kingdom of Bohemia.

But the Poles had an emotional attachment to Krakow, since it had once served as their capital city and Krakow Academy was still Poland's most prestigious university. So, Wallenstein would seize everything south of the Vistula, including the little town of Podgórze opposite Krakow—but did not propose to cross the river and seize Krakow itself. Thereby, he'd avoid as best he could stirring up Polish nationalism, while establishing a defensible border.

Sum it all up and what you had was what amounted to Wallenstein's preemptive strike at every existing realm in eastern Europe. He would seize all the territories that each of them claimed—but for which none of them had really established any mutual allegiance. The end result, if his plans worked, would be a Bohemian Empire that rivaled in territory and population any of the nations in Europe.

Morris scanned the map again, west to east. With Prague as the capital—it was already one of the great cities of Europe—and a mostly-rural territory stitched together by a number of major cities. Bratislava, Lvov, Lublin, Kiev—and Pinsk, way to the north, in what would someday become Belarus.

Morris couldn't help but chuckle. Pinsk, which already had a large Jewish population and would, by the end of the nineteenth century, have a population that was ninety percent Jewish.

There weren't many Jews in Bratislava. But Lvov, Lublin and Kiev were heavily Jewish.

"You propose to use us as your cannon fodder," he muttered.

Wallenstein didn't quite sneer. "Yes, of course. It's either that or serve the Cossacks as mincemeat fifteen years from now. Make your choice."

Idly, Morris wondered where he'd gotten the term "mincemeat," which Wallenstein had said in English. Probably from Edith Wild.

Make your choice.

Put that way, it was easy enough.

"I'll need the Brethren," Morris said.

"Yes, you will. Not a problem." Wallenstein's long finger came to rest on Lublin. "There is a very large concentration of the Brethren here, you know. And others, scattered throughout the region."

Morris hadn't know the Brethren had a presence in Lublin, as it happened. The news caused him to relax a little. If the Brethren could *also* serve as what amounted to Wallenstein's social garrisons in the major cities of his proposed empire, that would remove some of the tension on the Jews. They were themselves Christians, after all.

Well. Of a sort. The Brethren were usually referred to as "Socinians" by other Christians, and were generally considered the biggest heretics around.

Still, it might work—assuming Morris had any chance of translating his pitiful military experience into anything worth a damn on the battlefield.

To his surprise, it was Pappenheim who crystallized the thought that Morris was groping toward.

"Stop thinking of a 'general' in narrow terms," said the man who was perhaps the current world's best exemplar of a general in narrow terms. Pappenheim was a man of the battlefield, with little interest in anything else. "Think of it in broad terms. You simply have to organize the military effort, while you concentrate on the political and social matters. Let others, better suited for the task, lead the troops on the field."

He grinned again in that savage way he had. Then, jabbed a thumb at Wallenstein. "That's what he does, mostly, you know."

Morris stared at Wallenstein. The recently crowned King of Bohemia and proposed usurper of much of eastern Europe stared right back at him.

It was true, actually. Wallenstein hadn't been so much a "general" as what you might call a military contractor. He put together armies—and then found men like Pappenheim to lead them into battle.

Put that way . . .

It didn't sound quite so bad. Of course, Morris would still have to find his equivalent of Pappenheim, since he had no doubt that Pappenheim himself would be fully occupied in the next few years fighting Bohemia's immediate enemies. That'd be the Austrians, mostly. Probably the Poles, too.

"Yeah, sure." Morris looked back at the map, trying to estimate the territory Wallenstein expected him to seize and hold over the next few years. At a rough guess, somewhere around two hundred thousand square miles. About the size of Mexico, he thought. Just what a former army supply clerk-cum-jeweler had always expected he'd wind up doing.

"Piece of cake," he said.

* * *

To be continued in Volume 13

Birdwatching
by Garrett W. Vance

Prelude

The flash was so bright it pierced her closed eyelids, waking her from her nap. A thunderclap followed, Pam Miller felt the deep vibration even in bed. *Spring storm, maybe I'll get up and watch the show.* After a few minutes with no further drama offered by the April skies she went back to sleep.

Awakening hours later in post twilight gloom she felt disoriented. It took her a moment to remember it was Sunday and she was home in bed. A 'mental vacation' she had called her lengthy afternoon nap, although she didn't feel particularly rested. She reached over to switch on her bedside reading light. After several clicks with no response Pam noticed the digital alarm clock was also dead. *Great, the power's out.* She fumbled around in the bed stand's drawer groping for the flashlight she kept there; finding it she got out of bed with a groan to make her way to the kitchen.

She had left the kitchen door propped open; a chill breeze blew through the screen door, smelling strongly of pine. Her nose wrinkled at the unusually powerful scent. Pam peered out into the darkness of her garden, her flashlight playing across the six foot tall tower of the bird feeder, then the row of large rhododendron bushes that made the border between her yard and the copse of box elders and maples stretching up the hill beyond. There were a few pine trees up there she thought, but couldn't recall them ever putting off such a noticeable smell before. She shivered; the breeze was unseasonably cold so she hastily closed the door. After a dreary dinner of cold pizza which the candlelight failed to lend any romance to, Pam sighed and decided to call it a night. *So, this is the exciting life of the divorcee.* At least her ex-husband had helped warm the bed sheets.

The next morning she woke up before dawn feeling refreshed, finding the unusually cool air pleasantly invigorating. *It must have blown here all the way from Canada!* The power was still out so she made a fire in the wood stove that helped save on electricity in the winter. Soon she had a nice cup of rich 'Italian Roast' coffee, milk no sugar, warming her up, and sat down to enjoy the morning show at the little table she had placed beside the picture window looking out on the garden. Breakfast time at the bird feeder! A group of black capped chickadees were already enjoying some sunflower seeds in the pre-dawn grayness. Soon they were joined by a pair of rufous sided towhees, an attractive bird with a black head and rust colored sides. She sipped her coffee enjoying the company.

Pam had always loved birds, it was fostered in her at a young age by her grandmother in Fairmont who delighted in the nature walks they took together through the friendly West Virginia wooded hills. She had learned their names and over the years had observed their habits. She never really thought of herself as a 'birdwatcher' but her interest had only increased as the years went by. A well-worn copy of Peterson's *Eastern Birds* field guide lay beside a small but useful pair of field glasses on the table before her—nothing fancy, just a hobby. The birds had become regular company once she had put up the bird feeder. It was company she welcomed a little more than she liked to admit. After the divorce she had rented this little one bedroom house on the outskirts of town, a truly tiny place but featuring a spacious garden for her to putter about in. It was good to keep busy, between the garden and the birds she didn't feel all that lonely . . . most of the time. Morning with the feeder had become a daily ritual.

What in blue blazes happened to the power? Pam got up to pour herself another cup of coffee from the old copper kettle on the wood stove. Returning to the table she hoped that her favorite birds would make an appearance today, it would be nice to see them. A few minutes later her hopes were rewarded. A flash of flaming scarlet winged over the rhodies to alight on the bird feeder in red splendor. The cardinal had come. The brilliantly plumaged male dipped his crest at her in what she liked to think was

greeting and proceeded to help himself to the sunflower seeds. Even in the lingering shadow of night he glowed. Soon he was joined by his olive hued mate who wore just a blush of rose on her head and wings—nowhere near as striking as the male, of course, but still a very elegant and beautiful bird.

She watched them closely as they ate and was mesmerized for a time, deeply enjoying their bright movement in the stillness of the dawn. *No wonder they were chosen as our state bird—we weren't the only state that had chosen cardinals, either!* The cardinals sometimes seemed to her as if they didn't even belong in a place as normal as West Virginia; they had the look of a fanciful jungle bird from some exotic climate, such was the glamor of their crest and hue. They brought a sense of wonder to her garden and she was awfully glad to have that . . . it was important. Everything else seemed so drab these days.

Her eyes were taken away from her cardinals by the fluttering of a new arrival at the feeder. A bird about the same shape and size as the towhee was now testing the sunflowers with an inquisitive peck. It had a brown back, a creamy light orange border on the lower breast curved up around an eye catching bright blue bib flashing from breast to beak. It was a lovely thing and she realized with some surprise that she had no idea what it was! A new bird for her list and one definitely not common to the area! She grabbed her field guide in excitement and began flipping through its pages in search of the new, her attention torn between studying the strange bird and trying to locate it in the pages. As she searched it was joined by two more, another sporting the blue patch and then a drabber brown bird that shared the same creamy breast and belly—the female, obviously!

"This is ridiculous." Making herself go slowly and concentrating on each page she made her way through the entirety of *Eastern Birds*. There was nothing that matched the strangers at her feeder. Eyes narrowed stubbornly she went over to the small bookshelf by the bedroom door. She found the little *Golden Guide to American Birds* she'd had since she was a kid. On a whim she also grabbed the rarely opened *Birds of the World* her ex had given her as a birthday present. It was a typical gift from him, an attempt to show that he knew what her interests were but a failure to know them in any depth. He didn't understand her birdwatching, or for that matter *her*, at all. In Trent's mind it was a pastime for doting little old English spinsters. *Which is what you are becoming, isn't it?* Shaking the bitter thoughts from her mind she hurried back to the table. Amazingly the new birds now outnumbered the ubiquitous chickadees, nearly a dozen of them feasted in her garden!

"All right then, so they've wandered in from the western states." she mumbled to herself. The *Golden Guide* was quaint and full of pleasant childhood memories but it was an overview of all of North America and really wasn't any use. She would have to order Peterson's *Western Birds*; strays were rare but they did happen. She picked up her coffee then nearly dropped it in surprise. The cardinals had flown away and a new bird had taken their place at the feeder. It was as large as the cardinals, its body was a powdery orange combined with patches of light gray and it sported a bright blue bar on its wing. In place of a crown it had light and dark stripes running back from its sharp beak. It called out in a harsh rasping call causing the chickadees to scatter away into the safety of the rhododendron. She had never seen this bird before but she knew its voice: it was a jay, and it sure wasn't blue!

"What the hell!?" She grabbed *Birds of the World*, flipping directly to the corvids, the family that included jays and crows in its genealogy. There it was in a color plate photograph. The Eurasian Jay. Definitely a European bird and here it was helping itself to her feeder.

Maybe one stray in a day but not two, not two in a whole season! The odds are too much against, especially across the damn Atlantic! She watched in amazement as the big bird made itself right at home in her garden, devouring the sunflower seeds with messy relish in the morning sunlight . . . the morning sunlight. . . Pam stood up at the table, the wonder of the stranger birds forgotten.

Pam ran out the kitchen door into cold air, rife with the scent of too many pine trees. She stopped near the feeder, the birds scattering into the bushes at her intrusion. Pam watched the morning sun climb higher above the hill into a somehow too blue sky, no haze, no drift of pollution. The sun was beautiful, the sun was warm. The sun was in the wrong place.

"That's not possible." A lot of people go through their lives not caring or noticing where the sun rises and sets throughout the seasons and she was not one of them. Pam paid attention to things like that, to the world around her and this was *wrong*. She stood very still in her garden as the shrill cries of a bird that shouldn't be there rang out in a morning that shouldn't be happening.

She was afraid to move for a very long time.

One Year Later

There was no coffee left. Pam sat at her table with a cup of hot water that she'd poured some fresh cream and a single drop of artificial vanilla into—a poor substitute but it made the morning a little warmer. She watched what she now called the 'bluebibs' at the bird feeder picking at a meager assortment of flax and some wild grasses she had gathered. She couldn't give them very much since she was saving the sunflower seeds for next year's garden.

Pam frowned at herself. If she had been smarter last year she would have planted the entire yard in sunflowers! She, like everyone else in Grantville had been too busy just trying to survive. Her cranky landlord's precious grass had been turned up to put in vegetables in the rush to grow enough food for a seventeenth century German winter. Pam had grimly enjoyed that; the mean old coot hadn't even allowed her to plant a few trees along the road; such was his obsession with that damn grass. At least she'd had sense enough to plant one row of sunflowers in the midst of the chaos; twelve dried sunflower stalks from last year tied in a bundle leaned against the wall beside her garden window, their round heads full of seeds. There had been times where she had looked at those seed pods hungrily but had not allowed herself. If she could get enough of them growing this coming year she would have enough for the birds and not feel guilty. *No one starved, I'm right to hoard the seeds.*

A few black capped chickadees that had come with them through the Ring of Fire mixed with the native German birds at the feeder. They were tough little buggers; they had made it through the first winter and just may have a chance here. *I'm glad to see them, I just wish . . .* She knew she should just forget about it but she had never given up hope. . . *I just wish the cardinals were still here.* She knew the chances of a breeding population were entirely too slim. Pam swirled her faux coffee around in the cup. She had been through it in her mind a thousand times. *First of all I can only guess at the number that came through with us. Anywhere between the six I actually saw at one time at the feeder and maybe ten . . . twenty . . . or more? Wishful thinking!*

By autumn of that first year there were none to be seen. She had spent every morning watching for them but now only the chickadees and the native birds came to her feeder. She sometimes tried to make herself feel better by considering that there were still lots of cardinals . . . across the Atlantic. It never really helped much and usually just made her feel more lost. Even so, she couldn't help thinking about her lost cardinals. *Were they eaten by some new unaccustomed predator?* Various stoats and weasels from the Thuringian forests had found their way to Grantville and the formerly spoiled up-time house cats turned hungry feral predators were probably the biggest danger. *Maybe they flew away too far to find each other again.* That was also pretty likely. The chances of a successful breeding population remaining here in Thuringia were extremely low. And even if they did, she wondered if it would really be a good

thing.

Whenever nature's balance was changed something inevitably paid. Transplanted species had often become pests back up-time. The English sparrows and starlings brought to America to make it feel more like home had bred in such numbers that they often threatened native species. The starlings had begun with only one hundred introduced to York 's Central Park in the 1890's eventually spread throughout the entire North American continent. It wasn't natural. *But then again, neither are we.* There was some small hope for cardinals in Europe , if they stuck together and could breed fast enough for their population to grow. *They are out there somewhere, out there in this time's Germany .I need to believe it.*

Pam found herself becoming more and more devoted to her birdwatching. It was a hobby that didn't require technology or resources that could be better spent on Grantville's survival. She began taking long walks around Grantville, sometimes even stepping over what she personally called 'The Rim' to venture into Thuringia proper. This edge was becoming less and less apparent as West Virginian and German plant species mixed and mingled along the ring's edges. Grasses and runners had already covered most of the raw exposed earth created by the mismatched elevations. Nature at least was going to absorb the presence of this misplaced chunk of the world quietly. "Not so its people!" She laughed aloud thinking of the political turmoil their American presence had created across this century's Europe . *We are a weed that isn't going to die off too easily.*

* * *

On a fair June afternoon Pam was watching a flock of native birds playing in the pine trees at the forest's edge from a vantage point atop a crumbling Grantville embankment in the process of sliding into a Thuringian meadow at the rim. The birds were about thirty yards away across the meadow. She sat comfortably in the tall grass with her legs dangling over the rim *half in, half out* , enjoying the bird's antics with her fieldglasses. They were true beauties, bright lemon yellow with black wings and tail. She was quite sure they were orioles and had dubbed them such in her notebook. She put down the glasses to look at the pencil sketch she had made. It was in black and white, she was hoarding the lone box of colored pencils she possessed back at the house until she became a better artist. Around the simple but fairly accurate drawing she had described the colors in detail in her notes. At the bottom of the page she had whimsically written 'Lemon Oriole.'

"And why shouldn't I give you a name?" she asked the distant flock. *It's not like anyone else cares.* She had made nonchalant inquiries after European bird books at the school library and every private book collection in Grantville. *Oh, just thought it might be interesting to know what's in my garden these days.* Even a guide from Great Britain would have been useful as she knew it shared many species with the mainland. There wasn't a single one. *What the hell do coal miners care about European birds anyway?* This made her frown; she felt self conscious at her hobby. She had publicly kept her interest quiet, she really didn't want the other townsfolk to know how much it had come to mean to her.

Pam dreaded the day when someone would inevitably refer to her as 'The Birdwatcher'—yeah, that would stick. "Then they'll besure you're a nut." She thought of her ex-husband Trent down at the mine chuckling along with them. *"Yeah, I always thought she was a birdbrain!"* Pam blew a blast of air at a loose strand of hair that had fallen across her face. She knew she wasn't being fair, Trent wasn't mean-spirited like that. He would keep quiet and just shake his head knowingly. *Come on, let's not do this today. Just watch the damn birds, Pam.* She put the field glasses back up to her eyes. There were men there.

A trio of rugged-looking men had come out of the woods and now walked along the tree line. One had what must be a crossbow strapped to his back and they all wore sizable knives hung from their belts.

Down-timers. Most of the dangerous sorts had been scared off over the last year, but you really couldn't be too sure. She was far from any road and at least a mile from anyone's house. They may be just regular folks about their business . . . *or not.* Forcing herself to move slowly despite her racing heartbeat Pam pulled her legs up to her chest then slid on her butt backwards into the tall grass, keeping low. Any eye, animal or human, was attracted to quick motion. She watched the men continue on their path, snippets of their deep voices conversing in German came to her ears. She carefully turned over to crawl away from the bank's edge on her belly, not looking back. *They didn't see me.* She crawled through the grass until she reached the path through the maples she had taken to get there. She ran as far as she could until the stitch in her side grew too painful, then continued walking quickly home.

Later that night Pam sat at her table looking glumly through her notebooks. She had calmed down with the aid of some *kirshwasser*. Here was something she definitely liked about Germany. *Yay for booze.* She looked glumly at her notes. Her drawing of the oriole looked crude and amateurish to her now.

"This birdwatching thing is going to get me killed." Pam closed the notebook and stared at the darkness beyond the garden window. *I need to be more careful.* That was a fact. These were exceptionally dangerous times she now lived in. But she couldn't just stay in her garden anymore, it would drive her crazy. She had to get out.

Maybe I need to hire a bodyguard. She smiled and lifted the shot glass in a jaunty toasting motion. "Not a bad idea."

* * *

What the hell was I thinking? The next day Pam stood before a small crowd gathered near town hall. This corner had become an unofficial mustering point for Germans looking for work; as news of Grantville's opportunities had spread the population of the corner had increased. At the moment there were twelve men and four women, ages ranging from thirteen to sixty, in various degrees of health and what she considered shabbiness.

Pam tried to look nonchalant as she attempted to covertly eyeball them. Knowing they were on display many of the would-be workers smiled broadly and bowed as if she were a visiting princess, which only made her more uncomfortable. *Oh, just do it, Pam!* Squaring her shoulders she approached a fairly tall fellow who looked to be in his early twenties. He was thin and obviously in need of several good meals but seemed strong enough; although there wasn't much of the warrior about him.

"Uhh, do you speak English?"

"Ja!"

"Good! What's your name?"

The fellow hesitated slightly, a worried look on his face. "Ja?" he replied hopefully.

This isn't working.

"Okay, thanks." Pam moved away from the young man trying not to see his disappointment. She felt sorry for everyone here; desperation was heavy in the air. *I need someone with at least a little English; my German is just not good enough yet. Actually, I can hardly speak it at all. That's got to change.*

A determined-looking red-cheeked woman trundled up to her. She appeared to be in her late fifties but was probably only around forty. The hardships of this century could age people so quickly. Her round face was stern but had an honest look to it.

"I can English," she announced in a low, confident tone.

Pam smiled meekly. "I'm sorry, but I need a man, *aherr* . . . someone strong."

"Strong man." The woman nodded at her. "I know." With a business-like bow the woman motioned for Pam to follow her. Pam did so, not really having a better plan. The woman led her over to a brick wall where a man was leaning. A wide-brimmed hat the color of dirty white socks that may have once had some kind of shape was pulled down over his eyes.

"Gerbald." She pointed at the man. "Gerbald!" she announced loudly to get his attention.

The man slowly looked up, peering out from beneath the uneven felt brim, looking first at the German woman then at Pam. His eyes were a beautiful cobalt blue within a woven nest of deep wrinkles. He stood slowly up from the wall and gave a nod to the approaching women.

"Hello. I am Gerbald." The pitch of his voice had a pleasant depth, there was weariness there, but Pam heard confidence as well.

"Gerbald *strong* !" the woman proclaimed with a proud smile.

Gerbald chuckled. "My wife, Dore." He leaned his head toward the determined woman. "Dore is also strong." His eyes creased further with amusement, the remarkable blue shining out. Dore stood taller and moved proudly to his side.

I like them. Pam smiled back at the pair. "I'm Pam. It's good to meet you."

Gerbald was around five foot eight inches tall with wide shoulders and a solid-looking build. He wore a battered sage green long wool coat crossed by a wide brown leather belt, mustard breeches and knee high brown leather boots; an ensemble which made Pam think *Robin Hood!* What looked to be a saber hung at his side; there was little doubt that he had been a military man of some sort. Pam thought he might be around fifty-five but knew he was likely older. In any case, he seemed to be hale and in good health and the sort of man that other men don't trifle with lightly. Her smile broadened.

"Were you a soldier?"

"Yes, a long time. Not now. Good soldier, not bad man." He looked a bit worried that his former profession might not go over well with this female potential employer.

"Soldier my job before, but I am tired. I don't like fight anymore, too sad. Peace." He looked at Pam hoping she would understand him.

Pam's instincts seemed sure that he was sincere and very likely legitimate in his claims. There were a lot of men like this in these times, men who would have been farmers or carpenters if not swept up by the omnipresence of war. Gerbald cocked his head at her, one eyebrow lifting the brim of his monstrously ridiculous hat slightly upward.

"You . . . you need *soldier* ?"

"Yes. Well, not exactly. I need a guard. Someone to go with me outside of Grantville, into the forests and fields. I am looking for . . . *things*, in the countryside. You would guard me. Stop bad men from hurting me."

Gerbald nodded. "Yes, guard. I can do."

"Great!" She looked at the couple and realized there were a lot more things to discuss—how much would she pay Gerbald? Where did the two of them live? *I'll figure it out. I've done well today.* Pam was exceptionally pleased at succeeding in her mission, she was sure she had done better than she could have hoped. "Well, Gerbald, Dore, let me buy you a beer and we'll talk some more about the job." And so they headed for the Thuringen Gardens, a trio of contentment.

* * *

Over several rounds of the Gardens' fine beer, Pam learned a little more about Gerbald and Dore. He, like so many men of the age and region, had been a soldier for hire, and Dore his camp follower mate. He had left his last employer because his captain had ordered him to do something that Gerbald *did not* want to do, something he wouldn't go into any detail about. The name Magdeburg came to mind, but Pam did not press the issue. She knew he was being purposefully vague regarding many details of his soldiering career; it was perhaps better she didn't know. Dore sat stone-faced and silent during this part of the conversation. She was plainly deeply devoted to the man. Pam didn't hold their secrets against them; how could someone like her really understand the horrors that these people had faced in this war-crazed world they were born to? Her gut told her she could trust them and so she would.

Pam had asked around at the Research Institute about the going rate for German laborers in Grantville. She had told her co-workers that she wanted some odd jobs done around her house and yard; she was still intent on keeping her birdwatching habit very quiet. *Why do I do that? Just because Trent didn't get me doesn't mean they won't.* She pushed the thought out of her head, there would be time to indulge in 'Pam analyzes Pam' later. Pam made a tidy wage in the current economy, her up-time lab work experience and scientific knowledge had significantly increased in value here under these extreme circumstances. She was useful and in high demand. *Now that's a new concept.*

She offered Gerbald a little more than the current going rate, much to Dore's obvious delight. She only needed him part time and wanted to keep him around—the hiring process was not a performance she wanted to repeat any time soon! The deal was made and settled with a handshake. It turned out that the pair had lodging in a group shelter not too far from her place, which would be convenient. This news came as a relief to Pam. Her house was so cramped even for one that she had not been asked to take in refugees the last winter and besides, she very much valued her privacy. Gerbald and Dore walked her home so they could see where she lived and Pam went to bed, excited about the next day's birdwatching.

* * *

Pam got to the institute early the next morning. She worked like a whirlwind. She felt infused with boundless energy; now she was going to be able to go out past the rim and be as sure as anyone could be of her safety. There was no doubt that Gerbald could handle anything short of an army of bandits. She didn't take a lunch break and left around one, claiming she needed to go supervise the workers at her place. The days were getting long now and they would have plenty of time to hike out to her intended region of exploration and back before dusk. Pam's house was on the outskirts of Grantville at the northwest edge of town. *The new northwest, that is.* She and Gerbald would walk some gravel back roads and paths that didn't see much traffic these days.

When she arrived home, flushed from excitement and the extra speed she had put into her gait, she found Gerbald and Dore standing at attention on the road beside her front yard's edge.

"Hello, come on, come in!" She bustled up the incline of the long walk to her front door with them in tow. She had a big yard and a small house, just the way she liked it. She had kept her smaller back garden a private paradise of flowers and shrubs for her birds while the spacious front yard was now filled with row after row of rapidly growing sunflowers (*Her up-time landlord would hate that!*) watched over by an empty aluminum laundry tree. Except for a few rows of useful vegetables it had all gone to sunflowers this year. Her former landlord had mercifully been left up-time in Fairmont—the place was going to really be *hers* now and she could do with it as she pleased. She wondered sometimes if the bossy old coot had ever tried to drive out to Grantville on a mission to crab at her about keeping the lawn mowed precisely to his picky specifications only to find a chunk of this time's Thuringia in place of his property—that *would* be a surprise! *Now available in Marion County : Real German farm, quaint out buildings, wooded setting.* Pam figured they would never know.

"Sorry about the mess. I live alone and I've just been too busy to clean much lately." Dore and Gerbald nodded politely, standing just inside the door as Pam bustled about the small living room's clutter, gathering her notebook and field glasses. She pushed a sweater for the cool evening walk home into her rucksack, threw it over her shoulder and headed for the door. Dore looked a polite question at her.

"Oh yeah, Dore . . . well, you can wait here for us if you like, just make yourself at home." She motioned to the overstuffed loveseat that was still partially visible under a week's worth of laundry in waiting. "Have a seat and take it easy!" Dore smiled sweetly, nodding her understanding. "See you later!" With an indelible grin etched on her face, Pam marched down the walk, Gerbald in practiced step behind.

* * *

They walked northwest passing Highpoint on their right. Pam was eager to visit a new lake she had heard had formed where the watercourse of a lazy Thuringian stream had found a big West Virginian hill in its path. She thought there might be some marsh birds there and it sounded like some interesting "rim" terrain that she hadn't seen yet. Even after a year there was something about that border between her original everyday world and this strange (*new? old?*) century they now inhabited that drew her to it. Seeing it, *being* at the edge helped make it real to her, something that watching cars be replaced by horses in the streets of Grantville and the loss of such everyday items as toothpaste and deodorants still failed to do.

The retired soldier wasn't a small talker which suited Pam perfectly. They reached their destination at the top of a rolling hill ending abruptly in a razor straight plummet. Pam stayed well back from the edge which was now crumbling and unsafe—it would be a long fall. Below them a lake had formed, the top halves of dying German pine trees stood forlornly in murky water, the upturned roots of a West Virginia red maple that had lost its purchase were now a bleached tangle at the steep shore. She decided to make their way down the left side of the hill to a narrow flat spot along the rim where the water had flowed into a West Virginia hollow creating a narrow shady marsh.

"Gerbald, I'm going to be looking for birds. I'd like you to just stay quiet and keep your eyes open for any people." Gerbald nodded his understanding and backed off to stand under a nearby sycamore, calmly scanning the jumbled landscape. Pam pulled her field glasses out to begin looking for activity. A lone duck bobbed along at the far end of the new lake but it was too distant to make out in detail. A Eurasian jay gave a shrill cry from farther down the shore but remained out of view.

Around thirty minutes went by. Pam decided that there wasn't really much to see after all, so she wandered over to where Gerbald stood under the sycamore to collect him for the walk home. She noticed some of the "bluebibs" that so often visited her garden flitting about in the tree's higher branches. Even though these had become a regular backyard visitor she put the field glasses to her eye out of habit to watch their antics for a few moments while Gerbald quietly observed her. Shortly she joined him under the tree.

"Well, not much to see here. Let's start walking back, I guess." Gerbald, who instinctively understood her general preference for quiet, took this as a cue that it would be all right for him to speak.

"You are . . . seeing birds?"

"Yes, I am. I watch them." Gerbald nodded but made no further comment. Pam decided that she had to talk about her . . . *obsession?*—with someone and her new bodyguard was the only logical choice. If he were going to be following her around daily, he might as well understand what she was doing.

"I like birds. A lot. They are beautiful. I like to watch what they do, see where they live." Gerbald nodded understanding politely.

"These up here—" she pointed into the branches above them. "I call them 'bluebibs.' They are from here, Germany."

"Blaukehlchen"

"Pardon?"

"Blaukehlchen." He motioned upwards with his misshapen hat's brim. "Bird is named." Pam's eyes went wide.

"You know the name of that bird? In German?" Gerbald shrugged and nodded.

"Do you know the names of a lot of birds?" She felt an excitement growing.

"Some. They pretty. My father . . . he like bird. He tell name, I listen."

"Blau-kehl-chen." Pam carefully tried to pronounce the German name. "Blue . . . Chin?" She asked, pointing to her own chin. Gerbald smiled in what she took as assent.

"You know German a little."

"Not very much. That was just a guess! Well, I wasn't far off when I called them 'bluebibs' it seems." She grinned. Pam quickly dragged her notebook and pencil out of the rucksack. Beneath her drawing of the little blue-throated bird she now wrote *"blaukehlchen"* followed by "blue chin" in English. "So, now you have a name after all."

Somehow knowing the local name for the first German bird she had met on that shocking morning made Pam feel better. There was order here; wild things had been given names long before *her* coming and it made this century somehow less alien. *It wasn't like we ended up on Mars.* That rather chilling thought made the oddly patched together landscape before them look positively homey. *Mars would have been a short stay.* Pam pushed thoughts of a Grantville frozen and lifeless in the shadow of Olympus Mons firmly out of her head. She looked back at her notebook—an idea was forming.

Pam flipped to the "lemon oriole" she had drawn the other day.

"Gerbald, this bird is yellow and black." Gerbald looked at the drawing carefully.

"*Pirol*".

"Pi-rol?"

"Yes, I think. Yellow bird and here and here . . ." He pointed at the wings and tail. ". . . is black."

"Yes! I wonder if there is a direct translation for *pirol* in English. Well, it's a prettier sounding name than 'lemon oriole' anyway! . . . *Pirol*." Pam realized that she was about to begin studying German in earnest.

"Gerbald, from now on when we see a bird, please tell me if you know its name in your language." An idea was forming in Pam's mind, she put it on her mental back burner to simmer—in time, in time.

"Yes, I do for you," he said with a note of enthusiasm. It was going to be a pleasant job helping this nice American lady watch birds.

On their way back Pam suddenly came to a complete halt. Gerbald had already learned to anticipate this and also stopped, quietly—there must be a bird in their vicinity.

"Over there Gerbald—look!" She slowly raised her hands to point at a nearby thicket. Gerbald, whose former profession had sharply honed his powers of observation in the field, saw a bird with a black head and rust colored sides hopping about the twiggy growth.

"I am sorry. I not know that one." He apologized in a hoarse whisper. Pam's face shined with joy.

"I know!" she was obviously struggling not to jump up and down. "Gerbald, that is an *American* bird! I didn't think there were anything but chickadees left! It's a *towhee*, from here, from Grantville! It's an up-timer bird!" Pam allowed herself the thought: *Maybe the cardinals made it through the year, too.* They watched the towhee for a very long time. If it hadn't eventually flown away into the darkening shadows beneath the trees it seemed likely they would have stood there until dark.

* * *

Back at the house Pam practically skipped up the walk in the gathering dusk, past the aluminum clothes tree festooned with her bed sheets and weeks worth of laundry. It took a moment for the change in her yard's scenery to register—then she saw several of her bras and felt her cheeks redden.

"Let's get inside." She hastened Gerbald through the door into her immaculately clean living room. Pam's eyes widened. She had left behind a disaster area of clutter.

"Dore?" she called out questioningly.

"*Ja*, I am here!" Her voice came from the kitchen.

Pam entered followed by Gerbald who stood in the doorway so as not to crowd them in the narrow space. Dore was happily humming as she fussed over a big pot of what Pam had come to know as *spetzel* boiling away on the wood stove.

"Dinner!" she announced proudly.

"Dore! You didn't have to do that! I didn't expect you to work, I told you to just take it easy!" Dore, whose English was not as good as Gerbald's looked to her husband with a worried question. He spoke to her in German briefly. Dore looked embarrassed.

"You . . . you not like I do?" Her tone was very meek.

Pam now felt bad for embarrassing the woman. "No, I don't mean that. You did great! Really, really good, I like it and God knows I have let the place go. I just didn't expect it." Pam pulled her pocketbook out of her rucksack. "Here, let me pay you for what you did today." She began to pull some money out but Dore looked alarmed.

"*Nein!*No, good lady, I not do for money. I do—" Her English faltered and she began to speak quickly to Gerbald who nodded. He turned to Pam with a slight smile.

"Dore say she like to do for you. Money, she no need. You give me good job, Dore very happy! She do—" He swept his arm around to indicate the various housekeeping Dore had performed. "Shedo to say thank you." Dore watched Pam with a concerned look, afraid to have displeased her husband's new employer.

Pam rushed over to her and took both her hands in hers. "Thank *you*, Dore. You are very kind. I am happy to know you and Gerbald." Her face felt hot and flushed. Pam was not given to displays of affection and knew this about herself. Her ex-husband knew it all too well and she had admitted that she should have been more affectionate with her son Walt. She loved Walt very much, and had loved Trent once, too, but she just wasn't good with people.

Pam realized that she had been alone for a very long time now and there was something about the simple goodness of these two people she had barely met which was filling her with unexpected emotion. Pam held Dore's hands tightly and smiled at her, her lips trembling and eyes moist. The older German woman could see the pain there, and the hope; understanding without words Dore squeezed firmly back and gave Pam a long look with her sensible hazel eyes, a look that said "*You are going to be all right.*"

"You good lady. Good luck we meet you." Dore released her hands from Pam's grip with a last heartfelt squeeze, then led her to the door, shoos Gerbald outward. "You go, sit. We eat!"

Another Year Later

Pam, Gerbald and Dore established a routine that suited them all nicely. Five days a week, Pam and Gerbald went on birdwatching expeditions. On the fourth day, she would give Gerbald money for Dore to go shopping with for the next evening's dinner. On the fifth day, Dore came to the house with Gerbald and the groceries, did the laundry and general housecleaning and then made the wonderful dinner they would all share.

With the help of her new friends, Pam's German studies made rapid progress. Gerbald could read and helped her with her lessons on days when the weather was just too nasty to go traipsing about the countryside. The focus of her studies was of course the translation of German bird names into English, but she was learning to speak as well. She soon learned she had been mistaken in her assumption that the

"*kehlchen*" in *inblaukehlchen* meant "chin" in English. Even though it sounded like "chin" to her untrained ears, it meant really "throat." This turned out to be a common pitfall when learning a language that is a close cousin to one's own; the occasional appearance of "false friends," words that sound like they should mean the same things in both languages but really don't. The "bluechins," formerly "bluebibs" were now properly "bluethroats."

On the weekends Pam devoted herself to painting birds. She had perused a few artist's how-to books at the library, tried some of their suggestions and then decided that the best way for her to learn was to just sit down and *do* it. She had liked to doodle as a girl and recalled that she had always received A's in art, but never really believed she had any talent. It was possible she actually didn't have any talent, but she did have determination. Her paintings were not intended to be hung in a gallery after all. They were scientific works; their sole purpose was to catalog accurately the birds of Thuringia she encountered. She started by copying the illustrations in her own small collection of field guides. After she felt she had learned some of their basic techniques, she tried applying them to something closer to a live model, starting with a photo of a mallard duck. Her first attempt was definitely more "Daffy" than "Audubon" but she kept at it.

After this Pam began to paint in the field. She would quickly pencil sketch in the birds she saw, then try to capture their colors with her brushes. If they held still long enough, she would focus in with more detail. Gerbald offered quiet encouragement with approving nods as he kept his eyes open for intruders. Gerbald's steady and watchful presence made Pam feel safe, which allowed her to better concentrate on her work.

They had taken to ranging several miles past the rim on some days, seeking nesting grounds amongst the fields and forests of Thuringia. Although the situation had become fairly quiet in the region, there were still plenty of opportunities for brigands to sneak about. She and Gerbald had made it an unspoken rule to avoid strangers by staying hidden when they drew near. She had always considered herself fairly adept at moving surreptitiously in the field, but Gerbald proved to be a master of the art and a good teacher. They often made their way past other people under cover, off the road or path without those they observed ever having a clue they were in the vicinity. This pleased Pam who still preferred not to be seen wandering the area in the company of a *man* by fellow Grantville residents.

One Sunday afternoon in April, Pam walked into town to do a little shopping. Another year was beginning here in her new world and she felt amazingly optimistic about it. She realized that in many ways she liked her current life better than the one she had lived before the Ring of Fire. Why not? She hadn't felt this happy and focused in years. With a tinge of regret she wondered what her ex-husband Trent would think of her now. He had remarried of course. *Ah well, I'm glad he's found what he was looking for. Maybe I have, too.* Near the Freedom Arches, she saw a peddler's wagon parked at the curb. A cheerful-looking chubby fellow with a beard sat in a chair on the sidewalk. He reminded Pam of Burl Ives. Pam wandered over to the wagon.

"Hello good lady, welcome, welcome! I am a seller of beautiful things, please, maybe you like." He greeted her in accented but clear English. Pam was always impressed by the knack for languages Europeans possessed. She felt a surge of pride at her growing German abilities; there were a lot of up-timers who simply weren't bothering to learn the language that surrounded them.

Pam smiled at the fellow, stepping closer to look over the multitude of gewgaws perched on shelves in the wagon's open side or hanged by hooks from the propped up panel that formed a protective awning. Tin whistles, whimsically carved and painted wooden toys, mounted deer antlers, etchings of famous buildings of Europe. She wasn't much of a collector of such fancies, but she was impressed by the quality of workmanship. It was apparent that the peddler had a fairly wide range, certainly not all of his goods

were locally made. She looked at the jovial peddler as an idea came to her.

"Sir, you travel a lot, don't you?" The peddler stood politely when she addressed him.

"Why yes, of course! Well, as much as is safe in these troubled times, but my business takes me all about the Germanies and even down to northern Italy on occasion. I am always seeking new fineries for my selection. Do you like what you see?"

"Yes, very nice." Pam hesitated. *Oh why the hell not?* "I would like to ask you something. In your travels have you ever seen a bright red bird? It would be a new creature; it came to Germany with us."

"A red bird?" The peddler was somewhat surprised at such a question. "Why, I see many birds and animals in my travels, out on the open road as I am."

"This one I think you would notice. It's a beautiful bright red and has a black mask around its bill. On the top of its head is a pointy crest, like a hat." Pam's description was accompanied by a sort of pantomime of the cardinal's features.

The peddler nodded, a look of comprehension came to his eyes. "A red bird, face is black! Yes, yes, I have seen such a bird! I was down in Bavaria . . . here, I show you!" Pam's eyes went wide. The peddler ducked his head under the wood awning and proceeded to shift some of the items on his top shelf around. "Yes, here it is!" He pointed. Against her will, Pam followed the course of his finger to the shadowy upper shelves.

It was a bird. A red bird. A cardinal.

Stuffed.

Pam stood frozen in horror. The cardinal was posed with its wings outspread as if about to leap into flight from the gnarled branch it was mounted to. Glass orbs replaced living eyes, the beak open as if frozen in mid-song.

"Pretty nice, yes? A trapper sold it to me. He snared it in the woods last month. What a pretty bird, a nice display for your home!"

Pam started to cry.

Hours later, Pam sat at her window side table, a bottle of what was passing for whiskey these days half-empty before her. She poured herself another shot. Her bird guides, notebooks and precious painting supplies lay scattered about the floor behind her.

"God damn *people*!" The anger welled up again and she felt her face grow hot. She was on an emotional boat ride through fiercely stormy seas, rising on crests of towering wrath, sliding down into depressions of black despair. She hadn't eaten and the whiskey was only making her head hurt, the fiery liquid in her belly failing to warm the icy sense of helpless loss.

At five o'clock Gerbald arrived to begin the evening's work. Drunkenly Pam ordered him to go home. "No birds tonight," she said, her voice thick with pain and anger. Her head slumped onto the table with an audible thump, mind reeling with images of dead cardinals mounted in dead trees, forgetting Gerbald was even there.

The unflappable German's face creased up in worry, an emotion rarely seen there.

"I get Dore," he told her, exiting quickly.

* * *

Dore came through the door huffing and puffing. She was a bit on the heavy side and had run as fast as she could all the way to Pam's little house. Gerbald followed, barely having broken a sweat but face grey with concern for Pam. They found her still at the table, mumbling incoherently. One on either side, Gerbald and Dore gently lifted her, moving her over to the overstuffed loveseat. Pam began to weep softly, Dore held her close like a child, murmuring comforting words as she stroked Pam's hair. After carefully picking up the items Pam had cast on the floor in her despair, Gerbald paced about the room, his strong arms crossed in helplessness.

After a time, Pam became coherent enough to haltingly detail what had happened. Her friends listened closely with heartfelt sympathy. Dore made some thin chicken broth for her, gently feeding it to her as one would a small child. Pam had calmed down now and become sleepy, Dore helped her into bed, giving her a fond kiss on the forehead before turning out the light. Pam softly thanked her, the forgetfulness of sleep coming soon after, a welcome darkness.

Pam safe in bed and sleeping off her day's tragedy, Dore sat down on the loveseat. Gerbald sat in Pam's usual chair at the window side table, his brow furrowed in deep thought. Dore steepled her fingers contemplatively in her lap. They shared a long look of painful concern for Pam, whom they had begun to think of as a well-loved younger sister more than an employer. Pam didn't know how protected she truly was by these two strong-hearted Germans.

At last Dore spoke softly so as not to wake Pam in the bedroom behind her. "This bird. Show me."

Gerbald nodded. Opening *Eastern Birds*, he found the cardinal, Pam had shown it to him and he well knew it was her favorite. He walked the book over to Dore. "This one, the red one. It is special to her."

Dore studied the small painting carefully. "I can see that! It is an American bird from *up-time*, yes?" She used the English term for the concept.

"Yes. Some few of them came here with Grantville. She searches, but we haven't found one yet. Now she finds a dead one, it is too sad for her."

Dore nodded slowly. "Tomorrow we start," she announced confidently as she began the process of extricating her bulky form from the lumpy old loveseat. Gerbald brightened, giving her a hand up. She patted his arm affectionately.

"Yes. We will." He grinned.

* * *

"It is a red bird with a pointy hat," Dore told the women she worked with at the laundry.

"It has a black mask around its beak," Gerbald told the men he did construction work with during the day.

"If you see one, you must remember to tell me," Dore told the vegetable farmers who had brought their

produce to market from the outlying farms.

"If you see one, do not kill it!" Gerbald told his companions at the tavern over a lunchtime pint of *dunkel* beer.

"It is an *American* bird," Dore told the mail riders at the post office.

"Tell your friends. Tell your neighbors."

"Tell everyone! The red bird must be found!"

* * *

Pam recovered from her upset more quickly than she might have expected. It was dawning on her that she had changed since the Ring of Fire. Her depressions had grown shorter and she hadn't the time for the long sessions of self pity she had once indulged in. The stuffed cardinal had been awful, a terrible waste but it was also evidence that at least one of her cherished birds had survived two German winters! There could be more. In retrospect, the incident lifted her hopes more than dashed them.

Her list of American birds had grown by a large number this spring, more and more species were emerging from the woodwork: tufted titmice, redhead ducks, turkey vultures, killdeer, ruby-throated hummingbirds, scarlet tanagers—it was incredible! She had even witnessed a confrontation at her feeder between a gray and orange Eurasian jay and an eastern blue jay! The American blue jay had triumphed, boasting loudly in harsh jay tones as the native jay presumably fled back to the safety of the Thuringerwald—but for how long? It had some new competition!

It was strange how in that first year the American species had vanished from sight. Pam supposed it wasn't really unusual for animals to go to ground for extended periods when threatened. Perhaps the Ring of Fire had affected birds more powerfully and in different ways than it did mammals, which had continued their daily existence seemingly physically unaffected by the event. Birds had different senses, particularly migratory birds with their feel for Earth's magnetic fields. Who could know what havoc something like a journey through time and space would play on avians? Pam continued her project with a very welcome new wrinkle: Translating the names of the transplanted American birds into German!

Gerbald came up the road at a flat out run, his sage green coat tails flapping behind him. Pam, sitting on a lawn chair by the front door enjoying a pleasingly balmy May afternoon watched in amazement as he leapt from the road over the short decorative fence at the corner of the yard to cut across the rows of sunflowers instead of ambling up the walk as he always did. Pam couldn't help but chuckle seeing his goofy misshapen hat bouncing just above the cheery yellow discs of their blossoms as he zigged and zagged his way up the yard. She stood up quickly, now worried that something bad might be happening to provoke steady Gerbald into such flight!

"Gerbald!" "What's going on! "

"Pam!" He paused for breath. He must have run a long way, as Gerbald rarely showed any strain when exercising. "Get your field glasses. We must hurry!" Pam only hesitated a moment before rushing into the living room after her gear. Gerbald waited for her by the road, obviously in a great state of excitement. Equipped, Pam ran down the walk to him.

"Can you run?"

"Yes, let's go!" Gerbald took off at a steady trot, Pam running behind. They headed down the road into town. As they neared the end of that odd mile, it occurred to Pam that she was in pretty good shape these days. *My God, this would have killed me two years ago!* A brief thrill of pride shot through her but was quickly brought down by a sudden dark thought—*People are going to see us!* Gerbald looked back to check on her progress. Pam raised her hand in a brief wave, *I'm all right, keep going.* Whatever it was it must be important. Gerbald well knew her feelings on the matter of exposing their activities. *This better be good, mein Herr!*

Rounding a corner onto the main street, Gerbald led her to the city park where a small group of down-timer women were talking in hushed tones.

"Dore!" Pam exclaimed as one broke from the group to approach her and Gerbald as they came to a halt at the grasses' edge.

"Pam! Oh, it is good. Look, look!" Dore's chubby finger, flushed red from the hot water of the laundry, pointed up into a tulip tree near the town's bandstand. Pam's eyes followed, a look of stunned disbelief now on her face.

"It is the one, *ja?* The red bird? The *American* bird?" Dore's voice was filled with hope that she was right. Dore reached for her, beckoning her to come closer.

Pam slowly advanced to take Dore's offered hand, her eyes unblinking as she continued to stare into the tulip tree's branches. It was there. It was really there. A red bird. An American bird.

The male cardinal tipped its head at her as if in greeting, just as it used to do at her feeder every morning. His mate, rosy blush on peach in the spring sun, hopped down a branch to join him. A third cardinal appeared above them. He looked to be a yearling. The young bird threw back his scarlet crested head. He opened his beak with a thrilling song, the loveliest music Pam had ever heard, a symphony in the park, a serenade, the bright music of her heart's desire. Tears came, soft warm streams of relief and hopes satisfied. She felt Gerbald's comforting presence at her side as Dore squeezed her hand—the woman was grinning like a kid on Christmas morning.

"How? How did you know?" Pam asked. Dore chuckled.

"Know? We know much! Pretty smart!" Dore tapped her temple with her free hand. She started to laugh happily aloud, but quickly realized the need for quiet and clapped the hand over her mouth so as not to startle the nearby cardinals, hazel eyes sparkling with delight.

Gerbald spoke softly in his deep tones. "I show her picture. We tell everybody we meet, look for that red bird."

"*Der Amerikanische rotvogel!*" Dore interrupted proudly "My friends, washerwomen same like me, say today they see here in park. I send Gerbald!" If Dore grinned any wider Pam swore her head would split in two.

"I must thank them. And you." Pam hugged first Dore and then Gerbald who froze stock still in discomfiture. Shyly, he gave Pam's back a gentle pat with his large hand.

"You are happy now, Pam. We are happy, too," he told her. To his relief, Pam released him in order to take another long look at her wonderful cardinals. A number of Grantville children and their German schoolmates had approached, drawn closer by the scarlet birds in the tree.

"Hi, Ms. Miller!" one of the Grantville youths greeted her. "Those are cardinal birds up there, aren't they? Like back in America times?"

Pam looked at the earnest young face, a face full of curiosity, and wonder. *I have another job ahead of me now.* Her decision was made so quickly and so decisively she didn't have time to be surprised by it. *Who are you and what have you done with Pam Miller!?*

"They sure are, honey! They came through with us. But see that smaller one up there? It was born here, in Thuringia. They live here now, same as we do. They even have a name in German: *Amerikanische Rotvogel!* "The name cardinal might be a touch problematic given the religious tensions of these times. Back up-time I heard some folks calling it "redbird," I recall." "American Redbird," yes. *That has a nice ring. Why not a new name in a new place?*

The girl smiled at Pam. "I saw a whole bunch of them over by my uncle's orchard. Ten or so! They sure are pretty." Pam's heart left her body to fly around the sun a couple times. *Joy, oh joy, oh joy!*

"Hey, who is your school teacher?"

"Mrs. Clinter."

"Okay. I'm going to come see her pretty soon. Do you think your class would like to learn more about birds?"

"Yeah, I sure would!" The other children who had gathered around all chimed in their agreement.

"That's good, kids. That's really good."

* * *

A week later Pam sat at her window in the dawn hour. She had grown to appreciate the sun's new path; it had given her garden more light in the morning. The cardinals—*rotvogels!*— had rediscovered their source for sunflower seeds and now joined the tufted titmice, *blaukehlchen* and chickadees for breakfast nearly daily. She had counted as many as twelve of her treasured birds at once so far. Reports were coming in from Dore and Gerbald's word of mouth network that they had been seen on the road to Magdeburg! The species had adapted and was now spreading.

Pam leaned back contentedly in her chair. She had prepared her notebooks and paintings for the show and tell sessions she was going to do at the school today—Mrs. Mason had been so taken with the idea that Pam had been asked to visit every class! Birdwatching field trips were being planned as well as a special summer nature program series that Pam would help implement. Pam learned that many of the town's educators shared her hopes to avoid some of the ecological misdeeds of the up-time past by engendering a love and knowledge of nature in the school kids. What a good place to start! She looked down at the two documents on her table.

The first was titled "Birds of the USE.A Field Guide to Native and Transplanted Species." She had made her lists and written up a plan for organization by bird type. What she was going to do about the scientific names of the European species she still had no idea—she would figure out something. "Is Linnaeus around these days?" The question was only half in jest—she had better find out!

The second was a proposal she was drafting. It could certainly use a lot of polish but she felt she had

made a good start.

Citizens of the United States of Europe and their official representatives,

The following is a formal proposal submitted by myself, Pam Miller of Grantville, based on my personal observations and field studies. The proposal contains two separate yet related issues.

In Brief:

1. All transplanted American bird species (A list of sightings will be provided) be given protected status in the USE until we can determine what, if any, positive or negative effects they will have on the local ecology. I believe these animals have as much right to a new life here as we do and that we should allow them the chance to adapt as we have.

2. I would like to move that the cardinal, also known as the American red-bird and Amerikanischer rotvogel, be considered for status as the national bird of the USE. We are a new nation. We need a new symbol. I give you a bird that was once hailed as the state bird of West Virginia, a bird that is quickly gaining recognition amongst the down-timer population who admire its unusual beauty.

A bird from the Ring of Fire. A bird which has survived the journey. A bird which is thriving here and spreading its range.

A bird like us.

The Monster

by Gorg Huff and Paula Goodlett

The Eagle Flies

Magdalena van de Passe stood outside the building and stared. She paid not the slightest attention to what was going on around her; she had eyes only for the plane that was flying overhead. She had seen airplanes on TV, but she had seen dragons and giant apes on TV, too. A civilized person and old Grantville hand, she knew that just because they had it on TV didn't mean that they could do it in the here and now. It didn't even mean that it was real up-time.

She couldn't hear the engine, or maybe she heard it just a little; it might be her imagination. It didn't matter. The plane was real. Man had learned to fly and could do it in the here and now. And she was going to. She didn't know how, she didn't know when. But she was going to fly. Whatever the cost. She felt almost like she was flying now. After the plane had gone over and while people were running off to wherever they were running off to, Magdalena went back inside. She needed to be alone and to think. Her life had just taken a sharp turn and was running off in a new direction. She needed to catch up with herself.

Back in the building, she looked at the books that had accumulated over the last months. She had come to Grantville at the combined request of her father and her patron. An engraver from a family of engravers, Magdalena was here to learn about opportunities in that field and opportunities in general. To facilitate that, she was studying up-timer business practices. She had found it interesting; now she found it positively engrossing. Right there on her desk was a paper on the costs of mule trains and how they compared to barge traffic, the new rail lines, and trucks on the improved roads. What about airplanes? How much would they cost? How much could they carry? What were their hidden costs?

Suddenly, Magdalena's life was making another turn or perhaps she was catching up with the last one. The outline of a plan was forming. There were a lot of pieces missing, but she could fill those in; she was sure of it. Meanwhile she had some letters to write.

* * *

Dearest Father,

I pray that you will put aside your reasonable skepticism and gift me with a continuation of that trust you gave me when you sent me to this place of wonders. For what I have to tell you next may make you wish you had sent my brother instead.

Magdalena had been sent instead of her brother because she was probably the least trusting member of the family. Her brother was a talented artisan but "he'd buy the Brooklyn Bridge without even arguing the price," as she had heard Cora Beth say.

I would not believe the report I must now make lest I had seen it with my own eyes. Not ten minutes ago, I stood outside this very building and watched a flying machine overhead. With my own eyes, Papa. I would not accept such a claim on lesser evidence. Nor can I truly expect you to. What I do ask is that you begin to let yourself consider believing that it is possible.

I make this request because one thing came very clear to me as I watched the manmade bird sail over head. There are no toll collectors in the sky.

Your Services No Longer Required

"Sorry, Georg. But with Jesse Wood running the Air Force . . ." Vanessa Holcomb actually seemed sorry, though they hadn't gotten along. Kitt Aviation was letting all the down-timers go, because Jesse Wood had beaten them into the sky and would be deciding who got the government contracts. They said they were going to have to cut back. The rest sort of flowed over him as he dealt with the fact that the sky was no longer his to claim.

* * *

Two days later Georg Markgraf paced back and forth outside the Gardens. This was a crazy idea. He wasn't any good with people; he knew that. Maybe he should try to join the Air Force . . . but the line was long for pilot training. Besides, he wanted to build planes more than he wanted to fly them. And the up-timers had that part pretty much sewn up, so far as the Air Force was concerned. He had tried the Kelly's; they weren't hiring either. That left starting his own company.

* * *

Georg finally ran down and most of his guests left, but Farrell Smith stayed. "Kid, you are not good at public speaking. Your presentation skills are pitiful. You're not well organized and you get distracted. In fact, you pretty much suck at it."

Georg slumped and buried his head in his hands. "I know. I know. But I can build a plane." He thumped his chest. "In here, I know it. I have seen the designs at Kitt. Seen the designs at Kelly. I understand aerodynamics; the numbers and concepts make sense to me. I can do as well. Better. Because they are

not considering what we can do now. They all concentrate on what can be salvaged, not what can be built anew."

"How do you mean?"

"Craftsmanship!" Georg held up his hands. "I don't mean fancy doodads. I mean the ability of a good craftsman to judge wood, its strengths and weaknesses, by feel. To shape it using the structure of the wood itself. I mean the skills of a good leather worker to make a saddle or a wine sack and pick the right leather for the right job. Those skills can be combined with your up-time tools and knowledge to craft airplanes."

Farrell kept him talking late into the night. Because the kid had a point. Just before Farrell left, Georg asked, "Do you think any of them will invest?"

"Not a chance, son. I'd be running too, if I didn't know you a bit and Dad hadn't said some good things about you." Farrell shook his head. "Those folks came here half sold after Jesse Wood's flight. You managed to convince them that investing in flight was crazy."

"What do I do now?"

"You wait. Just hang on and let me see what I can do." Farrell assured Georg that he'd contact him in a couple of days. The boy had good ideas. After listening to him talk about the monocoque design he had in mind, Farrell was convinced of several things. Georg Markgraf was as qualified as anyone in Grantville, outside of Farrell's father, Hal, to design aircraft. Georg wasn't, however, qualified to run a company whether it designed aircraft or made thumb tacks. And, finally, Georg had to be prevented from making presentations in front of potential investors at all costs.

Farrell paused, then turned back. "Georg, where are you staying?" With the kids moving out, the house was a bit empty. He'd have to clear it with Mary but perhaps the kid could stay with them. Farrell wasn't really qualified to run a business, either. He could put together a presentation, even if it would end up sounding like a lecture.

"I was sharing a room with a friend. It's paid for the rest of the month."

* * *

Farrell wasn't all that much of a salesman himself, but after years of teaching shop at least he could sound like he knew what he was talking about and keep on point. He made the presentations. The fact that his father was the one and only aeronautical engineer who had been brought with the Ring of Fire didn't hurt and the timing was good. After Jesse Wood flew and, especially, after Hans Richter soloed, people were ready to throw money at flight projects. It had been proven that it could be done down-time and the down-timers—even more than the up-timers—saw the potential benefit.

There were more than rational reasons for this. The simple fact was that the New US, and much of the CPE, was caught up in the romance of flight.

We Need a Bigger Plane

Vrijheer Abros Thys van Bradt found it necessary to leave Amsterdam due to the sudden arrival of

unwelcome guests, an army of Spaniards under Cardinal Infante Don Fernando. He was forced to leave behind most of his wealth, taking only his wife and immediate servants. From there he had gone to an estate owned by a cousin. There he lived in the Orange portion of the Netherlands till the news of Hans Richter's heroic death reached him. It brought to mind a fairly minor investment he had made.

As the primary patron of the de Passe family, he had been allowed to read the letter she had written to her father and he had believed it. More than the word of the flight he was impressed with the cost analysis of other forms of transport that she had sent along. It was nothing he didn't already know, but it had taken him years of experience to get the feel for it.

Reminded of the investment by the events at Wismar, he arrived in Grantville on November fourth, with very little cash on hand and much of his wealth locked behind a siege hundreds of miles away. He still had connections and, surprisingly, the Amsterdam guilders were worth more than expected.

"So, girl. Tell me about airplanes and this airline you want to start."

Magdalena told him. She told him about the other investors she had lined up, about the costs she had calculated and what they would need. They discussed where they would get fuel, oil, pilots, aircraft and a host of other things.

He provided introductions to other investors and helped to persuade them to invest. The strategic reserve of fuel had been used, which had driven the price of fuel through the roof but that was a temporary problem.

"Yes, but," Fredrich Klein, one of the investors said yet again. "There is still the problem of shipping the fuel. That doubles the price right there, more than doubles it, I'd say."

"No, it doesn't," Magdalena said, "the fuel is a mix of fifteen percent gasoline and eighty-five percent methanol. Methanol is really just alcohol—twice distilled spirits, but not the drinkable type. So even when you do need to ship the gasoline to the airport, you only need to ship fifteen gallons for every hundred gallons of fuel."

Vrijeer van Bradt nodded. "It will take organization to set up airports and find the most economic way to get this gasoline to them. But Magdalena makes a good point. Spirits are available almost anywhere and—since they are not for drinking—the cheapest, poorest quality can be used."

* * *

December 5 1633

Dear Sirs:

TransEuropean Airlines is seeking bidders to produce one or more aircraft to open passenger and cargo service to various cities within and without the USE. The planes must be capable of carrying at least ten passengers or one ton of cargo for a distance of at least three hundred miles non-stop.

We will provide partial funding on approved designs. Further, we will provide aid in acquiring or constructing engines, within reason. We will provide final payment after successful test flights are completed.

On successful completion of testing of the first aircraft, we will guarantee to buy up to ten more, if the manufacturer can provide them to us within a reasonable period of time.

Contact M. van de Passe

Address: 2613 Makem Rd

Phone: 85-767

Magdalen looked at the letter and smiled. It had taken some wheedling, something any artist learned to do early. Still, it hadn't taken all that much. For every lord who controlled a pass, there were a dozen merchants and lords who resented having to pay the tolls. It was only partly economics; a big part was anger and the desire to get some of their own back. They liked the idea of their cargos sailing over the toll stations of "Baron-I'll-take-mine-off-the-top." That was where most of her investors had come from, people that had been hit with tolls or robbed by bandits.

Yes, it was a potentially profitable venture but the way their faces lit up at the thought of flying over all the tolls and risks of land travel . . . Magdalen honestly thought that some of them wouldn't care if they lost money on every flight as long as "Baron-Off-the-Top" didn't get it. Of course, each of the investors had their own unreasonable "baron" that they had to deal with, whether it was a Lutheran school or a group of merchants that collected the tolls. In fact, more than a few of the investors collected tolls of their own. That didn't change the fact that they resented it when they had to pay them.

The letter would go out to Kelly, to Kitt and to anyone else who might be doing anything serious in terms of aviation.

* * *

"I'm not sure I believe this." Georg Markgraf sat at the desk, staring at the computer screen.

Farrell glanced over. "What'ya got?" The computer was running an Excel spreadsheet, full of formulas, drag coefficients, lift calculations, wing stresses . . . all he had to do was plug-in a few variables and out came a pretty good estimate of the flight speed, stall speed, ceiling, empty weight, loaded weight. In general, the results were the probable flight envelope of the projected aircraft.

"That letter we got from TransEuropean Airlines. It got me to thinking. So I started plugging in numbers to see what I got."

"Umm hum?" The spread sheet had had started with something Farrell's father, Hal, and Vanessa Holcomb had put together. Excel was such a powerful program that the various designers, including Georg, had started adding bits. More formula based on up-time books, then more based on experimentation to fill in the gaps. It was a pretty good tool by now, one that let you try things and get a rough idea how they would work.

"Well, I plugged in a hundred and twenty-foot wingspan and got a stall speed of like twenty miles per hour."

"Never work. With the materials . . ." Farrell stopped speaking because Georg was glaring at him. He had forgotten Georg's wing stress kludge.

"I know that." Georg's irritation was as evident in his voice as it had been in his look. Then he visibly shook it off. "We couldn't support even an eighty-foot wingspan. Not in a monoplane."

"A biplane? They're a lot less efficient. You only get about eighty percent as much lift for the wing area."

"Sure. But the upper and lower wings support each other, so they don't have to be nearly as strong. And if the lower wing is shorter than the upper, we only lose lift where both wings are involved. It lets us extend the upper wing farther out. With a seventy-foot lower wing, we could have a hundred-foot upper wingspan."

"What about drag?"

"A lot, but drag is a function of speed and this would be slow." Georg laughed. "To think I would ever call sixty miles per hour slow. I'm more concerned about the strutting disrupting laminar flow."

Farrell scooted his chair over to the computer and started examine Georg's numbers for real. The four Jeep engines would only put out a grand total of maybe six hundred horsepower. But that was all this thing would need if the numbers were right. "A biplane with those? And have the darn thing *fly*?"

Georg waved his hand at the computer. "The spreadsheet says we can." He drew pictures in the air. "The upper wing would have a hundred feet of span, the lower seventy. The lower wing is as much to support and strengthen the upper as to give added lift." He sat back down at the desk. "I've got to check these figures. Go away."

Farrell did. There wasn't much point in trying to talk to Georg when he was calculating.

* * *

Slowly, as he went through checking the formulas to be sure he hadn't dropped a decimal some place, Georg began to believe it. It would be, he was convinced, unlike any plane that had ever flown. It would be more like a powered glider than an ordinary airplane.

Georg loved the DC3. He had ever since he had seen one in the movies; more so after he had read up on them. A lot of flight enthusiasts loved that plane, he'd discovered. The DC3 Dakota was perhaps the most-loved plane in up-time history. It was also totally out of the technical reach of anyone down-time. It had two radial engines, each putting out over a thousand horsepower. It was all metal construction and that much aluminum simply wasn't available. But it—or as close to it as they could get—was what TEA wanted.

The biplane that was staring back at him from the numbers on his computer screen would have over one and a half times the wing area of the DC3. It would need it, because it would have barely a third of the horsepower. It would need the extra lift just to get off the ground, as under-powered as it was. Its cruising speed would be less than half that of the Dakota's, but then its landing speed would be a lot less, too. With a full cargo load, it would have about five hours flight time. Right at three hundred miles.

It would carry a ton and a half of cargo, perhaps a bit more. The body would be a semi-monocoque construction—part of the structural support coming from internal bracing, part from the shape of the structure—made of a composite of fiberglass, and viscose that they had been testing, making for a light strong airframe. It would be a lot like the Dakota, except it would be made of fiberglass rather than aluminum. It would be well-streamlined, even the supports between the wings. But in power and speed it

would be closer to something out of World War One or earlier.

"We really can do it." Georg pulled out a paper and pen and started to draw.

* * *

Hal Smith snorted. "I can see what the kid's gone and done, Farrell. He didn't know it, but he's reinvented the wheel. If he'd ever seen a picture of the *Ilya Muromets* built by Igor Sikorsky near the dawn of aviation, he'd have recognized it right off. This is as close a cousin to it as I ever saw."

"So it will fly?" Farrell asked. "I thought it would, but couldn't be sure."

His dad gave him the look that said "I always was disappointed in you." Then he nodded. "It'll fly . . . assuming you can build it."

* * *

"Hand me the scraper." Georg didn't look up. He had heard a sound and assumed it was someone who belonged there. An instrument was put in his hand. He glanced at it. "Not that one. The corrugated one." He stuck his head out from under the section of fuselage enough to see a pair of legs in the split skirts that all the ladies seemed to be wearing these days. He didn't recognize the legs. "The wiggly one."

Having received the right scraper, he went back to his work. "Sorry. I have to get this done before the viscose dries. It's like cardboard, you see. The strength comes from the shape and where the bits connect." Having gotten the fabric pressed into the grooves, Georg climbed out from under the section he was working on and looked at his unknown helper.

He saw a woman of medium height and quite a nice figure, but it was her eyes that really caught his attention. Intelligent eyes that were examining what he had been doing. "Ah . . . Are you looking for work? We don't have anything right now, but check back in a couple of weeks. We're expecting a big contract."

"I've seen cardboard. This doesn't look like it. Isn't cardboard supposed to have flat sheets on either side of the curvy bits? And aren't the curvy bits straight?"

Georg grinned. He couldn't help it. "I'm constantly trying to figure a way of putting it that makes sense myself. Corrugated cardboard's inside sheet is given a curvy fold in one direction because it's easier to do it that way in a cardboard making machine and because cardboard is mostly used for making boxes. The corrugations add strength, but primarily in one direction. We need the added strength to go in different directions at different places in the structure. So we adjusted the corrugations to curve around the structure to give added strength where we need it in the direction we need it."

Georg waved his hand at Joseph Kepler. "Joseph is the carver. I just told him where the stresses were going to be. We'll add a smooth top coat later for added strength and streamlining."

* * *

Farrell finally got off the phone and headed for the shop. He had to get Georg out of there before he blew the deal. When he entered the shop he found Georg and the crew talking with a young woman about engraving, and how it was sort of like the way they made the forms. "I hate to break this up but Herr de Passe is on the way from TEA and we need to get Georg out of here before he opens mouth

and inserts foot." Farrell looked around the shop. "And get this place cleaned up. Let's try to look like a real company that might actually be able to build the airplanes they want."

"Too late," Magdalena said.

* * *

"You're not ready for this thing yet, Georg," Magdalena said after they had shown her the designs for what Georg called the *Jupiter*. "I've seen what you're trying and like most of it, but you don't even have a single engine plane in the air yet. Do you have any idea how much the fiberglass costs? It's too much to invest on a first plane. Finish the *Mercury*. You have a buyer for that one. Learn from it and refine your designs."

It clearly wasn't what Georg or Farrell wanted to hear. Well, it wasn't what Magdalena wanted to say. But facts were facts. After they had built a smaller plane that would fly, she would talk to them again.

* * *

They finished the *Mercury* and sold it to Cristoforo Racciato. They did learn from it. The *Mercury* was a bit of a mishmash of concepts and Cristoforo was quite good about telling them where he was having problems with it as well as what he liked. Cristoforo was introduced to Magdalena and took her flying. Georg wasn't sure how he felt about that. He wanted very much for TEA to buy his *Jupiter* four-engine biplane. But Cristoforo was charming and Georg wasn't. So he found himself glad that Magdalena was flying in his airplane but wishing that Cristoforo was rather less charming.

* * *

Cristoforo munched contentedly on a sandwich. He loved eating in the air. In fact, he loved doing just about anything in the air. He checked the gauges on the *Mercury*, then glanced at the horizon. A storm front was building, but he figured he could beat it to Leipzig. Or at least find a field closer to Leipzig to set down in. A little later, looking back, he saw lighting and begin to look for a good place to set down.

* * *

Five minutes later, he was still looking and the storm was getting close. He pushed the stick a little forward as the world turned into gray mist. Slowly losing altitude, he tried to get below the clouds where he could see to land. He was going to be late and Gus had said that the parts were needed in a hurry. He'd offered Cristoforo enough money for a dozen tanks of gas. While Cristoforo was trying to figure out how to explain to Gus that it wasn't his fault, the engine died. He tried to restart. He was losing altitude too fast, so he pulled back just a little on the stick and tried the engine again.

Between the added weight of the rain and the added drag of flying through raindrops, the plane was handling a bit differently than Cristoforo was used to. It went into a stall and he wasn't ready for it. The delay in his response cost vital seconds and Cristoforo's lack of experience cost more. Still, he almost made it.

He had managed to pull out of the stall, induced spin and had the plane level again but he had used up all his altitude doing it. He was going to land—like it or not—and he was coming in hot, fast and heavy. The field had been plowed and was in the process of being turned into mud by the rain. The *Mercury* bounced once on the top of a furrow but then a wheel hit in a furrow. The wheel stopped, but the plane didn't. It nosed into the mud, bounced again and landed upside down. The cockpit roof collapsed and his

skull was crushed by the impact.

* * *

Heinrich Bauer heard the noise and went out in the rain to check it out. What he found was what was left of a plane in his field. Well, partly in his field, partly in Johan's. He wasn't the only one. Several of the villagers had come out to determine what the noise had been. After checking on the pilot and confirming that he was in fact dead, they retreated back indoors to try to figure out what to do.

The next day they sent a rider to Leipzig and started cleaning up the mess. They were later told that they should have left everything just where it was till the investigators got there, but by then it was much too late. They did collect up the bits of wrecked plane and scattered cargo and put it in a barn in case it might be worth something, but they had work to do.

It wasn't that they weren't sorry about the boy. He had never done anything to them but crash in their fields, and it was clear enough that it hadn't been on purpose. But he was already dead. There wasn't anything they could do for him. And they had no reason to believe that anyone could tell anything from the crash site that they hadn't been able to tell.

* * *

"Damned shame." Georg shook his head and continued to pick through the rubble of the *Mercury*. It had been sent to them by the Racciato family in the hopes they could determine what had gone wrong.

Cristoforo had been a good kid.

"It seems to me that he waited a little long before he tried to set her down," Farrell said. "Or maybe it was just bad luck. The clouds were pretty low that day from the reports."

Georg nodded. But he was busy going over the report. "Look at this. The villagers didn't hear anything until the crash. The engine must have died. Water in the carburetor, you think?"

"Hard to tell. We'll know more after we go over the engine." Farrell pointed to a piece of the wreckage. "It could be that the weight of the rain on top of the weight of the cargo pulled some screws loose."

On the strength of Cristoforo's praise they had gotten two new orders for Mercury-style aircraft. With his death, those orders had been canceled. Georg was convinced that they would have kept them, at least kept one of them, if the designer had been an up-timer. And they still didn't have a contract with TEA.

The Contract
December 1634

Whap!

Georg jumped. Magdalena could be fairly temperamental, but she didn't usually try to beat the table to pieces as she was doing now. "Ah, Magdalena? What is the matter?"

Whap! The file folders hit the table again while Magdalena worked out her frustrations. "They won't sell."

We're going to build them, and fly them,' they said. So TEA can't buy their plane."

Georg cast a glance at Farrell, who hid a grin of relief. "We have the plans for the *Jupiter* ready, Magdalena. Well, almost ready."

Georg and Farrell had both been worried that one of the other aviation companies would beat them to the punch. Now, with the refusal to sell to TEA, they still had a chance. Georg, for more than one reason, wanted the sale to TEA. Not only did he want his own plane in the air, he was very interested in Magdalena, who appeared to return that interest.

Magdalena glared around the room. "I have a sneaking suspicion that you're not quite as sympathetic to TEA's plight as you pretend to be." Then just a touch of grin showed through the storm. "Never mind. Show me the progress reports. Where are you with the *Jupiter*?"

* * *

Magdalena was learning to be a pilot and had seen sea planes on TV since coming to Grantville but she wasn't an aircraft designer. An airport, while not that difficult to build, was needed for a large aircraft. At least she assumed it was. She didn't want a repeat of what happened to Cristoforo. Not with a plane full of passengers.

She asked Georg to replace the wheels with pontoons or make the fuselage into a hull.

Georg promised to look into it. It was only a couple of days later that he delivered the bad news.

"It won't work. Pontoons don't sit *on* the water, they sit *in* the water. They displace as much water as the weight of the plane on top of them, all the cargo and fuel it's carrying, plus the weight of the pontoons themselves. When the plane tries to take off they push that much water out of the way. All the way from the start of the taxi to lift off, and drag more water with them."

"But there are sea planes all over the movies from up-time."

"Yes." Georg snorted. "And thousand horsepower engines to pull them out of the water." Georg's face was a picture of desperation. "The long wings that let us take off at thirty miles per hour are just that much more weight when you put the plane on pontoons. I talked to Herr Smith about it. The flying boats of the thirties used ten percent of their fuel loads on takeoff and landing. They ran those thousand horsepower monsters full out—they had to just to get into the air—then they cut the power way down for level flight. I'm sorry, Magdalena, but with the engines we have, it would never get into the air."

"I'll hire Maria," Magdalena said. Maria was a friend from before she had come here. She had a knack for finding things in the National Library.

"Won't do any good." Georg glared at her. He was not, she knew, that fond of Maria. "I've already studied everything they have on aircraft."

Nor did he lack for ego. Sometimes Magdalena wondered what she saw in him. A lot of the time, actually. Yes, he was the smartest person she had ever met, but sometimes he was a real jerk. Of course, sometimes he was anything but.

"TEA needs a certain amount of flexibility if we can possibly get it." She gave Georg one of her best looks. "It's worth a try."

* * *

"Eureka," Maria whispered. What she really wanted to do was shout. MSP Aeronautics was her first major client. They had hired her after their investors had insisted that the plane must be capable of water landing and take off. But who would have thought that she would find it in a *Time* magazine article? She read the first part of the article again.

"Aug. 25, 1967

Everything seemed normal when Test Pilot David W. Howe eased the LA4 "Lake" amphibian toward Niagara Falls International Airport earlier this month. He radioed a highly abnormal report to the tower: "Bag down and inflated." Seconds later he landed—without wheels—on a cushion of air."

The article went on to describe—with a maddening lack of technical detail—the principles and basic structure of ACLG, Air Cushion Landing Gear, conceived by Bell's T. Desmond Earl and Wilfred J. Eggington. It was simple enough in principle—put an airplane on top of a hovercraft. At least that's the way the article made it seem. Maria spent the rest of the day getting a start on learning about hovercraft to try and fill in some of the technical details that the *Time* article left out.

* * *

"This doesn't make sense," Georg complained. "If this is so good why didn't they use it up-time? This article says it happened over thirty years before the Ring of Fire."

"I have no idea." Maria smiled. "I do know that a lot of stuff they had, they didn't use. Mostly it was because they had something better, but not always. Sometimes—" She shrugged. "—they just didn't."

"I think I might know," Farrell said. "Look at the date. By sixty-seven little private airports were all over the place. I used to love to look at the planes as we went by one on the highway. Most planes had no need for amphibious take off and landing. So ninety percent of the potential market is gone before they start. As for the planes that did need to be amphibious, well, pontoons were a known tech. The FAA already had all the guidelines in place. The manufacturers knew how to build them, the FAA knew how to test them, the pilot knew how to check them before flight. By the time the air cushion came along in the sixties, it was competing with established tested products.

"It probably would have cost Bell millions to jump through all the hoops the FAA would have wanted. For what? Maybe a thousand sales a year and liability down the line if someone blew the maintenance requirements and got themselves killed." Farrell shook his head. "I'd lay five to two that the bean-counters got hold of it and said, 'Don't bother.' Once that happened, well, they never took off because if you owned a plane you could buy pontoons but you couldn't buy this ACLG stuff."

"That's not the real question," Magdalena interrupted. "The real question is 'can we do it?'"

Maria pulled another file from her case. This one consisted of a report she had made after interviewing Neil O'Connor, who had turned out to be something of a creep. Neil was the proud owner of a home-built hovercraft that he had built after the Ring of Fire. After his discharge from the Army—a discharge he and his family didn't discuss—he used it to provide rapid transport down the Saale River. Because it was a hovercraft, it didn't care how shallow the water in the Saale was. It went right over sand bars without even noticing them. He could get you from Grantville to Halle in half a day. And right now

the railroads were looking like they were going to put him out of business in the next year or so.

Neil was probably going to be needing a job any time now, and building air cushion landing gear might well be his out. That hadn't kept him from hitting on Maria from the moment they had met. He was one of those up-timer guys that figured any down-timer girl would just naturally be thrilled to be his latest conquest. However, if Maria had it right, they were going to need Neil even more than he needed them. While simple in principle, air cushions weren't all that simple in practice. They weren't just skirts but a sort of a cross between skirts and leaky balloons. The design had to push the air inward.

Neil's air cushion was a series of tubes pointing at the ground, placed in a circle around the outer edge of his craft. There were two layers of plywood above that, with a gap between them. The fan was set into the top layer of plywood. When the fan was turned on the air was spread between the two layers of plywood and escaped from there into the tubes which inflated. The tubes formed an inward curving ring around the craft and as the air was forced through them it much of it escaped into the area surrounded by the ring.

The way Neil explained it, there were three levels of pressure. The lowest pressure was the air outside the hovercraft. The highest was the air in the tubes and between the two layers of plywood. The middle pressure was in the area below the plywood bottom and surrounded by the inflated tubes. It was the way the air had to flow that kept the skirt of the hovercraft from blowing up like Marilyn Monroe's skirt in *The Seven Year Itch*. Neil had leered at her when he said that part.

The tubes were made of oiled leather, with removable thicker bits at the bottom where the worst wear was. Neil generally had to change out one or more of the extensions every trip, which was one of the reasons why his service was so expensive.

Maria hesitated but she was a professional. "There is another option."

Farrell looked at her and smiled encouragement, so she continued. "Hydrofoils. Herr Bell, inventor of the telephone, was working on hydrofoil landing gear from the beginning of the twentieth century. While it's clear that he got hydrofoils to work, I have not been able to see any case of a plane actually taking off using them. I have no idea why but I think they didn't work." After some discussion—and over Georg's objections—they decided to go with the air cushion landing gear. The *Time* article was proof that it did actually work.

* * *

The problem with air cushion landing gear became apparent as soon as they started to seriously look at it in terms of something designed to leave the ground. Once the ground was taken away the air escaped almost instantly, the skirt deflated and stayed deflated till the plane landed. Not till it was *going* to land, until it was *on* the ground. They worried over that a lot. It was the *Time* article that finally came to the rescue. "Bag down and inflated," the pilot had said. The air cushion on the plane up-time wasn't a skirt, not even a fancy skirt. It was a bag.

Building the Monster
January 1635

The ACLG required several changes in the design of the aircraft. The lower wings were shortened and their width increased. They became short stubby things, barely forty feet wide. The upper wings were

increased in length. The *Monster* began to look less like the *Ilya Muromets*. While all this was going on, Georg was working out the thousands of details that go into making an aircraft. Where the control runs would go, how to save weight and drag while increasing lift.

Georg really wanted to use monocoque construction and mostly he did, but not all of it could be built that way. The materials he had to work with would actually increase the weight if he tried to make a pure monocoque plane. There were places where internal supports would be needed to save weight. But he spent weeks balancing the numbers to determine just where the internal supports had to go, where he could use the shape of the plane to provide the support. The good news turned out to be the engines. Though water-cooled, they were lighter than expected, if weaker than he wanted. He refined his estimates, did drawings, changed things around, did more drawings, refined his estimates again.

He got in knockdown drag-out fights with Magdalena over weight versus cost, which didn't help his love life any. Lost some, won others, redesigned again. After that he got in knockdown drag-out fights with Farrell, Hans, Karl and the guys in the shop over how to build each and every component. How to make the forms, how to angle the fabric, how much of which glue and resin to use, in what mixture.

Testing and Turnover

"Bag motor on." The putt-putt of the small lawn tractor engine that powered the two fans and inflated the ACLG was loud in the cabin. Farrell looked over at Magdalena and grinned.

He put the engine in gear. "Bag inflating." Farrell looked out the window and saw the large leather bag balloon out below the plane. He waited till the plane lifted on the air cushion, and he started the left inboard engine. The plane started to spin. They hadn't realized just how little drag there would be. He managed to kill the engine but not before the plane had made a full half circle and not before he had scared the heck out of himself and Magdalena. He felt a thump as Georg apparently leapt onto the plane. The door opened. "Magdalena, are you all right?"

Neil was sitting off to the side laughing his ass off. It rapidly became apparent that after checking to make sure she was all right, Georg's next intended destination was to murder Neil. Farrell almost let him. Air cushion landing gear apparently didn't include brakes. And air, it turns out, is more slippery than any grease.

* * *

"We'll have to work out some sort of procedure to handle it," Magdalena said. "Start the engines with the props feathered."

"It will take more than that, I'm betting," Farrell countered. "Each engine will be a little different. They'll idle at different speeds. What we're looking at is having to fly the plane from the moment the engines come on."

"Kickstands." Georg snapped his fingers. "Kickstands, like on the bicycles in town. One about twenty feet out on either wing. And maybe one near the tail. They'll have to be retractable. And they won't work on the water or even on muddy ground, but even if you land on water you should be able to taxi onto solid ground."

"But what about water and muddy ground?" Farrell pointed at the four levers that were the thrust controls

for the four main engines. "We need something that will let us adjust the thrust on each engine to match the thrust on all the other engines. We'll need it in the water as well as on a runway."

They tried several things before settling on what amounted to an anchor. Near the tail, a retractable tail skid provided drag. Since the drag point was well back from the engines, uneven thrust twisted the plane less. It wasn't a perfect solution but it was workable.

* * *

Another day, another test, and this time the *Monster* only slewed a bit back and fourth as Farrell brought up the engines. When Magdalena retracted the tail skid, off they went. The surprising thing was how fast it picked up speed till the air drag matched the engine thrust. They started to bounce a bit when the air speed indicator read twenty-five mph, which was before they were supposed to. Farrell gave it a bit more power and at thirty-two indicated air speed, they were off the ground. And drifting left. Farrell adjusted the flaps and the engines again.

It handled like a barge. Slow and steady. You turned the wheel and it took a while for the plane to turn. Banks weren't just slow, they were physically difficult. The *Monster* had a lot of wing and a lot of flaps and no power-steering. In fact, it took both of them to bank it to any great degree. They made a slow circuit around the field and landed.

After that came the water landings. Any stretch of water a hundred feet wide was a landing field. Well, two hundred feet wide. Or a body of water that didn't have trees or too steep a bank.

Fields were landing fields, too, and they didn't have to worry about rocks unless the rocks were three feet tall.

Each flight brought them closer to the final turnover of the plane to Trans European Airlines. Each flight used more of the gasoline-methanol mix that they had adjusted the engines to take.

Testing completed, TEA paid the final delivery payment. It was a great deal of money. Markgraf and Smith Aviation was in the passenger plane business.

TransEuropean Airlines
The Wietze Oil Field

Since its creation in 1633, TEA had been an airline without any airplanes. All outgo, no income. Arrangements had been made, deals agreed to, money spent—all on the basis of Magdalena's promises and the investors' hopes. Now they had a plane. They needed fuel. Well, gasoline. They had the alcohol stations. But they had been unable to contract for much gasoline until they could show a working aircraft.

On a sunny Thursday afternoon, the oil men at Wietze looked up into a clear blue sky and saw a plane. It wasn't the first they had seen, but it was the biggest.

The manager came out to see. As did Duke George of Calenburg, who owned the oil fields. The manager was impressed, Magdalena could tell, but not nearly as impressed as the duke.

"There they are." Magdalena climbed down from the plane and helped an older gentleman down after her. The older gentleman was Vrijeer van Bradt. And Vrijeer van Bradt was here to buy gasoline. Lots of

gasoline. He wanted it shipped to various places in and out of the use and he wanted to make arrangements for some to be carried by the Jupiter itself.

If it wasn't carrying much of anything else the *Monster* could carry close to three hundred gallons of gasoline. When mixed eighty five gallons of methanol to fifteen gallons of gasoline that came out to seventeen hundred gallons of aviation fuel. Enough for fourteen three-hundred-mile trips.

Van Bradt looked at the approaching men, then looked at all the people who had stopped working to watch. He rubbed his hands together. "Time to, how do they say? Oh, yes. Let's make a deal."

* * *

The first trip to Venice was just the three of them: Magdalena, the copilot, Johan, and Vrijeer van Bradt, along with a bunch of extra gasoline. As luck would have it, they arrived three days after Pope Urban. They hadn't had any intent to upstage the man, since they hadn't known that he was going to be there. The neat thing was he came out and looked at the *Monster* and blessed it. The official name of the plane was the *Jupiter*. But it's real name had come about when Colonel Jesse Wood had come by for a visit, taken one look at it and said "What a monster." From then on, no matter what Georg said, it was the *Monster*.

They spent three weeks in Venice that first trip and a week in Bolzano with Claudia de' Medici. Now that a real live plane was part of the deal, they could work out the details of the agreements they'd previously made. Magdalena came away convinced that Claudia was one smart cookie. The deal they had worked out had real advantages for TEA and Claudia.

Among other things, it just about guaranteed them full cargo loads because Claudia got half-price for standby cargo transport. If they didn't have a full load, they stopped at Bolzano and carried what she wanted, carried it at about the cost of the flight. In exchange for which Claudia provided docking facilities and didn't charge tariff on what they carried. At the end of the year if they hadn't carried at least the required amount of her stuff, or offered to, they paid her a fee.

Three months later

Magdalena glanced back at her passengers who were crowding the portholes on the right side of the plane and over at her co-pilot. Their navigation had been just a touch off this trip. It looked like they would pass about a mile to the east of Munich, closer than the five to ten miles on most trips. They were also a bit light this time. Their passengers were two Venetian merchants who had business in Grantville, and Claudia de' Medici, who was taking one of her free flights.

Magdalena grinned. This was still a very new thing and it was a first flight for all of their passengers. While their ceiling was higher, they were flying at about three thousand feet to facilitate sightseeing. One of the merchants pointed out a feature of Munich that he recognized. The other apparently missed it.

Claudia de' Medici spoke up. "Signorina de Passe, might we go around again to get a better look?"

Magdalena looked over at Johan and shrugged. He shrugged back. They knew relations between Duke Maximilian were in the dumps, but heck. They weren't doing anything, just flying over. She started a slow right turn that would take them around Munich and if they lost a bit of altitude in the turn, that was all to the good. It made for better sightseeing.

* * *

On the ground, a captain of the duke's guard cursed. They were rubbing it in. The duke had been livid every time they flew near Munich. Now it seemed they wanted to rub salt into the wound, and there wasn't a damned thing he could do about it. At least, at first he thought there wasn't, but as they circled they got closer and lower.

The captain started shouting, "Load with canister! All cannons! And double the charge!" That got him a questioning look from the sergeant but they did it right enough. It took a couple of minutes for the plane to make the circuit around Munich and by the time they did, they had dropped to eighteen hundred feet and were less than half a mile from the wall. By that time, His Grace had arrived and the captain had the guns aimed at a point in space he thought the plane would fly through.

* * *

"What are they doing there on the wall?" Claudia de' Medici asked, just as the puffs of white smoke appeared.

It wasn't a golden bb, not even a silver one. The cannons missed entirely; no single bit of shot from those guns came within a hundred yards of the plane. They were much lower and closer to the cannons than they should have been, and the *Monster* was a big, slow-moving plane. Still, it wasn't close enough or slow-moving enough—or, most especially—low enough, to be hit by cannon fire. They weren't, however, far enough away to avoid being frightened by it.

What it actually was, was a loose copper fuel line, combined with suddenly ramming the throttles to their stops. The fuel line on the right inboard engine came loose and sprayed the hot engine with fuel. Johan had already kicked the rudder over and started to reverse his bank by the time the fuel line came loose. The engine didn't catch fire; there was fuel and oxygen in plenty but in spite of the heat of the engine, there wasn't a spark.

As the engine died, the torque of the left side engines was no longer balanced by the right side engines. The plane started a right roll and right yaw, bringing it closer to Munich and lower. Magdalena and Johan struggled with the controls. Neither of them were what an up-timer would call qualified. They had more time in the *Monster* than anyone else, but it was still only a few hundred hours. They had very little experience flying with one engine dead and none at all with it happening suddenly out of the blue.

"The right inboard engine is out," Magdalena shouted. While Johan tried to remember what he was supposed to do. Some of it was obvious they were rolling right, so stick left. They were also yawing right, so left rudder.

Johan noticed that all the engines were at their max. Magdalena must have done it. Then what Magdalena had shouted penetrated and he cut the fuel to the right inboard engine. While Magdalena was holding the stick left, he throttled back on the left engines.

"Take the stick, Johan. I've got to adjust the trim."

* * *

It took a few minutes and almost five hundred feet to get everything as well balanced as they could. Magdalena pulled out a pencil and started doing sums. The *Monster* could fly with three engines.

At least, with its tanks half empty. But three engines delivered unbalanced thrust, so the right outboard engine was being run full out.

They couldn't do that with the left side engines or they would end up going around in circles. As it was, they had the left inboard engine at about fifty-five percent power and the left outboard at eighty-five percent. The rudder was almost all the way over and they were in a slight left hand bank to keep from slipping right. All of which meant that they were using about twenty percent more fuel than they should be using at this point in their trip.

They weren't in any danger of crashing, not as long as the right outboard motor held. They would just run out of fuel before they got to Frankfurt. As long as the left outboard motor held. They were stressing the heck out of it. The engine wasn't designed to handle that sort of RPM on a constant basis.

They had time before the fuel shortage became critical, but they needed that engine fixed. Normally, they would put down in a field or on a lake or river to fix an engine. It had happened a couple of times before and was generally no real problem. But to do it where people pulled up cannons and shot at you just for flying over seemed unwise. This was not a place where you wanted to land even for a few minutes and they didn't know how long the repair would take.

Johan was not as familiar as Magdalena was with engines. Generally, when they stopped to fix something, he held the tools. They discussed the matter in whispers, in an attempt to avoid alarming the passengers.

"I could go out on the wing and have a look." Johan didn't look happy about it but he didn't hesitate either.

"Don't be silly, Johan. You've never met an engine that you couldn't make worse by looking at it." Magdalena looked down at the rudder pedals; the left one was almost to the floor. "Besides, you weigh one eighty, I weigh one twenty. Which of us is going to do a better job of holding the rudder hard over?" Even with the trim set all the way it was still taking muscle to keep the plane straight and level.

He nodded. "What do we tell the passengers?"

At that point it became apparent that their whispered consultation had not had the desired effect. "You might try the truth." Claudia de' Medici arched an eyebrow. "Just how bad is our situation?"

"Well," Magdalena hesitated. "It would be just inconvenient if the duke wasn't a crazy man. We'd just land, fix the engine, then be on our way."

Claudia nodded. "How far away were we when they fired at us?"

"Around eighteen hundred feet up and a bit less than half a mile off. Why?" Johan asked.

Claudia shook her head. "Crazy people, indeed. To have had any chance of hitting us, even to reach us at that range, he would have had to double charge his cannon. He was willing to endanger his men in order to have a very slight chance of hitting a target that was no danger to him. Just out of spite. I agree. I don't want to land in his territory. What options does that leave us? We seem to be flying well enough on the three engines remaining."

"There are two problems facing us. One is fuel. Flying this way takes more," Magdalena said. "The other is that we are over stressing the remaining right side engine. It will last for a while, but we don't know

how long. The longer we wait before fixing the inboard engine, the worse it will be."

"How long will it take to fix the damaged engine?"

"We don't know yet. The only way to find out is to go out and look. Normally we'd land and look but in this case . . ." Magdalena pointed back toward Munich . "What I am going to do is go out on the wing and look at the engine to see what's wrong with it."

One of the merchants swallowed. "Go out on the wing?"

"It's not that bad." Magdalena smiled at the man. "I've seen it done and our air speed is low." She didn't mention that the only time she had seen it done was in the movies in Grantville.

* * *

The *Monster* had one real disadvantage when it came to wing-walking. Its streamlining. Hand holds were hard to come by. Magdalena wing-crawled to the right inboard engine with one hand on the leading edge of the bottom wing. To keep the engine away from the water when making water landings, it was hung from the upper wing rather than sitting on the lower. There was a support that went from the bottom wing to the streamlined box it was in. But the bottom of the engine casement was four feet from the bottom wing and she was only five feet six.

After she reached the support, Magdalena carefully tied herself to it and looked around. She was terrified and at the same time exhilarated. Standing in the open with just three and a half feet of wing below her, twenty feet from the body of the plane. With a forty-five mile an hour wind blowing in her face. She wanted to shout for joy. She wanted to get back inside the plane where it was safe. Her hands were shaking and that wasn't all. She wanted to jump Georg and would have if he weren't over a hundred miles away.

Instead, she took a few minutes getting herself under control. She forced the cowling open against the wind and examined the damage. By now she wasn't sure whether she wanted to jump Georg or kill him. The cowling worked fine on the ground. But in the air, with a gale blowing in your face, and that gale trying to slam the cowling on your hand, it sucked.

She found the problem easily and it was an easy fix. She decided that she could fix the engine right there, and there would be no need to land. She reached for the line and bumped the strut holding the cowling opened against the wind. It slipped and the forty-five mile per hour wind slammed the cowling against her back and head.

There wasn't time for it to build up much momentum or she would have died at that moment. As it was she was knocked senseless, and left dangling from the strap she had used to tie herself to the support.

* * *

Inside the plane Johan, Claudia de' Medici and the two merchants watched helplessly as Magdalena dangled from the strap. Johan started looking for a place to put the plane down. Duke Maximilian be damned, and all his soldiers with him.

They had come just twenty miles since they had left Munich . No rivers of any size were within another twenty miles but there in the distance was an open field. There was going to be an unhappy farmer.

Johan cut back on the power to the remaining engines and started the bag engine. That was what they had come to call the small motor that ran the fans for the air cushion landing gear.

* * *

The farmer watched as the plane floated down onto his field, across his carp pond and out the other side. It stopped, still sitting on the big brown bag. He saw a woman—he thought it was woman, it was hard to tell at this distance—dangling from one wing. Then he saw the large man come out of the plane and run along the wing to the woman. He thought of going to give aid, he thought of calling the local lord, but on due consideration, he decided that he didn't want to get involved.

He knew that the duke didn't like the people from the future. Had even been told that they weren't from the future, also that they weren't people but demons. He didn't know what he believed about them except that he didn't want either the duke or the people who flew mad at him.

* * *

Johan reached the still woozy girl only seconds after touch down. He used some ammonia as smelling salts and that seemed to mostly do the trick. Magdalena had been semiconscious as the *Monster* landed and the spray from crossing the carp pond had helped. "Let me up, damn it. Where are we?"

"What? About twenty miles north of Munich ."

"Well, if we were going to land anyway, what the hell was I doing out on that wing?"

Johan paused for a minute. "Got me. I'm not crazy enough to do it, that's for sure."

That was when Claudia stepped out on the wing. "I hate to interrupt, but since I doubt that they have any airplane fuel here and since Maximilian has never impressed me with his forbearance, perhaps we should see about fixing the engine and being on our way?"

Magdalena looked at Claudia, who was standing calmly on the lower wing of the *Monster*, shaded by the upper wing, and suddenly realized what "unflappable" meant. Claudia was unflappable. Magdalena got up. It hurt, but she did it.

Looking at the engine without the wind in her face, she saw a problem. The nut had been over-tightened and the threads had slipped. "Johan, get me a five-eighths inch wrench, would you? And the vise grips!"

She had to bang the connection a bit to make it fit again. And she gooped it up to keep the stripped threads from leaking too much. She used the vise grips to lock it in place and taped that. All in all, it took almost fifteen minutes.

Fifteen increasingly nervous minutes. Johan had climbed up on the upper wing, which put him almost twenty feet off the ground and gave him a good view of the surrounding territory. About twelve minutes into the repairs he shouted down, "Riders!"

"How far?"

"A couple of miles, perhaps a bit more."

"I'm almost finished."

"Well, finish later. We need to leave. We'll make a short hop, ten miles or so then you can finish."

"Can't. If we lose the vise grips, we'll be even worse off. Just another minute. Go ahead and start getting ready for takeoff."

"Right! Ma'am, gentlemen . . . if you'll kindly take your seats, and fasten your seat belts for takeoff."

Claudia might have been unflappable, but Matteo dal Pozzo, one of the merchants, certainly wasn't. In a nervous voice, he asked, "'How often does something like this happen?' I don't mean being shot at, but having to land in the middle of nowhere."

"Not that often," Johan said. "Certainly a lot less often than it did in the early days of flight up-time. Our engines are better and better maintained. It does happen sometimes, though."

"So our cargoes aren't really safer than if this were a mule train?"

"Of course they are. A mule train spends the whole trip subject to being found by bandits. It can be tracked by them. We can't. For your cargo to be taken by bandits, they would have to be right where we happened to land. And be there right when we landed."

Claudia laughed. "Matteo, we have regular flights from Venice to the USE. That is worth millions. Perhaps a bit more expansive than a mule train would be and certainly a little less per trip. Still, it is faster and much safer."

* * *

While Magdalena was tying down the vise grips, she felt the plane shift under her as the bag inflated and took the plane's weight from the stands. She closed the cowling, and ran.

"The wind's from the south," Johan told her as she was strapping in. "And so are the troops coming our way."

There was really very little choice. They had to get into the air as quickly as they could. They took off into the wind and into the faces of the approaching riders. There were no puffs of smoke from the riders as they passed overhead at only a couple of hundred feet. But Magdalena could see them trying to get their flintlocks ready. And one guy waving a sword at them.

Magdalena couldn't resist. She stuck her thumbs in her ears, then wagged her fingers at him. She leaned back into her seat. "Let's try to keep this a unique experience, Johan. At least on this airline."

Technical Notes:

The *Ilya Muromets* is, or was, a real airplane built by Igor Sikorsky in Russia in 1913. It had flight characteristics quite similar to those described for the *Monster*. It was Russia's large bomber during World War One, but was initially designed as a luxury passenger plane with seating for sixteen passengers.

Likewise, the air cushion landing gear is real as is the Time article on it. There is also a small hybrid hover/flair craft that is sold as a sports vehicle. The technology is proven but does have several drawbacks. The primary one is weight, after that comes the lack of friction. It's like taking off and landing on a slip and slide. Everyone seems to assume significant issues in terms of drag while in flight, but from the reports the drag issue is minor to nonexistent. Besides, parasitic drag is more of an issue for high-speed aircraft than for the sort of low-speed aircraft envisioned here.

The composite materials are a bit more iffy. There are several possible routes that might be taken to achieve the desired ends. The fabric could be the fiberglass we used, or silk, or even linen. The bonding agent might be glues or Viscose, the material that is extruded into both cellophane and rayon. Viscose was originally developed to act as a coating for fabric tablecloths. It failed in that use because it made the tablecloths stiff. It apparently didn't occur to the inventor that there were circumstances under which that stiffness might be a good thing. If it had, we might well have had the composite materials revolution a century early in OTL. We can point to no instance of viscose and fiberglass being used together and the specific properties of that composite aren't known to us. It's a WAG.

What isn't a guess is that the down-timers, being made aware of the concept of composite materials that are light and strong, will experiment with the concept using the glues and resins they have. They will, we're sure, combine those glues and resins with up-timer knowledge of chemistry to make new ones. There is, for instance, a better than even chance that they can make carbon fibers within a very few years of the Ring of Fire. Carbon fibers are produced by baking polyacrylonitrile (PAN), however, lower-quality fiber can be manufactured using pitch or rayon as the precursor instead of PAN. Further heat treating can improve the quality. Our point, however, is that while what the particular composite is may be somewhat unpredictable, that some fairly decent ones will be developed, is predictable.

Semi-Monocoque is not quite the same thing as monocoque. What semi-monocoque means is that there are internal supports but fewer of them are needed because some of the stresses are supported by the shape of the structure. The use of corrugations, as in the skin of the Ford Trimotor, is a semi-monocoque; the corrugations in the aluminum add structural strength. Since then, quite a bit more has been learned about ways of effectively adding strength to materials through structure. And most modern aircraft, and car bodies, are of semi-monocoque or monocoque construction.

One Step Toward the Clouds
by Sean Massey

Hans Richter Field
Near Grantville
December 1633

Marie Moritz concentrated hard as she lined her plane up for final approach. The drone of the engines poured from the speakers next to the monitor as she fought a thirty mile-per-hour crosswind within a simulated Cessna. Although she routinely flew flights like this on her computer, she usually didn't do it while waiting to present this software to the top brass of the new USE Air Force.

The base didn't have a conference room and Colonel Wood's office was supposedly too small, so Marie had been directed to set up her equipment in one of the unused hangars that had recently been constructed. Through an arrangement with Lieutenant Miller, she managed to have her computer delivered to the base and set up two days prior to the meeting.

The room was cold—much too cold for Marie's comfort. The buildings on the base lacked heating. Had she known that, she would have brought gloves and worn something warmer than a skirt.

"Come on, Marie," she told herself. Her left leg began to bounce, draining off her nervous energy. "You can do it. You just have to concentrate." She reached up and adjusted the plane's flaps for landing and began to ease back on the throttle. *That's it, just ease her in. You've done this a hundred times. It's no different just because you're going to be demonstrating this software.*

Marie kept one eye on the altimeter and the artificial horizon as she descended. She didn't want to descend too quickly and end up as a smear on the ground, and she had to make sure she wasn't descending so slowly that she overshot the runway. The rest of the landing went quickly, and before she knew it, she heard the chirp of the tires on concrete as the plane touched down. As soon as she had brought the plane to a stop, she ended the simulation.

Before she could start another flight, Colonel Jesse Wood, the chief of staff of the nascent Air Force, entered the room a good half an hour late. "Marie Moritz?"

Marie stood up. "Colonel Wood." He had more than a few inches on her 5'3" frame and a strong grip to match.

"And this must be the flight simulator that you plan on showing me. If I remember correctly, you're in high school. I believe you were in Greg Ferrara's Rocket Club."

"Yes, sir," Marie responded.

"I realize you probably have a presentation, Ms. Moritz," he said, "but I think we can dispense with that. I'm familiar with flight simulators from my days in the Air Force. I had to do simulator checks in order to qualify in the aircraft I flew. Flight simulators are very useful for training, but they're a lot different than the real thing."

Marie began to tremble. *This isn't going the way I planned. My whole proposal is ruined.*

"I need simulators, Ms. Moritz," he said. "I need a way to weed out unsuitable pilot candidates before they get behind the controls of one of our few planes. And I need a way to put potentially good pilots into dangerous or emergency situations without risking them or their planes, so they can learn to handle those situations calmly when they meet them in the air."

"None of the simulators I have experience with came through the Ring of Fire," Colonel Wood continued. "Back up-time, I was aware of home computer based flight simulators, but I never had the time to really delve into them. I recognized how useful the software could be when I was forming up the Air Force this summer, but I didn't have the time or the resources to research it." He gave Marie a wry grin. "I wasn't sure if anyone even had the software or if they would be willing to part with it."

Colonel Wood gestured at the computer. "So tell me more about your flightsimulator. Which one are you using? Can you create new aircraft and new terrain files? How realistic is it? And how easily can it be modified?"

Marie took a moment organize her thoughts. Although she could answer most of his questions, her nerves had driven the answers from her head. "I think it'd just be easier for me to do my presentation, Colonel Wood. It should answer most of your questions."

"I'm sorry, Ms. Moritz. I guess I got a little excited by the prospect of having a flight simulator. Please, continue."

"Thank you, Colonel." With her notes in hand, Marie started her rehearsed presentation. The longer she presented, the more comfortable she became. She began by describing the two flight simulators she was familiar with, then went on to discuss how they could be used in training.

"Honestly? I don't know how real these programs are," Marie said as she neared the end of her presentation. "The program literature and comments on the news groups by experienced pilots suggest both programs are realistic. The biggest issue with realism, though, is the aircraft model. If they aren't modeled perfectly, their flight profiles won't be realistic. And even then, it might take some tweaking to get it just right."

Marie took a breath. "Back up-time, that was one of the biggest complaints with all flight simulators. The models would look like the real thing, but avid fans and pilots would take the time to tweak both the default planes and custom creations to ensure they would fly as realistically as possible."

Colonel Wood nodded his understanding. "I can't elaborate too much, Marie, but we have some new plane designs. Can we use the computer to test the design?"

Marie shook her head. "I'm not sure. I know you can't test a design with one of them, but I'm not so sure about the other. The two programs have completely different flight models. I could look into it, though."

He nodded and jotted down some notes. "Okay, you do that. Now, what sort of information do you need to accurately model an aircraft?"

"I'd need to know basic information about the aircraft. Thrust, drag, stall-speed, engine horsepower and so on. I'd need measurement data to build a 3-D model of the plane. I'd also need trained pilots, preferably the ones with the most hours logged, to perform virtual test flights to help fine tune the model."

"Can you recreate a control panel?"

"You mean on the computer screen?" Marie asked. "Yes, you can."

He closed his note book. "I'd like to have at least three of these simulators up and running by summer. I'd prefer more, but I'm not sure you'll be able to find many people willing to part with their computers. You'll need to model the *Belle II* and, possibly, another plane or two that might enter service in the next couple of months. With the way things have been going lately, I doubt I'll personally have the time to help, but I'll let it be known that everybody should give you all the help you need. Without a doubt, you're my man. Uh, person.

"I'll be able to wiggle some money out of the budget for this, but Mike Stearns will give me an earful about it. I'll need your budget within two weeks, and please keep it as low as possible. "

Marie was startled at the speed of his decision. "Thank you, sir."

As she rode home from the base that evening, she thought about her assignment. She hadn't expected to be offered a contract to work on the flight simulators, but she wanted this opportunity to get to know the people in the Air Force and be close to the planes. All she had really wanted to do since she was three was fly. The Ring of Fire had destroyed that dream, and Marie had been in a deep depression for several months. The revival of powered flight and the development of an air force reinvigorated her and she quickly overcame her depression.

She also wondered what her mother would think. Since she first expressed interest in flying, her mother been against it. It had driven a wedge between the two of them, and Marie found herself spending more time with her father, who encouraged her to be who she was. She could never understand why her mom objected to her desire to fly. She thought it might have something to do with wanting to fly for the military.

* * *

Two days and five pages of notes later, Marie was overwhelmed. Colonel Wood had sent her a copy of his priorities. She was doing at least ten different tasks, half of them at the same time. She had never worked on a structured project before, and she had no concept of time management and multitasking.

She read through the list for the tenth time as she sat in her father's den. *Why does he want me to change the scenery package before creating the down-time aircraft?* It had been the first item on the list, and she wondered if he had written the list in order of importance. As she continued to look down the list, she recognized other items that they had discussed.

Marie began to type up the list of priorities, making sure to rank items by their importance. *Computers, planes, and controls should be at the top of my list. I should probably get in touch with that computer guy I met a while back in case I need his help with any of that. But I also need to select which simulator I will use. That has to be my first priority.*

Marie finished typing her list and saved the file. "So how do I go about getting the computers? I need machines that are at least five hundred megahertz if I want them to run smoothly." She began to ponder where suitable computers would be found in Grantville. She doubted there would be a gamer or a business willing to part with one, especially the top end kind she needed.

Except, possibly, for her father. "Dad!" she yelled. "I need to ask you something!" She and Dad had always been close. He was the encouraging parent, and had always supported Marie's interest in flight. This inevitably led to confrontation with her mother, who didn't always agree with her interests.

Ted walked into his home office. "How many times have I told you not to yell across the house?"

"I dunno, Dad. But I was wondering if you still had those two old computers."

"Yeah, they're in the basement," he said. "Why?"

"Remember when I told you about that job I got setting up flight simulators for the Air Force?" she asked. "Our computers are good, and I'm wondering if you would sell the new ones. If we can get the old ones running, you'd still have what you needed."

"You know that I did get one of those for work, right?" he asked.

"Yeah, Dad. I know. But this is important, and they will pay very good money for them."

"Well," he said, after a few moments of thought, "I suppose I can talk to your mother about it. I don't think she'll be too happy with the idea, but she'll probably give in. You'll have to do all the work yourself, though."

"Thanks, Dad," Marie said. "You're the best."

* * *

By the time breakfast came around the next morning, things had changed. "That's not fair!" Marie shouted. She slammed her fist on the table, rattling a few bowls of oatmeal. "I have a job to do, too."

"You think I don't?" her mother replied. "You're not the only one who works, and some of us need the computer for more than just playing games."

"It's not for playing games," Marie responded. "It's for training pilots. And that's why I'm going to get the two we have in the basement up and running. So we still have computers we can use."

"There you go with your flying stuff again," her mother retorted. "Why can't you just be like your sister for once and be interested in normal girl things? And have you even checked to make sure those computers work? Because they've been down in that basement for an awfully long time."

Marie hated being compared to her younger sister. It was something her mother always brought out against her in their arguments, and it made her feel like she was some kind of freak because she didn't fit her mother's image of an ideal daughter.

"Karen!" Ted Moritz interjected. "That's enough."

Like the typical mother-daughter fights in the Moritz house, this one had gone from being about some issue to being about their personalities. Karen Moritz wanted daughters who did typical girl things. She was disappointed that her eldest had ended up climbing trees and working on projects with her father. They had become very close, and Marie had always known that her mother was jealous of that relationship.

"Mom, I'm a cheerleader. If that's not normal enough for you, I don't know what is. And that has nothing to do with my job with the Air Force."

"Fine," Karen said. "Sell your computer. I don't care anymore. But that's the only one you can sell. The one in the office stays right where it is."

Her mother was one to hold a grudge, and Marie wanted to be anywhere besides home. She didn't want to upset her mother any further or fall behind in the multitude of tasks that she was facing. So following the fight, she stayed late at school on weekdays for cheerleading practice or Rocket Club, and after that she worked on homework until the last library staffer turned the lights off. Marie had left her computer at the base, so she had to travel there on the weekends to work on the simulator.

Project work caught up with her quickly, though. Reports and budget requests didn't write themselves, and she still had to convince someone to sell a computer or two. That meant something had to take a back seat, and it couldn't be the project. There was no way she would let Colonel Wood down, so the project began to eat more and more of her time.

* * *

Marie was leaving the school's library a month later when it all came crashing down. "Hey, Marie! Wait up! We need to talk." She turned around to see Kristin Washaw approaching. Kristin was many things that Marie wasn't—tall, blond, outgoing, and popular, but despite that, they had somehow become friends.

"Hey, Kristin," Marie said. "I hope you can keep it short. I have to meet with Mrs. Kindred about my English Lit. paper ."

"Can I walk with you?" Kristin asked. "We haven't talked or hung out in a while."

"Sure," Marie said, somewhat sheepishly. Both girls were quiet as they started to walk.

"Is everything all right, Marie?" Kristin finally asked.

"Yes," Marie lied. "I'm just under a little pressure right now." She hoped that Kristin wouldn't be able to see through the lie, but she knew that it wasn't likely. Kristin was good at reading people.

"Where have you been? You've haven't been to practice for the last three weeks. You were supposed to have some new cheers for us last week, and some of the girls have been telling me that you're not handing in homework. And I've been hearing that you aren't as involved in the Rocket Club. Have you started taking drugs?"

"No!" Marie was outraged. "Of course not."

"Then what's wrong, Marie? You haven't been yourself lately, and I'm worried. You love cheerleading, and you never used to miss a practice."

"It's just . . ." Marie stopped herself. She wanted to tell Kristin everything, about how she had taken on this large project for the Air Force, the fights with her mother, and how it all was affecting her at school. *But should I? She's my friend, but what will she think of me if I tell her about it?*

"I've just taken on a very big project for someone," she said. "I didn't realize that it would have this sort of effect on everything, and I'll take care of it."

Marie hadn't said anything to the girls on the cheerleading squad about her project or the trouble it was causing her. At this moment, though, she regretted that decision because it caused one of her friends to worry about her.

"A top secret project?" Kristin smiled. "I thought it would be something like that. But you really need a break. How about you come over on Friday night, and we'll have ourselves a slumber party."

It felt like a huge weight had been lifted off Marie's chest. "That sounds like a plan. I really need the break."

"We're practicing today," Kristin said. "If you're not there, I'll find you and drag you over."

Marie laughed. "You'd have to have the whole squad to help you. Don't worry, Kristin, I'll be there."

It was the first time she had smiled in weeks.

* * *

Marie paced the back of the hangar, nervously chewing on a lock of her hair while she watched Lieutenant Emil Castner test her simulator. A lot had changed in the hangar since December, and the front part of the hangar was now occupied by a partially completed aircraft. The winter snowfall had also revealed a few gaps in the roof, and Marie's equipment was under a plastic tarp.

She was watching Castner, and was shocked when got up and started to walk away from the computer, the flight still in progress. He flashed her a look of disgust. "This doesn't work for me."

"What do you mean, Lieutenant?" she asked. "The model is built based on the information Colonel Wood gave me."

"It just doesn't feel right," he said. "Why do we have to use this contraption? It is nothing like flying. It's not realistic at all. It doesn't *feel* like flying."

Marie started at his words. She had thought that using her flight yoke and rudder pedals would provide a more realistic experience. She had also expected Castner, being one of the more experienced pilots, would be able to grasp the idea of simulated flight.

Although she still had a month before she had to have a simulator ready for testing, she had put a lot of effort into getting this done early so she would have more time to test it.

"So what should I do to improve it?" she asked.

Castner thought for a moment. "Make it move. Make it feel like I'm in the plane. If you can't do that, then this isn't worth the trouble. The Air Force doesn't need simulators that don't work. I didn't have a simulator when I entered flight training last summer. I got all my experience behind the controls."

"Colonel Wood is saying something different." Marie could tell by the tone of his voice that he was disgusted with the idea. She wanted to say more to him, to come up with the magic argument that would get him to love it, but her mind had frozen, and she stood there waiting for some argument to come to her.

Castner pushed away from the table, nearly knocking the flight yoke to the floor. "We don't need this . . ." he said, and stormed out of the room.

Marie sat down in front of the computer and fought back tears. She had expected everything to be so much easier, and for everyone to cooperate. *You can't let one bad review throw you completely off track. You have another review on in two days.*

"Maybe the other pilots will be more helpful."

* * *

Spending an hour in the office of School Superintendent Ned Paxton was the last thing Marie wanted to do any day, especially a Friday. But it was the only time he had available this week, and the Air Force needed a pair of the school district's computers for the flight simulators.

She had tried every other source she could think of, but most people had refused to sell. The machines that people had been willing to sell would barely run a decades-old operating system, let alone a flight simulator, and she had to turn them down. The schools were the last option, and they were the only organization in town that might have one or two to spare.

"So tell me what you want them for again?" Paxton asked.

"Flight simulators, Mr. Paxton," Marie said. "Colonel Wood would like to have some computer-aided

training so he doesn't have to risk the few aircraft we have training new pilots. With the war . . ."

Mr. Paxton sighed as he wrote something on a scrap of paper. "Yes, the war. I know. I suppose that means all those fancy new Gustavs and the Belle will be off fighting at the front. Kinda hard to train pilots when you don't have any aircraft around."

"Yes, sir. It is."

"Thing is, *everyone* is coming to me to ask for computers." Paxton handed her the scrap of paper. "The government. New businesses. Everyone just wants *afew* of our computers. Granted, your reason seems better than most."

"What's this?" Marie asked.

"That's how much it will cost," he replied. "Per computer."

Marie thought her eyes were going to pop out of her head when she saw the cost. "That's . . . outrageous!"

"Demand is high," Paxton said. "The government taxes us more than enough, so they should be able to afford it. And besides, the school could always use the extra money."

Marie sighed and bit her lower lip. She didn't think the Air Force had that kind of budget, but if they wanted the simulator, they needed those computers. "I'll talk to the Air Force and let you know sometime next week."

March, 1634

"Be careful with that!" Marie shouted. "Those are fragile, and if you break one, it can't be replaced."

The young Irish enlisted looked confused, and he probably had no idea why the metal box was so important. "Aye, lass, we'll be careful with your little boxes."

"Good." Marie couldn't help being short with them. Somewhere in the back of her head, she just couldn't trust anyone else with the computers. She had expended considerable time, effort, and a lot of the government's money, to get them from the school district. The last thing she wanted to do was try to replace one.

She was nearly at her wit's end from trying to get the aircraft models perfected. She had barely gotten the *Belle* model running to her satisfaction when Major Horton dropped the technical data for the *Gustav* in her lap. That had been much harder to complete. Most of the pilots who had any experience flying that aircraft were at the front fighting a war.

Marie must have done something right, though, as she had been teaching some down-time pilots and flight cadets the finer points of using the simulator. A few had started to visit her in the shed, and she assumed they were the ones who lobbied to get her into someplace better. Her new room was in one of the first buildings on the air base and much closer to the flight school. It also had a ceiling that didn't leak and a floor that wasn't dirt.

"So how do you like your new digs, Ms. Moritz?" Colonel Wood asked

Marie nearly jumped five feet into the air since she hadn't realized he had entered the room. "It's better than the back of a hangar. It's nice to have a ceiling that isn't a plastic tarp."

"The secret is that we put the tarp over the roof," he said with a smile.

Marie smiled and giggled. *I'm glad someone around here doesn't have a stick up their butt.* "What bring you up here? I thought you were out of town on official business?"

"Just passing through, Ms. Moritz," he said. "I'm just stopping in to get my mail." He turned to leave the room, but stopped just before the doorway. "Since I'm here, how about you set me up on the simulator."

"You'll have to give me a minute," she said. "I don't have the computer hooked up yet." Marie slid under the table, connecting the computer with its peripherals. The room had electricity, but the only outlet was a power strip fed by a bright orange extension cord that ran across the floor, so she had to be careful not to overload it by plugging in too many items. The last thing she wanted was to be responsible for the "Great Hans Richter Air Field Fire."

Once everything was plugged in and running, Marie inserted the program's CD and set up a flight. "How would you like to be the first one to test the *Gustav*?"

"I'd be honored, Ms. Moritz," Colonel Wood replied.

The Price of Dumplings
by Terry Howard

"Hey, John Ose, which one of these birds is the scrawniest?" Arch Pennock asked, eyeing the chickens.

Janos Tamas stopped what he was doing and looked up from his place inside the open air market stall. Behind him were crates of live chickens. In front of him were half a dozen plucked, gutted birds, hanging head down. Off to one side was a hook over a large kettle of boiling water for plucking. At the other side of the stall was a gutting and sorting area. Livers, hearts and gizzards, and chitterlings each went into separate buckets.

"Mister Pennock, good morning. What means scrawniest?"

"The least plump, the smallest."

"Mister Pennock, if you want a cheap chicken, they are cheaper live."

Arch shook his head. "No, John. I want it plucked. I just want an old, tough, scrawny one that's too stringy to fry and too skinny to bake."

"Mister Pennock, are you sure? Nobody asks for that."

"It's what I want, John."

"Well, if you are sure, I have just the bird. You come back in little bit and I have it ready for you."

"That's fine, John. I've got some other things to pick up."

* * *

After Arch had walked the market and picked up some garden produce, he stopped back for his chicken. As asked for, it was indeed a scrawny old bird. Arch smiled. "It's exactly what I wanted."

Janos was worried. He thought the only way he was going to sell that bird was when it was the only one left. He found Arch's smile reassuring. "Mister Pennock, can I ask why?"

"Sure. I've got a hankering for my grandmother's chicken and dumplings. She only used the oldest hens to make dumplings and I want it to be just right. I could make a better dish, but I'm cooking a memory as much as I'm making dinner." He didn't add that he could get a chicken from the grocery store near his home for not that much more, and he could save himself the walk. He liked the walk. Then, too, he wanted a freshly plucked bird, not one that had been in the meat locker for several days even if it was kept just above freezing. His grandmother's chicken went into the pot minutes after it was plucked. He thought it made a difference.

Janos got a faraway look in his eyes. "I know just what you mean. *Mybushka*, my grandmother, she would make the most wonderful dumplings. When there wasn't enough of any one thing in the house to feed everybody, she would make dumplings. I miss them. The food is good, but I miss those." Janos was living in a settlement house, a co-op one step up from a refugee camp, practically a dorm. When he said the food was good, he meant there was enough to eat, but, truth be told, it wasn't the cooking he was used to.

"Well, hey, you know where I live don't you?"

Janos nodded.

"Tell you what, I'll start the pot a little late and you come on 'round after you shut down for the day. You can share a bowl or two with me so I don't have to eat alone."

"Are you sure, Mister Pennock?"

"I asked, didn't I?" Arch grinned. "See you tonight. Bring your appetite, there'll be plenty. I don't know how to make less than two gallons at a time anyway."

* * *

Arch walked back into the market to buy more milk. It was pasteurized and the heavy cream was skimmed off, mostly for butter, but it still separated out when it set. Homogenization was just a word in Grantville, which was all right with Arch. His grandmother had kept a cow and he remembered the difference between cow's milk and store milk. The younger generation didn't like it at all, claimed it just didn't taste the same. As far as Arch was concerned, the raw milk tasted better.

Meanwhile, he used the half gallon mason jar he used for milk full instead of half full. He was having a guest and wouldn't dream of having anything to drink with the chicken and dumplings except milk, even though Janos would probably prefer small beer.

* * *

When the market closed, Janos got cleaned up and ready to go. All day long his mind and his mouth had

been busy remembering his home and the meals of his childhood. At Arch's home, he was again reminded of just how rich these people were. The table was set for nobility. There was a bright white tablecloth and expensive paper napkins from up-time. Janos thought they should have been sold. You could use the back of your hand or a cloth which could be rewashed and reused. The flatware was steel and the drinking vessels were glass. He knew from past experience that the up-timers had so much they just didn't think about how rich they were.

Arch was stirring a pot on the stove. "Hey John," he called when Janos knocked on the screen door. "Come on in and set yourself down. Everything's ready." Arch turned the fire off under the pot then he opened the refrigerator and poured two tall glasses full of milk after giving the jar a good shaking to re-mix it.

"I hope I got all the bones out when I cooked the chicken. I always think I have but then I always find at least one I missed when I'm eating, so be careful." The bread Arch bought at the market was sitting in a rack. He took an electric knife to it and set half a dozen perfect slices on the table next to the butter. At last, he set the pot in the middle of the table. "My ex-wife would have raked me over the coals for doing that. I should have put it in a soup tureen or at least a serving bowl before I put it on the table. I didn't even know what a tureen was until I married her. I haven't had one in years, not since she moved out. Besides, it's just us three chickens here anyway."

Arch scooped a healthy serving into the bowls and dug in.

Janos looked at the meal set before him and swallowed his disappointment before he started swallowing a rather tasty meal. Three bowls later, Arch brought out ice cream for desert. When he knew he had company coming, he'd gone home and grabbed a covered Tupperware dish, some ice from the ice maker and a small cooler, then walked back into town to the ice-cream store. Most of the ice cream was sold over the counter and eaten in a hand-made waffle cone or in dishes on site. If you wanted to take it home you bought a container or brought one with you.

"Well, John Ose, what do you think?"

"MisterPennock, that hit the spot. Those were first rate noodles. They were the first real noodles I've had in Grantville. Thank you."

"That's what my grandmother called dumplings. I know it ain't what Yankee's call dumplings. I've had Yankee dumplings and it was what I would have called broth pudding."

Janos hurried to explain. He didn't want to offend anyone. "Mister Pennock, please, it was very good. I ate three bowls, did I not? You had more pepper than Grandmother used but the noodles were just like hers except yours were wider. I miss her noodles, too." He finished the serving of ice cream and sighed. "Mister Pennock, I have Sunday off. Could I use your kitchen Sunday after church and I will cook for you real Hungarian dumplings like my grandmother used to make."

"Well, John, it's my turn to host poker night." In the old days they would meet to watch sports on Sunday afternoons. Now they played poker. "I usually feed them sandwiches. But I tell you what, if you let me pay for it and you cook enough for twelve, you're on."

"You have twelve for poker?"

"Nah. There's five of us, and you'll make six. But I know how these guys eat."

"Can I bring things by on Saturday and put them in your refrigerator?"

Arch nodded. "How much cash are you going to need?"

"Twenty dollars ought to do it, unless you want me to pick up the beer."

"I'll get the beer." With the number of brewers in town increasing every time you turned around, Arch didn't think it was safe to let a foreigner pick up the beer. After all he liked it warm and dark, not thin and pale. "You sure twenty's enough?"

Janos ran through what he would need to buy, where he could get it and how much it would cost. Most of what he wanted, he could get in the market where he worked at a better price than customers could get. Of course, any chickens that were plucked at the end of the day went home with other vendors at live chicken prices. "Mister Pennock, I'm making dumplings. Twenty is more than enough; there will be money left over, unless I need to buy salt and ground black pepper at the grocery store." Importers usually sold wholesale, so if it wasn't locally-raised, the grocer was pretty much the only option.

"I've got plenty on hand," Arch said.

* * *

Sunday afternoon Arch had bowls full of crackers, dip, pickles, carrots, celery and green onions set on the cardtable. He was a bit worried about what he had gotten himself into. The idea of making enough food for twelve on twenty dollars had him a little worried, so he was ready with back-up food, and had plenty to snack on.

Kirby Frank showed up first. "Hey Arch, what's up? You getting fancy on us? We've always used the kitchen table before."

"John Ose, the kid who works in the chicken stall down at the market, is making dinner for us so we're playing out here."

"Oh, okay. What's he making?"

"Dumplings."

"Real dumplings or Yankee dumplings?"

"Hungarian dumplings, like his grandmother used to make."

Kirby got a sour look on his face.

"Hey, Kirby," Arch whispered, "don't sweat it. If it don't work out I've got head cheese and cheddar in the fridge."

Kirby smiled. "Hey, I came to fleece the flock, not feed my face," which was less than half true, in Arch's opinion. Kirby came out of habit for an afternoon of male bonding, but if he wasn't fed, he wouldn't stay. He had a closer bond to a growling stomach than he did to anything else.

About an hour into the game, Janos stepped into the room to announce that dinner was ready.

Kirby threw in his hand. "I was playing on a busted flush anyway."

"Well, bring your chairs and your glasses on into the kitchen and let's see what Hungarian dumplings are like," Arch said, getting up and taking his own advice.

The old five gallon canning pot was sitting, a bit over half full, in the center of the table, along with bread and butter and beer. Five bottles were out of the refrigerator and sweating drops of dew in the warm kitchen. The sixth one was room temperature. Janos started scooping servings into the bowls. Verlyn poked at it with his spoon, Kirby cautiously put one to his mouth and bit it in half. When his face lit up instead of him spitting it out, the others followed suit.

"Hmn.""This's good!" "Hey, it's the first time I ever saw ravioli served with something other than spaghetti sauce." "Best damn ravioli I ever ate." "It is not ravioli, I have had ravioli,they are dumplings." "I don't give a damn what you call 'em hand me the ladle." "This really is good." "Here, dip me another scoop." With the exception of Janos defending the national pride of Hungary against an Italian invasion, it was rather unclear as to who said what as they repeatedly slurped the bowls empty and then scraped the bottom of the pot.

When everyone was stuffed and the dumplings were all gone Verlyn said, "I've got the game next week. You think you could come over and cook this again?"

Kirby popped up about the same time, "I've got to have my brothers and sisters and their kids over to the house for a family dinner later this month. They always poke fun at my cooking.How about it, John?"

Before Janos could answer, Arch spoke up. "Verlyn, everybody else has folded and it's a hundred to me. I'll call and see your raise with a Hungarian dinner next week?"

"You're on."

"I'm serious," Kirby said. "I could use a pot that size for a family dinner. It's worth every penny of a hundred dollars."

"But when will I have time?" a rather stunned Janos asked.

"Kid, don't sweat it," Arch told him. "I'll take care if it. As of now, you and me are in the catering business." Arch could do the math. There was a lot of money sitting across the kitchen table."You up for it?"

Janos grinned. "I'm up for it."

Thunder in the Mountains
by Richard Evans

Bern, Swiss Confederacy

Midwinter, 1634

The Inn of the Sleeping Mule

"Thomas, are you sure this'll work? Those illustrated magazines of yours may have been explicit enough for you, but I've never seen a cannon with two open ends before. How does it fire and what are we going

to do with it?" Giuseppe Benito-Fransoni asked.

"I checked them myself, against the magazines." Thomas "Boom-Boom" Cahil chuckled. "I'll show the Americans that firing me for experimenting was a bad move. That I will."

Giuseppe knew that "I" meant "we" again. Sometimes the half-Irishman irritated him immensely, but other times Thomas amazed him with his wealth of knowledge from the future.

Thomas had the magazines and formulas to support his claims, but he didn't look like the type one would want assisting in an alchemist's lab or even blowing things up. Thomas' build was that of a born laborer, one only fit for grunt work, something Giuseppe was definitely allergic to, unless it involved cannons.

The two of them seemed to have a mutual fascination with the idea of blowing things up, and in the comics Thomas had lots of things got blown up. Including a pass filled with an attacking company of infantry covering a line of twelve tanks. Giuseppe had wanted a tank for himself, but he knew that was well beyond anyone's means.

But this "bazooka" in the comics—yes, that they could get built. The other, darker, comics about the vigilante with a skull on his body armor even had pages with detailed explanations about a similar weapon and a cutout drawing of the device. Those were Giuseppe's favorites, when he could pry them away from his partner.

Thomas had made the decision to simplify the design until they had something that could be built and that they could afford. The rocket parts hadn't been as easy. No cut outs, no formulas, just what Thomas said he knew and learned before he was invited to leave Grantville.

Thomas winked at Giuseppe. "Everything I learned in Grantville is still up here." He tapped his battle-scarred forehead.

Giuseppe mentally counted the months since Thomas had said he'd been discharged from the USE Army. It didn't leave him much time at the explosives factory that he went on and on about. Or with their dynamite and the magical RDX they had just started producing either, but apparently he'd been there long enough to copy the formulas and take note of the methods used to produce the explosives.

With the right alchemist, maybe we can do this, Giuseppe thought.

"What about the tasks I set you, Giuseppe?"

"That Austrian smith you had me find can build the 'zooka-tube.' It's not much more than a long pipe with a smaller tube for a sighting mechanism, and the other side has a latch and catch in the rear for this 'rocket-round' you've mentioned. And a lever-trigger for activating the battery."

"I've heard of batteries being made in Lucerne from passing merchants. Can we build one of those here?" Thomas asked, as if this were just another minor detail. Details that usually cost them money or another midnight shopping expedition.

Giuseppe calculated his own wealth. He had exactly twelve Italian copper pesetas and two silver crowns. It wouldn't last long, not the way his partner was spending money. At least Thomas was an adequate thief when he needed to be.

"If we can make one, it will be larger than what they are selling in Lucerne and it will have to be

connected by copper wires to the launcher. That means it will take two of us to operate the 'zooka.' If we can't get one of those, maybe one of the smaller Elektrische Generators that are popping up in every store here in town might work."

"One of those Elektrische Generators will have sufficient power for our needs. We just need enough power for a spark to the launching charge." His partner once again had the answers before Giuseppe could ask the question himself.

"You've only shown me parts of the final rocket designs, Thomas. I . . . we . . . need to be sure that all the parts we get made fit together properly so that when I load them with . . . you know what . . . we're sure they'll work."

Thomas nodded and passed him a sheaf of drawings and contracts. Giuseppe eyed the plans for the bazooka and the bits and pieces of the rocket they were supposed to be firing from this weapon.

If it worked there was no doubt everyone would want to build their own bazookas. That was why they'd had the parts built by different men, with strict tolerance requirements written into the contracts.

What that meant to them was that the contractors would never know what the parts they were making would end up looking like once assembled or what they'd be used for. Much safer for the two of them that way. Much safer. Giuseppe was sure he could put the various parts together easily enough.

He remembered the fateful words that night two months ago when word had come that the passes were closed for the winter. *"I wish there was a way we could bring down all that snow hanging over the passes, let the mountains settle and the roads could be cleared."* Then Thomas had smiled and pulled out the several comic books and two worn magazines he'd brought with him to Bern. Several buckets of cheap beer later, a plan was hatched. One that Thomas said he had the necessary knowledge for. Giuseppe would get his wish, and they'd be able to make money doing it too.

This bazooka wasn't going to be a weapon of war, but one to start controlled avalanches. From a safe distance. Giuseppe hoped it was a very safe distance. He was no math genius, but he did know how to load cannons. Loading and firing the "bazooka" should be child's play for him, but still . . .

"I used the last of our project money to buy enough of the explosives." Thomas grinned. "I think I got the mix right this time."

Giuseppe snorted. He hoped Thomas was right about the blend. Their first attempt had blown up their shack just outside of town, where all the new labs were being built.

Using a fulminated mercury impact fuse to set off the warhead was just a bad idea. They were down one partner from that mistake and the city watch never did find all of him either.

They'd finally decided to use a standard skyrocket time fuse ignited by the last gasp of the propellant as the rocket motor burned out to set off an explosive detonator inside the warhead. This one used a mix of one of Thomas' up-time formulas and old fashioned black powder, ground real fine, mixed with some other ingredients Thomas kept secret even from Giuseppe.

Mathematically, Thomas insisted, it would work perfectly. His math was much better than Giuseppe's. Thomas' drawings showed exactly how it was supposed to work, but still, Giuseppe's guts quivered every time he remembered their shack rising into a cloud of debris moments after they'd stepped out of it.

* * *

All the merchants caught in Bern had to go somewhere to spend their hoarded money and this was the cheapest of the cheap inns in town. It was a natural marriage with the stingy merchants who were waiting on the spring thaw and clear passes, not to mention safety from avalanches. The merchants were losing money with each day they were stuck in Bern .

While they waited for the inn to fill up with its nightly crowd, Giuseppe studied the drawings intently looking for any flaws and asking Thomas questions.

Between questions Thomas related his experiences with the Swedish Army and his time at the explosives factory. The story changed with each telling, but Giuseppe could tell some parts were true. His palms itched when he'd heard about the RDX and other explosives. Especially the dynamite. RDX was beyond their means right now, so they'd settled on a form of dynamite Thomas knew about and the alchemists could make if they were really careful. Something he would insist upon.

Giuseppe imagined what he could do with a pack full of this fabled dynamite and smiled.

* * *

Thomas Cahil stood up and straightened the "ball" cap that had some words on it in what Giuseppe thought was English. It simply said "Get-R-Done." Giuseppe wasn't sure what or who "R" was, but Thomas insisted it was a "Real American Relic," and to let him do all the talking. Giuseppe was happy to do so. He hated talking to crowds; they made him nervous.

Thomas stood up on his chair and got the attention of everyone in the bar by waiving his ball cap. "Gentlemen. Here we sit, while the snows pile higher and higher in the mountains and over what passes as our roads."

There were a few scattered chuckles. There was a reason the roads through Switzerland were nicknamed the *Via Mala* .

"What if these passes could be cleared of the threat of avalanches weeks, if not months, earlier than nature intended? What then of the trade profits you could be making by being the first through the passes? If you are interested, bring a bottle of good wine or some food, and an open mind, and join us as we discuss how BF&C Enterprises will make this possible! First investors will get shares at a discount and first word of when the passes are cleared!"

"Here we go," thought Giuseppe.

Late February, 1635
A Southern Swiss Trade Pass

"Any sign of those two con artists?" Sergeant Ulrich pulled his hooded cloak tighter about him. "They were last reported coming this way. Why anyone would come up here at this time of year is beyond me." This made six passes they'd visited in the last two weeks. The previous pass had nearly been their last. It hadn't been cleared—any fool could see that, but the lieutenant had to check it himself, until the snows had started to shift. At least no men had been left behind that time.

The sergeant eyed the edges of the pass to either side of the road. Strangely enough, they looked clear of the normal snow overhang that kept this road closed. Most roads that led from Bern were normally closed well into late spring.

"This pass looks to be clear too, Lieutenant. That's strange." Ulrich scanned down to the other side of the pass. "Look down there, sir. A merchant train, and it's a big one! And it's not even March yet! How did they get word that these passes were cleared?"

The lieutenant glared at Ulrich. "I don't care how the passes got cleared or what merchants are doing tempting the fates this early. We're looking for two murderers who buried an entire village near Thun. Playing with explosives in an avalanche zone! How stupid can two men be?"

"No matter. When we find them, the executioner shall make good examples of them. Order another twelve men to station themselves here as guards, until the weather gets too bad for them to stay. And check everyone leaving the Confederacy. Make sure they have the wanted posters too. Oh, and be sure they collect the proper tolls when and if the caravan makes it up here." The lieutenant tittered.

Sergeant Ulrich bit his tongue on the angry retort that threatened to emerge. His command was now spread out all over the borders of the Confederacy because of the pass-clearing idiots they'd been sent after.

Secure the men for trial and secure their device and learn their methods at all costs. That's what they were supposed to do

Those merchant trains would be in for a surprise. Normally no one stationed a toll guard here until the risks of heavy snows and avalanches were long past.

It was a small comfort to Sergeant Ulrich.

Grand Hotel, Bern, Swiss Confederacy, March 1635

"We missed them, sir." Private Heugelmann scratched his ear. "There was nothing left in their rooms, even though the hotel had been paid in advance for a whole month just before the two suspects disappeared. The innkeeper is definite about that. There is nothing here that might lead us to where Thomas Cahil or Giuseppe Benito-Fransoni might have escaped to."

"No one's talking, sir." Heugelmann shook his head. "Not even the remaining merchants they purportedly spent several weeks with over at the Inn of the Sleeping Mule. Most of them left town as soon as word got out that the southern passes were open."

"We'll find those two, I'm sure. It's not like they can fly. It's still high winter." Sergeant Ulrich laughed. "And now that we have posters up everywhere, someone will turn them in for the reward. There are only so many roads in and out of the Swiss Confederacy. We'll get our men, don't you doubt it."

"Yes, sir. I'm sure we will." Heugelmann doubted it. Highly doubted it.

* * *

The boom of thunder echoing off the mountains and the terrible roar of an avalanche woke the bear from

its winter sleep. The two frozen and broken corpses, half buried under the debris and snow near its den were a bounty of protein that made its early awakening worthwhile.

It ignored the crushed and bent metal tube that smelled of fire and smoke.

Mrs. December, 1636
by Chet Gottfried

Justus Corneliszoon van Liede's smile was all teeth. Big teeth. Broad teeth. Dazzling teeth. Many men would have wanted to punch in his teeth at first sight. Many women would have been tempted to do the same. Flo Richards was different.

"Have another piece of cake, Herr van Liede." She daydreamed about the cavities that the rich white icing could cause in those brilliant teeth of his.

The Dutch cavalier accepted the cake with a flourish that went well with his flamboyant clothing, from satin doublet to orange breeches and tall red boots.

"Thank you, dear lady. My ride from Amsterdam was well worth the opportunity to enjoy your most wonderful cake."

Flo watched Justus's goatee move back and forth like a metronome as he chewed.

"How long did it take to travel from Amsterdam to Grantville?"

Justus smiled. "Not long at all. A few weeks, dear lady."

Flo didn't trust the smile. "Call me Flo."

"Of course, Flo, dear lady. And you may call me Justus Corneliszoon."

She sighed. Justus was the most difficult person she had ever met. He combined seventeenth-century courtier with twentieth-century used car salesman.

"I'm flattered by the letter you sent: your invitation. I'm impressed by your mastery of written English." Flo paused a moment. She wasn't at all sure whether she wanted to tackle traveling anywhere except maybe Jena. It wasn't like you could just hop in the car and travel a hundred miles in a couple of hours.

"Thank you."

"But a few weeks in each direction means that you expect me to be away from my farm for over a month. In autumn. That's harvest time, and I'm pretty busy."

Justus swung his arms wide and his smile grew wider. "But think of the honor, dear lady Flo. To have your portrait painted by Pieter Paul Rubens is a privilege you can tell your children and grandchildren."

"There's a war going on."

"What war? There isn't any war, not in that direction. That was settled last year."

"There are thieves and looters on all the roads."

"You shall have a dedicated escort. I have already arranged to have good men accompany you."

Flo was beginning to feel desperate. "I've never been away from J.D. for over a month."

"You mean your husband? Yes, I know about J.D., and we expect him as well. Dear lady Flo, you and J.D. will love seeing Amsterdam. It is particularly beautiful in the autumn." He smiled.

"Well, maybe." Flo tried to recall the last time that she and J.D. went traveling. They hadn't been anywhere since the Ring of Fire. Before that, all she could recall was their second honeymoon to New Orleans. And that was that. "I'll have to talk it over with J.D. first."

"Of course. I would expect nothing less." Then Justus cleared his throat. "Pieter Paul Rubens made a special request in regard to you."

Flo was on her guard. "Yes?"

"He has a certain technique in regard to his portraits of women."

"I am not—most definitely not—going to pose naked for him. I don't care how many portraits he's done or how many women he's painted. I am *not* appearing naked for him!"

"No, no, dear lady Flo. Whether you are dressed or undressed is your own decision. Rubens' request is different: He wants to include a few symbols of yourself in the painting, such as your love of coffee. You would bring a pot in which you brew your coffee, as well as a few cups."

Flo settled. "That's okay."

"And he would like you to bring your wonderful ram Brillo."

* * *

When J.D. came home later that day, Flo cornered him and took him into their bedroom.

J.D. began undressing. "A little early in the day for this, isn't it?"

"Keep your pants on, J.D. It's not what you think. Have you been drinking?"

J.D. hiccuped. "Gerhart opened a new pub in town. Calls it the Hole in the Wall. It's a small place but quiet. He's studied a variety of cookbooks from the library and is going to serve light meals. But you don't want to try his pizza. He uses Swiss cheese. Some of the other dishes aren't bad, I have to admit. Gerhart is trying hard enough, and right now he's in the middle of decorating. Today, we were sampling some of his brews."

"Smells like you've downed a keg."

He sat on the bed. "Real ale. You used to pay extra for it, but here, it's all they have. No fizz, but it packs quite a punch. I wonder what the alcohol content is?"

"Whatever it is, it's too high. Now listen, J.D. Are you ready?"

"I'm ready."

"I have a surprise for you. What are you doing?"

J.D. had stretched out on the bed. "I can take surprises better while lying down, dear."

"You'd only fall asleep. Okay. How would you like to take a trip together?"

"Like to Amsterdam?"

Flo became suspicious. "What made you say 'Amsterdam'?"

"It seems as good a place as any. Besides, wouldn't it be good to get away?"

"Who told you about Amsterdam?"

J.D. grinned. "Gerhart, me, and a bunch of us were talking about how good a painting would look over the bar. You know, a naked woman. Every pub should have one. Something by Rubens, since Varga hasn't been born yet. I hear tell that he's pretty good for that sort of thing. So we were talking about who in Grantville would look best naked and who would be most willing to go to Amsterdam. Opinions were hot! It could have become an out-and-out fight, but in the end we made paper ballots and had a vote. Guess who won?"

He patted the bed, and Flo, blushing lightly, sat next to him.

"J.D., you're not telling me that your buddies would prefer me to one of the young lovelies we have in town?"

Hugging Flo, J.D. gave her a kiss. "You'd be surprised the reputation you have. For starters, maybe you should remember to button your blouse more often."

Flo rolled her eyes. "And here I used to wonder what you geezers talked about." Then she looked at him suspiciously. "Just a minute. Would one of your drinking companions be a piece of fluff known as Justus Corneliszoon van Liede?"

J.D. smirked. "Do you mean Corny? He's a right good fella and a fine drinking companion."

"Corny? Not Justus Corneliszoon?"

"It might have been something like that for the first glass or two. Then he let his hair down. He could certainly talk up a streak. And he has to have the brightest teeth in the world. It's like staring at a laser. Funny though. Gerhart wanted to punch Corny's teeth in. For no reason whatsoever. Well, before Gerhart could do anything, out jumps Corny's sword, and four cuts later, Gerhart's shirt is in shreds. Then they were friends, slapping each other's back and laughing. I guess Gerhart was happy to be alive, and Corny is willing to be friends with anyone. Good thing too. A guy that good with a sword has to be someone to have on your side."

"And he told you all about our going to Amsterdam?"

J.D. gave her a hug. "Why not? We've been working around the clock, helping the town settle in, helping the Germans settle in, helping our kids settle in. So why don't we take a vacation?"

"What about Ed Piazza?" Flo asked. "We'll be gone six weeks or more. Can he spare you that long?"

"He'd better. I haven't had a day off since the Ring of Fire, so I'm due. Don't forget Mike Stearns is a long-standing union man. Try talking to the unions about no one having time off anymore, and then you'll see explosions that'll make the Thirty Years' War look like a kid's game."

"Now, J.D. It's a good job. I don't want you to get into any departmental fights and jeopardize everything for the sake of a picture."

"I was going to resign anyway, babe. I don't want to move away from the girls. So I talked to Ed and then talked to the tech school. I'll be back teaching as soon as we return." J.D. grinned. "We're going, and we'll be having fun! And I'd like to get my hands on as many bulbs as I can. Tulips will help brighten our place, and we can sell them too. Not to mention it will be great to have a calendar."

Flo pointed to the calendar hanging on the wall. "What's that, J.D.? We already have calendars."

"But not a Rubens' calendar. Didn't Corny tell you? Sure, part of it is to go to have your portrait painted. But Corny is putting together a calendar of Grantville notables—as painted by Rubens."

"Grantville notables, huh? I suppose that's why he wants Brillo along. Do you think it's going to be easy to get that ram to Amsterdam? He's almost as stubborn as you are."

"Why shouldn't Brillo come along? He can walk part of the way, and Corny said that he was hiring an up-time wagon, should Brillo be his rambunctious self and prefer to ride. Rubens included Anne Jefferson's pom-poms and baton in her painting, so why shouldn't you have Brillo in yours? Not every ram has inspired a rebellion. And a Rubens calendar would be a collector's item. Did you know that Rubens has a whole flock of artists and printmakers working for him? They've been into prints for years, but this will be their first calendar. I wonder whether it is going to be Gregorian or Julian. I hope Gregorian, but you never know. Down-timers never cease to amaze me."

J.D. was going a little too fast for Flo. "I'm going to be in a calendar?"

"Sure, Flo. How does it feel to be Mrs. December, 1636?"

"Get one fact straight, mister. I'm not posing in the nude for anyone. Look at me! I'm a grandma! Who's ever heard of fifty-somethings posing naked?"

J.D. agreed. "Absolutely not. It's totally out of the question."

Flo got off the bed and looked into the mirror. "Totally out of the question? Are you trying to tell me something, J.D.?" She turned right and left and critically inspected herself. "I still have a pretty good figure. Or do you think I'm too heavy?"

"Rubens likes well-rounded women, dear. And so do I. I'm sure you'd look great however you posed. One thing's for certain. The boys would really love to have you naked—over the bar." J.D. grinned.

For a moment Flo was lost in her thoughts. Then she snapped out of it. "Come on. Let's get Johan, Anna, and the rest for a decent dinner. Lord knows what we'll be eating on the road." Naked, she thought. And snorted to herself: That will be the day!

* * *

A week later, a procession headed into Flo's yard: a handsomely painted wagon drawn by two horses, with two saddled horses tied to the rear of the wagon. Justus rode a high-stepping black gelding in front.

Flo, J.D., their three daughters, and their partners in running the farm, Johan, Anna, Wilhelm, and Ilsa, soon surrounded the wagon. Justus casually dismounted while giving a nonstop description of all the wonders of his preparation for the vacation to Amsterdam, not least of all the wagon, rented from an up-timer. It had a seat in the front for two drivers, and the wagon had benches on either side that could be dropped down. "Very convenient for sleeping, should you stop between cities or inns." The wagon also had bales of hay for the horses and Brillo.

"And allow me to introduce you to your noble escort. I present my brothers Frederik van Liede and Johan van Liede. They are brave men, wonderful shots, excellent drivers, and will see you through every obstacle anyone could encounter."

The two brothers slouched on the front seat. For each aspect of Justus that said dandy, the two brothers screamed despair. Where Justus had finely groomed hair, wisps of yellow stuck out in random directions from their heads. From his brothers' lifeless clothing to drooping expressions, they looked as if they had been dragged through every puddle from Amsterdam to Grantville.

Flo was shocked. "My God! Whatever happened to them?"

"Ah ha!" Justus declared. "You have noticed! All has not been well with my brothers. They were aboard the good ship *Brederode* in the battle along the English Channel, for which the English changed sides and attacked the Dutch fleet. The *Brederode* exploded, killing the entire crew except my brothers, who were thrown into the sea. They were fished up by the Spanish, and I, Justus Corneliszoon van Liede, had to pay ransom to release them. So, dear lady Flo, my brothers are in my debt. And until such day as they can repay it, they are in my service. It should only be another five years before they are free to return to the sea. And perhaps by then, the Netherlands will have another fleet, so that my brothers can be sailors again."

Flo asked, "What do sailors know about horses and roads?"

"My dear lady Flo, my brothers were farmers and often traveled these routes until several years ago. They would probably be farmers today if their joint farm hadn't burned to the ground. A pity we didn't know about lightning rods back then. Then they took to the sea. Or rather they were drunk and were taken to the sea. No matter, aboard the *Brederode*, they became crack shots, and between them killed twelve Spaniards before their ship went boom."

J.D. scratched his head. "Farmers? Sailors? They look more like flotsam and jetsam to me." The nicknames stuck, and thereafter everyone, including Justus, referred to the younger van Liede brothers as Flotsam and Jetsam.

Flo's one consolation was that however bedraggled Flotsam and Jetsam appeared, Justus knew his way around and was an expert swordsman. So her heart sank when she saw Justus mounting his horse.

"I've put together a farewell party with all types of meat, soup, and bread for us."

Justus took off his broad-brimmed hat and waved it with a flourish. "No, no, dear lady Flo. Business attends. I must ride on ahead, for there are other contracts to arrange. I leave you in the capable hands of

my brothers. They won't let you down, for they know what will happen if they do. Farewell!" And he galloped away.

While watching Justus disappear, Flo had a brainstorm. She asked Flotsam and Jetsam, "Do either of you speak English?"

Flotsam looked at Jetsam, and Jetsam looked at Flotsam. After a minute of mute consultation, Flotsam shook his head.

"*Nee.*"

"But you do understand English?"

After another consultation, they both slowly nodded, as if any suggestion of speed would cause a head to roll off.

"*Ja.*"

Johan entered the conversation. "*Konnen Sie deutsch?*"

"*Nee.*"

It soon came down to the fact that the only language between the two Dutch brothers was Dutch, whereas they appeared to understand most other languages—to some extent. Flo turned to J.D. "I've lost my appetite."

J.D. patted her on the shoulder. "Remember, Rubens likes plump women. You don't want to be losing any weight."

She punched him on the arm and marched into the house.

* * *

The following morning saw intense activity while everyone helped load the wagon—except Flotsam and Jetsam. They stood by and sadly watched the load increase and increase and increase. Food, clothing, blankets, dry wood, coal, coffee, soap, books, yarn, knitting needles, and sundry items were piled high into the wagon.

Each of Flo's three daughters managed to speak to Flo alone.

Kerry gave Flo a small package wrapped in brown paper. "You'll bless me for this."

Turning the parcel this way and that, Flo asked, "What is it?"

"A clean queen-sized sheet. You'll want to strip any bed in any inn and put this on. You won't believe the fleas."

Flo laughed. "I'm sure it won't be necessary."

Kerry asked, "Mom, are you going to pose in the nude?"

"What ever gave you that idea?"

"If you did, what would I tell my children? What would happen if they saw their grandmother naked?"

Flo had to bite her tongue not to say that the children would hardly be scarred for life if that happened. Instead, she said, "I'm sure you can find something better to worry about. It's not going to happen."

Later, Missy trapped Flo in the kitchen and handed her a box. "Ma, here's something you'll really need."

The box was about the same size as the parcel. "Let me guess. It's a sheet."

Missy was surprised. "Did you pack any? Even if you did, I'm sure you could use an extra."

In the bedroom, Amy cornered and stared intently at Flo. "Mom, you're not going to pose naked, are you?"

Overall, Flo was starting to get a bit insulted by that question. She freely admitted that she wasn't as thin as Anne Jefferson, but it wasn't like she was fat. And she certainly wasn't old. She laughed uneasily. "Good heavens, no, Amy. What ever gave you that idea?"

"It's what the whole town is talking about. Everywhere yougo, people are saying that Rubens wants you naked." Amy gave her mother a heavy package in a small backpack. "You'll need this. It's a revolver and a handful of bullets."

"Are you telling me to shoot Rubens?"

"Don't be silly, Mom. It's for the road. You don't knowwho'll you meet. And if you want to protect your virtue when you're being painted, that's okay too."

Outside, J.D. was also receiving gifts from the men around the farm. His sons-in-law gave him a second shotgun in addition to J.D.'s own, muskets, and a variety of knives. Johan gave J.D. something particularly valuable: a large plastic tarp.

"Do you think we're going to have picnics?" J.D. asked.

"No. You will be in an open wagon and want some protection for when it rains."

"But the tarp's red," J.D. complained.

"So?"

"Do you have anything in green?"

Johan laughed and slapped J.D. on the back. "You need a vacation."

Meanwhile, both men and women found time to talk to Flotsam and Jetsam. Each person promised that should anything untoward happen to either Flo or J.D., the Dutch brothers would lose their hands, fingernails, private parts, eyes, or whatever piece of anatomy the speaker preferred. Tone and body language supplemented the brothers' limited German and English. With each additional speaker, the two brothers looked sadder, more forlorn, and more crumpled.

Early the next morning, Flotsam and Jetsam hitched the horses to the wagon and tied the saddle horses to the rear.

By nine o'clock, J.D. had a pleased look on his face. He had arranged all their belongings in the wagon. "I guess that's about it. We're ready to go, and I've used up every square inch of space. How's that for packing?"

Flo put her hands on her hips. "What about Brillo?"

J.D.'s face sunk almost as low as that of the Dutch brothers. "You get the ram. I'll begin rearranging."

Chuckling all the way to Brillo's pen, Flo never noticed the enormous grin on Johan's face as he followed her.

"Brillo's gone!" Flo gasped.

"Relax, Flo," Johan said. "I put him with the ewes for the night. I thought that might make him more manageable."

"Good idea."

The two of them found Brillo peacefully dozing among the ewes.

Johan laughed. "He's in heaven."

They pushed and prodded the sleepy ram all the way to the cart, in which J.D. had cleared a space for him.

"It's not much room," J.D. admitted, "but there's bound to be more space as time goes by."

Brillo blinked peacefully until J.D. and Johan swung him aboard. Then the ram was wide awake. His first baa was somewhat weak, but each succeeding baa gained in strength and terror.

Everyone pretended to ignore the cries while Flo and J.D. were kissed and hugged. She and J.D. got into the back with Brillo, and Flo stood up and gave her farewell speech.

"We'll go, we'll see, and we'll return."

Everyone applauded, Flotsam shook the reins and clucked at the horses, and the wagon rolled away to various cheers and ever-louder baas.

Flo closed her eyes. "However long this trip takes, it is going to be longer than I had imagined."

That was at the end of August.

* * *

Three weeks, four sweaters, five caps, and seven scarves later, they were still in Germany. Flo had calluses on her knitting fingers, J.D. was working on a beer belly, and Flotsam and Jetsam were more ragged than ever.

J.D. lifted a stein of beer. "It won't be long now."

Flo was working on another sweater for J.D. "You mean when we reach the border?"

"No, dear. When they serve dinner." He burped again.

They were sitting by a table in a small inn a few miles west of Osnabrück. It wasn't the most desirable inn, but the weather was stormy, and neither of them looked forward to another day of being stuck between inns and sleeping in the open at night while it was raining.

A fat man wearing torn clothes staggered over to them. He had a large knife stuck in his belt, a patch over an eye, greasy hair, and various scars. He was the innkeeper, and Flo didn't trust him.

A young woman followed the innkeeper. She was somewhat better dressed and was carrying a large tray with bowls.

The innkeeper spoke and understood English in terms of single words. "Dinner."

Flo groaned. "Stew?" She thought of chunks of indigestible meat sunk at the bottom of a bowl that had a scum of fat floating on the top.

The innkeeper smiled a terrible smile, exposing black teeth. "Mutton."

She gave a little shriek and thought: Brillo! Jumping up, Flo ran outside the inn and into its stable on the side. There she saw one of the van Liede brothers leaning against a stall. He had a musket lying across his thighs and was staring blankly in the distance. Next to him, Brillo was peacefully chewing his cud. A strange warmth descended over her, she was incredibly thankful, and she wanted to hug the two of them. Then she felt guilty that she didn't know whether it was Flotsam or Jetsam guarding her ram. The two might have been identical twins.

"Hello," she said somewhat shyly.

"*Goedenavond.*"

"Excuse me, but are you Flotsam or Jetsam?"

"Jetsam."

The indignity of calling these two men after the debris of the ocean occurred to her, and Flo tried to apologize.

The corners of his mouth turned upward. It might have been a smile. "*Nee ,nee. Het Geeft niet.*" Then he thought about it some more. "Good name."

"Would you like to learn to speak English? It would help to pass the time on the road."

Jetsam nodded.

Wheredo I begin, she wondered. Flo pointed to her nose. "Nose." Jetsam repeated after her. After Flo ran through her face, she started on her body and worked down to her thighs.

Jetsam put his hand on her thigh and smiled in earnest. "Thigh!"

Flo recognized the look of the predatory male and hastily stood up. "I think we've had enough English for one night."

Going back inside the dark inn, she sat down by her table. "J.D., you won't believe what happened. J.D.?" As soon as her eyes acclimated to the numerous people milling around, she saw that the serving girl was sitting on J.D.'s lap. His right hand held a tankard and his left hand was inside her blouse.

Looking at her with bleary eyes, J.D. burped. "Strong ale."

Flo said pointedly, "I don't know about the ale, but maybe you should take it easy on the milk."

The girl removed J.D.'s hand, curtsied, and, laughing, left the table. J.D. said, "I think she'd like to come to Amsterdam with us."

"Really?" Her voice dripped sarcasm.

What began as a nod ended in a plummet, and J.D.'s head rested on the table. Flo finished her cold meal in silence.

* * *

Three days later, in the bedroom at another nameless inn on the nameless road, J.D. complained, "I don't know why you aren't talking to me. It happens. I was drunk. I thought she was you."

Flo stripped the bed and put one of the travel sheets over it. "She was taller than me, had blond hair, a squint in one eye, and warts. So how in all hell did she look like me?"

J.D. began undressing. "She had your boobs."

After putting a top sheet over the spread one, Flo critically inspected the blankets for lice and fleas. "Maybe you shouldn't have mentioned her boobs. Maybe I was ready to forget."

"Honestly, Flo. You've a great body. I can see why Rubens would want to paint you naked. I mean, you'd be the naked one. Rubens would have his clothes on. Well, he better have his clothes on."

Flo warmed to him. "You think so?"

Nodding vigorously, J.D. got under the covers. "Let me show you."

She got into bed next to him. "I don't know, J.D. You're the only man who's ever seen me naked—if you don't count doctors. I don't know if I could do it even if I wanted to do it. What's that hand doing? Hmm." And the time for conversation rapidly slipped away.

* * *

By the end of September they had almost reached the border between the Netherlands and Germany. The problem involved a fork in the road and one of those rare occasions when there was no other traffic. J.D. and Jetsam had taken the saddle horses to explore the forks, as well as to buy some bread and other provisions. Flotsam was snoring in the wagon, and Flo was sitting on the driver's seat and stitching

a ram needlepoint. She had drawn the design at home, and this was the first opportunity she had to finish it. Brillo was tethered nearby to a tree and was nibbling in the high meadow.

Half-dozing in the sunlight, Flo became aware of the large wagon drawn by a team of four horses when it drew near. She immediately recognized it as an up-time conveyance not only by the driver having a seat in the front but also by the "We Love Feet" logo and the "Eisenhauer Shoe Company" lettering on the side.

Flo waved to the driver. "Hello!"

The driver reined his horses to a stop. "*Gutten Tag*." He took in her appearance and wagon. "You are an American."

"Yes, and are you ever a sight for sore eyes."

"Do your eyes hurt?"

"No." Flo reminded herself to avoid being literal with down-timers. "I meant that I didn't know that Eisenhauer had expanded this far so soon."

"Ja, Herr Eisenhauer's shoes are very popular. We will be branching into the Netherlands next year. Why wear wood clogs when you can have leather boots at the same price?" He jumped off his wagon. "I'm Siegbert Zuckertort, but everyone calls me Ziggy."

She got down and offered her hand. "I'm Flo Richards, and I wouldn't mind another pair of shoes."

They shook hands.

"I'm sorry, but I've delivered all the shoes. You see, I'm taking hides back for more shoes." He smiled. "We don't want any wasted trips, and Herr Eisenhauer insists on a full load in both directions. But I have a catalog. Perhaps you would like to order something?"

"Another time maybe. When I'm back in Grantville."

"Flo Richards, Flo Richards," he murmured. "Yes, I know you. You're the one with Brillo the Ram. You're famous. He's famous! I have seen the video *Bad, Bad Brillo*."

"Really? How did you like his performance?"

"Brillo is one hundred percent ram. So what are you doing here? Where are you going? And who is looking after Brillo while you are away?"

"We're going to Amsterdam, and Brillo is right over here . . ." Turning, she pointed to where she had Brillo tethered.

He wasn't there.

Looking in the distance, Flo saw three men leading Brillo away. "My God! They're stealing Brillo!"

Ziggy reached into his wagon. "You're lucky that they haven't killed you." He pulled out a heavy cudgel and charged the thieves. Flo took her wagon at a leap and began looking in all the green backpacks for

the one that had the revolver. Finding the gun, she jumped down and started running. She prayed the gun was loaded.

One of the thieves threw a rock at Ziggy. He missed, and then he was on them and hit the first bandit on the neck. The bandit crumpled, but the other two used their clubs and soon had Ziggy on the ground.

By that time, Flo was close enough. Standing in her stocking feet, at only around five foot one, she wasn't particularly tall even by seventeenth-century standards. Flo was also a tad on the plump side and not accustomed to running. For this occasion, however, she had no trouble screaming curses while racing at full speed. It was enough to make the two bandits hesitate. When she began firing the revolver in the air, they decided that they had had enough for one day and ran away. The third managed to get up and didn't do too bad a job in keeping up with his fellow thieves.

Panting, Flo helped Ziggy to his feet. "Are you okay?"

He was bleeding from a head wound and seemed a little woozy. "I have had better days."

Facing Brillo, Flo asked, "What's the idea, you big goof? Youbaa your head off day in and day out, but when three strangers sneak over, untie you, and lead you away, and you don't make a peep. What do you have to say for yourself?"

"Baa!"

Flo laughed. "I think he's gotten over his trauma of being ramnapped. I'm not sure about myself though. I could use a cup of coffee. Would you like to join me?"

"Ah, coffee! But of course!"

Half leading and half dragging Brillo, Flo walked alongside of Ziggy back to their wagons.

"You saved Brillo."

Ziggy laughed. "You saved Brillo. I performed a delaying tactic." He shook his head. "I have had enough of soldiering and prefer a quiet life. Deliver shoes and buy hides. That's a good life. I have already earned enough for a roomy cottage outside Bamberg. It has been two months since I have been home, and I look forward to seeing my wife and children." He sighed. "I miss them."

By the wagon, Ziggy nodded toward Flotsam. "I wonder how he managed to sleep through it all."

Flo sniffed. Flotsam's state of unconsciousness was due to schnaps. "Yes, he's a great bodyguard." She bound Ziggy's wound.

"Thank you, Flo. You are kind."

"That's nothing. Let's see if this sweater fits you. That's the least I can do for a friend of Brillo."

When J.D. returned later that afternoon, looking rather beat, he scowled at the picnic that Flo had set up for Flotsam and Ziggy. "I wish I could spend all my time eating and chatting."

Flo laughed. "Stop grouching. If you brought back any cheese or fresh bread, I'll let you enjoy the last of our coffee supply."

* * *

On a bright day in early October, Flotsam reined the wagon over to the side of the road. Approaching them was a sea of wool, a flock of sheep led by a young blonde girl of about twelve. She smiled and waved her shepherd's crook, in thanks to the travelers standing aside.

Flo waved back to the girl. To J.D.: "Look how those ewes follow her. We should be so lucky back home."

J.D. nodded toward Brillo. "He's beginning to become restless."

Tied to the wagon, Brillo was pulling and straining at his tether.

"Relax, J.D. Brillo can't get away. I know how to tie a good knot."

"Was it a slipknot by any chance?"

Breaking free, Brillo charged into the middle of the sheep. Following him were Flo, J.D., and Jetsam. Flotsam was analyzing the situation throughout somewhat bloodshot eyes.

From the rear of the flock, a middle-aged farmer joined the pursuit. He seemed very upset and was talking nonstop.

While Flo and J.D. held Brillo, who was baaing for all he was worth, Jetsam explained in broken English and gesture that the farmer was taking his ewes to a different pasture. He was also a bit that the spring lambs would look like Brillo.

"Brillo didn't do anything!" Flo declared. She kept a tight grip around Brillo's neck.

J.D. had a less ambitious hold around Brillo's middle. "Not yet."

The farmer did a Moses act, parting the ewes and giving Brillo plenty of clearance. However, one particularly cute ewe was more than ready to respond to Brillo's advances. The ewe began running around them and avoiding the farmer's best attempts to have her move with the other sheep.

While the ewe ran her circles, Brillo dragged Flo and J.D. after him.

The farmer was shouting, Jetsam was laughing, and Flo and J.D. shared curses.

"J.D., why don't we just buy the ewe?"

Standing tall, J.D. spoke with the voice of authority. "If we give in once, what happens when Brillo meets another ewe he wants?"

"Let's handle one crisis at a time," Flo panted. "We can afford a ewe. Besides, look at her. She'd be a good addition for the breeding program."

Brillo baaed in agreement.

Flotsam, whether drunk or sober, understood the fine art of negotiation and immediately got into the

spirit of bargaining. The farmer haggled with equal enthusiasm.

The young girl walked over to see what was happening. After a few words from the farmer, she burst into tears.

"What's wrong now?" Flo asked.

Jetsam explained that the particular ewe happened to be the girl's favorite. She didn't want her father to sell it. She said that he should buy Brillo, but her father didn't want to.

Between the sheep baaing and the girl crying, Flo felt a headache stirring. But she persevered, and leaving Brillo in J.D.'s perhaps capable arms, Flo walked to the girl. "What's your name, sweetheart?"

Jetsam rapidly translated everything Flo said.

"Maria."

"Listen, Maria, you don't want money for your ewe, do you?"

She shook her head no.

"But what if you had something wonderful?"

Jetsam told her that Maria wanted to know what could be more wonderful than her ewe.

"Tell Maria to wait a few minutes." Flo got into the wagon and began selecting objects: a pair of scissors, strong thread, and the red tarp.

"You're not cutting our tarp!" J.D. said indignantly.

Flo cut a rectangle from the plastic tarp. "You never liked it." While the haggling continued, Flo worked wonders with needle and thread. "It isn't easy sewing plastic. You have to be careful or the plastic will crack and tear."

Fifteen minutes later, she was done, walked over to Maria, and held up a red plastic cape with a hood. "This is for you, sweetheart. It will keep you dry in the rain." She put the cape around the girl, who began to smile and talk rapidly.

"Maria is excited," Jetsam said.

Flo grinned. "I could have guessed that."

The farmer and Flotsam came to terms on the ewe's cost. Although Maria shed a few more tears over the loss of her ewe, she didn't make any more verbal objections. Maria and the farmer began moving their flock. The girl's step seemed lighter with her new cape.

"That wasn't so bad, J.D. And we've a good-looking ewe for our flock. What should we call her?"

"Pad?" J.D. suggested.

"Don't be foolish. That's a boy's name. I'll call her Pat. Or maybe Patty? Should we tether both of them

to the wagon or let them ride?"

J.D. smirked. "I think they'll both want to ride afterward."

Flo saw what J.D. meant. "Honestly, Brillo, don't you have any self-restraint? Couldn't you have waited until we reached the privacy of a stable?"

Brillo baaed very contentedly.

* * *

The road to Utrecht was a traffic disaster. Carts, wagons, and what have you carrying fruit, wood, grain, and every type of dry good imaginable had ground to a standstill along the soft verge. Marching from the city, Spanish troops and cavalry dominated the road, and few people dared challenge the soldiers' right of way. Civilian opportunity arose between soldier formations, when everyone would go onto the firm grade and try to make some progress before the next group of soldiers appeared. Anyone too slow paid a high price: Earlier they had passed a smashed cart and its unhappy driver who didn't leave the road fast enough.

Perched on the driver's seat, J.D. idly held the reins. He snarled when a cart attempted to ride over the meadow next to them as a shortcut. But the cart didn't get far at all. It sank deep into mud hidden by the tall grass.

"And it serves you right!" he yelled. "Damned cheaters."

"What's that, J.D.?" Flo was busy giving Flotsam and Jetsam knitting lessons. It wasn't so much that they enjoyed knitting, but it was more comfortable sitting in the wagon than on the driver's seat. Whatever their interest in knitting, Flo was pleased with the progress that her students were making.

J.D. asked, "Do you think the Spanish are leaving the Netherlands?"

"Perhaps they intend to subjugate some other country?"

"They're subjugating us," he grumbled. "I hate sitting still."

"Do you want to try knitting? I'm sure Flotsam or Jetsam will let you have a turn."

"I hate knitting."

"Don't be gloomy. The traffic will clear. It always does. We should be in Utrecht by tomorrow. Then it's only a hop, skip, and jump to Amsterdam."

"Hop, skip, and jump?" J.D. grimaced. "And it's only mid-October. Some vacation."

"You shouldn't have taught them how to play poker. If you didn't owe them how many thousands of God knows what currency, you would be looking forward to a soft bed, a real bath, decent food, and warm water."

"Why are you so cheerful? Aren't you the same Flo who threatened Brillo yesterday with death and damnation? Something about sending him to a desert without a blade of grass for a thousand miles?"

"That was yesterday. Today I've made a decision."

"You mean like inventing an automobile for our next 'honeymoon'? Or putting in a train line?"

Flo stood up and put her arm around J.D.'s shoulders. "I mean a real decision, J.D. I'm going to do it!"

"Do what?"

"I'm taking my clothes off for Rubens. I've been debating that with myself every day since we set out from Grantville. Should I or shouldn't I? Don't interrupt! I want to say this straight. You tell me it's okay. Our daughters tell me they're aghast. So which way do I go? Well, what the hell. It's only skin, and it's not like I'm doing a bump and grind on the stage. It's art, and am I ready! As long as someone offers me a real bath, off they come!"

"All your clothes?"

"You got it, mister, every last scrap."

J.D. twisted around to give her a hug. As he twisted, he accidentally pulled on the reins and the horses reared, shifting the wagon into the road proper.

As fate would have it, an extravagant carriage passing in the opposite direction locked wheel to axle with them, tangling the two vehicles and jolting all the occupants. Flotsam and the coach driver began working to separate the two vehicles, and J.D. gladly gave the reins to Jetsam.

An official-looking head poked out the carriage window and began yelling alternately in Dutch and Spanish.

J.D. was in no mood to negotiate and cursed back at the official.

The personage managed to squeeze a fat arm out the window. The stranger shook his fist, and J.D. gave him the finger.

"I hope he understands that," J.D. muttered.

"No problem, J.D. Looks to me like you got your point across."

The door to the near side of the carriage was blocked by the wagon, and the carriage bobbed up and down while the person inside shifted his position. The far door was kicked open just as a cavalryman was passing, and the door swung out right in front of the horse. The horse performed various pyrotechnics and saved itself, but the rider was tossed head over heels.

After getting to his feet, the cavalryman threatened the fat personage, and the fat personage screamed at the cavalryman. The cavalryman pulled his saber halfway out of its scabbard, and the official puffed and postured while his face turned bright red.

"You see," J.D. said. "It's all sorting itself out."

As soon as the two vehicles were separated, Flo asked, "Maybe we should drive on?"

"Sounds good to me, but exactly how are we going to move?"

A crowd of curious onlookers had surrounded them.

"Rubberneckers," Flo moaned, "and in the seventeenth century."

"Makes you feel right at home, doesn't it?"

A Spanish officer rode up and dismounted. He silenced the angry official and cavalry trooper and then listened to each in turn.

"He'd make a pretty good traffic cop," J.D. said.

"I preferred it more when they were yelling at each other."

Flo's instincts proved correct. The fat official walked into plain sight and pointed at J.D. Then the cavalryman also came over and pointed.

"That's not fair," J.D. complained. "It wasn't my fault that the guy rode into the door. Fatty should have looked in both directions before opening it."

The Spanish captain approached them. Flo thought the captain's glare wasn't too cold. She didn't expect to be drawn and quartered for an hour at least.

In answer to the captain's questions, J.D. said, "Sorry, I don't speak Spanish. Or Dutch. I'm an American."

"Ah, American." The captain smiled, and Flo's heart fell to the subbasement. Somehow she knew that the captain was among the few soldiers who had survived the American attack on the castle Wartburg in 1632, during which the Spanish troops were not only killed by lead and fire but forced to listen to *Wozzeck*. To the present day, debate raged among the survivors about which was worse: to be honorably killed in battle or to suffer the torments of Berg's opera.

The captain continued to smile. "You will follow me." He pointed south. Away from Utrecht. Away from Amsterdam.

"I'm an American citizen," J.D. said.

"And you Americans are great believers in law. So. You have committed serious crimes against his excellency. You have caused much damage. All this must be sorted out. Fines must be assessed, damages awarded." The captain nodded his head thoughtfully. "Yes, all this must be thoroughly looked into. You will be made quite comfortable, for you will be with us a considerable time."

Flotsam and Jetsam, never too cheerful in the first place, became less than splinters on the seas of life. J.D. was speechless. Flo broke.

"Two months! We've been on the road for two months to go to Rubens! We were almost there. Almost. Just a few days more and now this. I don't believe it. I honest to God don't believe it. Why in all the world did I ever listen to Justus Corneliszoon van Liede? I must have been freakin' out of my mind. There are dozens of painters. Hundreds of printers. Why Rubens? Why Justus Corneliszoon?"

It was the captain's turn to become pale. "You are acquainted with Justus Corneliszoon van Liede?"

If Flo's traits were to be assessed, among those highest ranked would be paperwork and organization. It only took her fifteen seconds to find Justus's letter and put it in the captain's hands.

After reading it, the captain handed the letter back to Flo and bowed. He said very quietly, "Excuse me one moment." He stalked over to the cavalryman, who had been grinning with delight.

"You!" the captain yelled to him. "Why are you standing here? Where is your regiment? Get on your horse, and if you fall off it again and do not break your neck, I will personally break it for you." The captain whirled on the fat dignitary. "Pig! Why were you driving on the road? Don't you see the soldiers? What gives you the right to be among them? Do you have a uniform? A rank? There's nothing soldier about you."

The official protested and waved his arms and pointed at J.D.

The captain drew his sword. "I envy you, for you have a simple choice. Move or die. Which do you prefer?"

Fat does not imply slow. Personage and carriage were away before the captain could return to Flo and J.D., whose mouths had collectively dropped open.

The captain bowed again to them. "I sincerely apologize for any mistakes."

"You know Justus?" Flo asked.

The captain grinned and suddenly looked years younger. "Of course I know him! He asked me to watch for you. That was maybe three weeks ago. It was odd meeting him. At first I wanted to punch his teeth in, because he was that type of fop. But before I could even draw my sword, he cut my doublet to shreds. Imagine that! Well, there's only one thing to do with such a swordsman. We promised each other eternal friendship, and I agreed to help you the best I can. Now, how may I assist you?"

Flo looked at J.D., and J.D. looked at Flo. They were somewhat embarrassed to ask, since they weren't accustomed to favors that put them ahead of everyone else, but the captain understood those glances.

"Attend! You will bring your wagon on the road and proceed after me. I will arrange an escort to guide you to Utrecht." He glared at the onlookers, who immediately dispersed. He was that type of captain.

And they were on their way, and Flo sang, "Amsterdam here we come."

* * *

Flo slammed the door, and J.D. jumped a couple of feet skyward.

"Lord, woman! Don't I have enough gray hairs?" He waved the binoculars he was holding in front of her. "I nearly put an eye out. That would be a fine addition to this 'vacation.' You know, standing on a roof is perhaps the best way to see Amsterdam. Through binoculars. The tours are okay, but the canals stink. They're more like open sewers than waterways. I keep hoping to spot the Gretchen statue. Wasn't there talk of putting one up where she was on top of a building somewhere and waving a flag? We should be able to see it from here."

They were staying in Paulus Pontius' house, which was next to Rubens' studio. Between the two buildings was a large courtyard and stable.

J.D. noticed the expression on Flo's face. It was a cross between the Mother of Demons and Lucrezia Borgia, only not as pleasant. He asked innocently, "Didn't the first sitting for Rubens go okay? Did you have a place to change? Was the studio warm enough? Did Brillo do anything unmentionable?"

Flo grabbed J.D. by his shirt and shouted, "When can we leave?"

"Well . . ." J.D. was taken aback. He had never seen Flo so angry. "We'd have to send messages to Flotsam and Jetsam. They weren't expecting to be ready for another week. We need fresh provisions. What happened? What did Rubens say?"

"It's not my portrait!"

"Excuse me?"

"It's not my portrait. It's Brillo's. I'm not Mrs. December. It's Mr. December. I was only invited because they didn't think anyone else could manage Brillo. He has a reputation, you know. He's a one-ram revolutionary. What am I? Huh? I'm a frumpy housewife. That's all." She sniffed.

J.D. hugged her. "Those miserable bastards. I'm going to have a few words with this Rubens. I don't care who he is. No one can treat my wife like that. And after two months on the road to get here? They have their nerve."

Flo returned the hug with interest. "No, not a word to anyone. It's too humiliating. I just want to go home."

"We'll get started immediately."

She shook her head no. "I have to see this through. Brillo will be painted and get a month on the calendar. That's something. Then we'll have nothing to do with these people again."

"At least we'll have a fine portrait of your unfavorite ram."

"Not even that!" Flo wailed. "Someone already bought it."

"What? Has Richelieu been up to his old tricks? Sneaking and conniving among everyone?"

"No, it's some collector in Italy. I've never heard of him."

"Well I'll be damned. I wonder how whoever heard of Brillo?"

Flo smiled glumly. "We have the most famous ram in the world."

Listening by the half-opened door was Paulus Pontius, Rubens' favorite printmaker. Deciding not to join his guests, he quietly shut the door and left.

* * *

A week later, Flo and J.D. were busily packing for their return journey when someone knocked on the

open door.

Flo straightened up and smiled. "What a pleasure to see you!"

"A pleasure to see you, dear lady Flo." Justus Corneliszoon bowed deeply. "Flotsam and Jetsam have loaded most of the wagon, and I have a present for you." He offered her a small cloth bag.

"Can I believe that aroma? Can I?" Flo opened it. "It is! It really is! Coffee! It's been weeks since I've had any. Let me heat a pot of water, and we'll have some."

"Not to bother, dear lady Flo. I left some beans with the kitchen wench, and she's grinding them to make a fresh pot for us even as we speak. Shall I meet you in the dining room downstairs in half an hour? We can have a farewell chat."

Flo hugged Justus. "That's a date!"

He laughed. "Then I shall see you shortly." Justus left the room.

"Thanks for noticing me," J.D. said. "I don't understand you at all, Flo. You didn't get your portrait painted, we didn't get Brillo's portrait, and you're all smiles. That is, you're all smiles after Corny reappeared. Do you have anything to confess?"

She was all innocence. "Who? Me? No, I'm only happy that the calendars came out so well. Who'd think that Paulus could turn out plates for printing so fast?"

"You sure were happy to see Corny."

"Well, at first I thought that he ran out on us. But, who'd think he'd spend so much time on the road marking a route for us, making friends, and eliminating brigands. It's like having Ivanhoe on our side."

"Can't you think of a Dutch hero?"

Walking over to a tall and narrow wooden box, Flo tapped it significantly. "Rolled up inside is a wonderful drawing by Rubens of Brillo. It's almost as good as a painting, and maybe even better. I think I prefer his drawings to his paintings."

What Flo didn't mention to J.D. was that rolled within the Brillo drawing was a second one, in red chalk and white washes, of Flo reclining on a sofa. In the nude. Flo thought it was very flattering, but Rubens had a flattering manner in general. Perhaps she would give it to J.D. for his birthday. Perhaps. But it wouldn't leave their bedroom back home. Some things were too private.

"I'm really looking forward to being home. You know what I think, J.D.? I think we're going to have a fine trip back to Grantville."

J.D. looked out the window. "Maybe."

It had started to snow.

Cowspiracy
Written by Kerryn Offord

January 1633, The Bristol Channel

Anna Kettenacker tried to keep her eyes on the horizon. She'd been told that it would make her feel better. Her stomach tightened and she could taste bile surging up her throat. The sailor who had advised her to get out of the cabin and to stand amidships to minimize the action of the ship had been right. She did feel better. Still miserable, but no longer suicidal.

"Try this, Anna." Richard Tomkins, one of the Englishmen in her party, was trying to push a bottle into her hand. She grabbed it gratefully and rinsed her mouth out.

"Agh. I feel awful."

"Not long now, Anna. The captain says we should be in Bristol in another five hours if the wind holds."

"Five hours. Why did I ever let Swiger talk me into this?" Another surge from her stomach made Anna hang her head over the rail again. "Agh. How can you stand there looking so healthy?"

Richard snickered. "No idea. I don't get seasick, I guess." He took the bottle of boiled water from her hand, then said, "As for Swiger, he offered a lot of money."

"I should have asked for more."

"Probably. But look on the bright side. It could be weeks before we find what we're looking for and have to start back for Grantville."

Anna gripped the rail, trying to hold herself upright. "You're not helping, Richard. Why don't you just leave me alone so I can die in peace?"

Richard gave Anna a quick grin before leaving her to her misery.

* * *

"How's Anna holding up?" Thomas Welford, the second Englishman on the four-person team, asked.

"She'll live. Not that she'd agree with me right now," Richard said.

"It was stupid to bring her along. What do we need her for?" Valentin Weber, a very self-important German merchant and the self-styled leader of the team snorted. "I know what we're looking for as well as she does."

"I doubt you've got her experience," Richard said. "We need someone who can recognize the cowpox when they see it. Dr. Alexander, the large animal vet, said she was the best of his students,"

"She's the best Grantville had to offer? All they did was show her some pictures in a couple of books. I saw them, too."

Richard sighed. "Herr Weber, Anna's father was a knacker . . ."

"A knacker! Nobody told me I'd be pretending to be married to a knacker's daughter."

"Nobody told you, Herr Weber, because they probably didn't think it mattered. Anna probably has a

better chance of recognizing cowpox when she sees it than anybody in Grantville. And that includes Rudi Muller, who's been dealing with animals all his life."

"Better than Rudi?" Thomas shook his head. "Seriously?"

"That's what I heard Dr. Alexander tell Herr Swiger." Richard turned to Valentin. "And I'd be careful of letting your prejudices show, Herr Weber. Anna's not one to suffer slights meekly."

Bristol, England, several hours later

"No! Absolutely no way. You are not getting me back on some poky little sailing boat." Anna folded her arms and glared at her colleagues.

"Come on, Anna. It won't be so bad. It's only about sixteen miles. The Little Avon River runs into the Severn River, and we can sail right up that to Berkeley. We could be there inside three or four hours. If we go by road, we can't leave until first light tomorrow. And we risk spending a night on the road." Richard tried to get Anna to see sense.

"No. The next boat I get on is the one taking me home. Anyway, we really should travel by land. We might miss an infected animal if we don't. We don't know exactly where Dr. Jenner found the cowpox he used in his experiments. All we know is that it was from somewhere near Berkeley."

"Anna's got a point," Thomas said. "There's a pretty big bonus at stake if we can bring back an infected cow. It'd be foolish not to maximize our chances of finding one."

Anna turned to Valentin. "Herr Weber, I suggest you see about getting some horses. There's over sixteen miles of farmland between Bristol and Berkeley. The sooner we leave, the sooner we can start looking."

Valentin bristled at the order, as he'd been doing for days. It was obvious that he didn't care to take orders from anyone, much less from Anna. Richard wondered just how much trouble the self-important little squirt was going to cause.

* * *

"Anna, have you finished yet?" Valentin called.

"Nearly. Just another three to check."

Valentin stomped away, calling, "Will you hurry? If we want to get to Bevington before nightfall, we have to leave soon."

"It takes as long as it takes." Anna returned to examining the cows. They'd been on the road a week and hadn't found any sign of cowpox. There hadn't even been scars on the cows to suggest they might ever have had the disease. Surely if there was any cowpox in the area, some of the hundreds of cows she'd examined should have had it at some stage. But the signs weren't looking good and Anna was starting to lose hope.

She finished her examination of the last animal and stood up. The rest of the team was watching

hopefully, so she shook her head to indicate no luck. Wiping the worst of the muck from her hands with a rag, she followed the farmer's wife into the wash-house where she could get cleaned up. That was something she had been able to do, pass on the Grantville ideas of hygiene and sanitation. After drying her hands, Anna reached for her satchel and withdrew several printed pamphlets.

* * *

"Woman! What took you so long? I thought you were only supposed to be washing your hands?"

Valentin was obviously annoyed. Not that Anna cared. "I'm supposed to talk to them. It's all a part of spreading the knowledge and you knew that when we started on this trip." Anna had given the woman several of the Sanitation Commission pamphlets, and because the woman had had difficulty reading them, she'd gone over each pamphlet with her. Anna wouldn't be surprised if the woman sold the information to her neighbors, but that wasn't any of her concern. Distributing the information was the important thing. If the woman made a little money in the process, that was just a bonus. "I'm ready now."

"Right. Well, hurry up. We have to get the pack animals loaded before we can leave." Valentin nodded to Thomas and Richard before leading the way toward the waiting ponies and horses.

Anna sent a speaking look toward Richard and Thomas before following Valentin. *Why didn't that idiot start loading the pack animals while I was talking with the farmer's wife if he's in such a hurry?*

Berkeley, Gloucestershire, England, a couple of days later

"So this is Berkeley ." Anna sat on her pony and gazed at the irregular structure that was Berkeley Castle , infamous as the site of the murder of Edward II more than three hundred years ago.

"It's no good looking in that direction, Anna. There'll be no beds for the likes of us there," Thomas said.

"I was just wondering if they offer tours of the room where Edward the Second was murdered. And maybe we could tour the park and some of the tenant farms. The more animals we can check out, the better."

Thomas groaned. "Not more animals. It was bad enough chasing around in the muck on the way here. I'm learning more about cattle than I ever wanted to know."

"You do want that bonus, don't you? And I'd have thought you knew a lot about cattle. You come from Hereford , don't you? The up-timers say the Hereford was a well-known breed."

Thomas shook his head. "Never heard of no Herefords. Mind, before I became a soldier, I worked on the orchards. Richard?"

"There were no cows on the hop fields I worked on," Richard answered.

"What?" Valentin's face was nearly purple with anger. "Neither of you know anything about cows? Then why did Herr Swiger lumber Team Delta with a couple of useless ex-soldiers from Hereford ? Surely there are suitable people in Grantville who know cows?"

Richard shrugged his shoulders. "No idea. Maybe Herr Swiger figured we'd speak the local language,

Herefordshire being so close to Gloucestershire."

Anna did her best to ignore Valentin. The man was a royal pain as far as she was concerned and she was getting very tired of him and his attitude.

Stroud, England, Two weeks later

Thomas looked up from his mug of hot cider and sniffed. "When can we head home? It's been three weeks, the last two in miserable weather, and you still haven't found any sign of cowpox . . ." Thomas wasn't happy. It was winter, and it wasn't just cold, it was wet and cold.

"We can't give up yet, Thomas. We've barely started looking," Anna answered.

"And we are being paid by the day. So it's not as if we lose out by taking our time," Richard added.

Thomas was so deep in his misery that their comments passed over his head. ". . . and as for the lousy oilskin rain capes we were issued, they're worse than useless. Why couldn't we have some of the new pattern gear?" He glared at the faces of his colleagues. "Yes, yes, I know we couldn't have up-time weapons because they'd stand out, but those new rain capes they're making for the army. Why couldn't we have some of those?"

"Because we'd look different, Thomas," Valentin answered. "When we get back to Bremen you can change back into your favorite clothes. But look at Anna. Do you hear her complaining because she can't wear her divided skirts?"

Anna grinned at that. "I'm obviously not muttering loud enough." Valentin might be an arrogant pain, but at least he had the mission in mind.

Valentin ignored the interruption. "Anyway, Anna's found no sign of cowpox around Stroud, so I suggest we make our way towards Gloucester next. They make a lot of cheese there, so there should be a lot of cows."

Richard buried his head in his hands. "And to think I became a soldier to escape the farm."

Near Gloucester, England, February 1633

Anna had learned early in this mission that a vicar's wife was the person to talk to in any almost any English community. They were usually well-educated by English standards, especially for females, and they tended to know their communities well. Grace Barneby was the best of the breed Anna had come across since arriving in England. While the vicar talked with the three men, Anna and Grace talked about health and the Sanitation Committee pamphlets.

"The Americans say that someone who has been vaccinated using cowpox won't catch smallpox. Well," Anna corrected herself, "the person is protected for at least ten years. Then they have to be given the vaccine again in what they call a booster shot."

"But if they variolate, they are protected for life?"

Anna nodded.

"That doesn't make sense. Surely it would be better to 'immunize' a person for life rather than have to 'vaccinate' them every ten years," Grace said.

"I agree, Grace. However, the Americans claim that variolation is dangerous even if you deactivate the smallpox. They don't feel it's worth the risk, not if cowpox is available."

"And that's why you're in England."

"And still not finding any sign. Yes, I know. But the Americans want cowpox, so we have to try to find it."

"At least you're inside and warm. I don't know why you didn't think to offer a reward for the farm worker who found an infected animal earlier."

"Me, either." Anna smiled. "It's certainly much more comfortable having other people doing the searching."

"Of course. Now, let's see what the next little book is all about." Grace glanced at the title of the pamphlet in her hands. "Treatments for safe drinking water . . ."

* * *

The knock on the door was followed by a young housemaid popping her head into the room. "Sorry to disturb you and your guest, Missus, but one of the farm workers is wanting to talk to you."

Grace paused in her reading of the safe water pamphlet. "What do you think? Has someone found something interesting? I won't be a moment."

Anna hoped someone had found something interesting. This search for cowpox was starting to look like it might end in failure. She tried to sit quietly in her chair while she waited for Grace to come back.

A few minutes later the maid popped her head into the room again. "The missus would like you to follow me, Miss."

Anna shot to her feet, grabbed her satchel, and followed the maid to the back door. There she found Grace, a farm laborer and a scruffy little urchin.

Grace smiled at Anna and gestured towards the boy. "Young Peter here thinks he's found what you're looking for."

Anna walked up to the boy and knelt down in front of him, offering him her hand. "Hello, Peter."

Peter placed his filthy hand in Anna's and gently shook hands. "Do I win the pennies?"

Peter's father gave him a clout across the ear. "That's no way to speak to the lady."

Anna looked from father to son. The twelve pennies she had promised to whoever found an infected animal would be a lot of money to this family. "Yes, Peter, if you've found what I want, the pennies are

yours." Anna turned to Grace. "If you'll let my companions know where I'm going, I'll get some boots on and follow them."

"Not without me, you won't. Betty can tell the men to join us," Grace said. "Right, Betty?"

The maid nodded shyly and retreated to pass on the instruction.

* * *

The horse was a sorry-looking beast. The first thing Anna did was move the gelding into better light. That was difficult, as the animal didn't want to move. When he did move, he lifted his feet high. That was an obvious sign that something was wrong.

Given that sign, Anna had high hopes for what she might find. Grace had been horrified when the child led them to a horse instead of a cow, but the child had said it had pox pustules. So far, this horse was showing the symptoms Dr. Alexander had told her to look for.

She lifted the animal's front off-side foot and looked at it closely. "There we are, Grace. See? Lots of little pox pustules just below the fetlock."

Grace shuddered. "I'd rather not look, thank you."

Anna stifled a laugh and searched in her satchel for a small glass bottle, a small spatula and needle. Then, holding the foot on her thighs, she began to drain the noxious-looking pustules.

It took a while to deal with all four feet, but finally she finished. She wiped the gelding's legs down with a cloth soaked in a weak bleach solution to sterilize the wounds, then stood up to see that her male companions and the vicar had turned up to see what was happening. She held up the glass bottle. "Success."

"What do you mean 'success'?" Valentin asked. "That's a horse."

Anna wrapped the precious bottle in a cloth and placed it in her satchel. "Horse or not, we have what we came for."

"But . . ." Thomas stopped. "Anna, I don't understand."

"What Thomas is trying to say, Anna," Valentin said, "is we're supposed to be looking for cowpox. Not whatever that horse has."

Anna looked over at the still silent Richard. "Do you have anything you'd like to say?"

Richard shook his head. "Not me. I'm sure you've got your reasons."

"Yes, I do. I'm pretty sure that horse has 'grease,' which is also known as horse pox." She gently patted her satchel. "This is more than enough horse pox for our purposes. All we need now are some cows to infect. Then we wait about twelve days for the pustules to form, and there we'll have it. Cowpox."

* * *

Anna was feeling smug. Valentin was pacing the sitting room, obviously unhappy. Thomas and Richard

were curious, but as they were on the team purely as bodyguards for Anna and Valentin, they had always been out of the loop.

Valentin stopped pacing to turn and glare at her. "Why wasn't I told everything?"

She had to smile at the picture Valentin made. He wasn't taking the realization that a knacker's daughter had been the real head of the team at all well. If Grace and her husband William hadn't been present, Valentin would have been screaming the question. "Because you didn't need to know."

"What?" Valentin was barely holding onto his temper now. "Of course, I needed to know. How many opportunities to find this grease have we missed, because I didn't know to look for it?"

"None. Whenever we visited a farm I asked about any sick animals and all you ever did was complain about it." Anna grinned at the furious look Valentin sent her way. "And, of course, I never complained when you asked me to examine any of the sheep you were interested in."

"Sheep? Is there such a thing as sheep pox?" Thomas asked.

"Sheep pox, cowpox, horse pox, even cat pox, they're all pretty much the same thing," Anna answered.

"Cats can get cowpox?" Grace asked.

"Yes. But I wouldn't advise using the pus from cat pox without deactivating it. The trouble with cats is they can also catch smallpox, so there's always the risk that you might infect the patient with the wrong disease and give them real smallpox."

"Young lady, I'm curious. Why do you want to infect a cow?" Grace's husband asked.

"I want to be sure that I can infect a cow before going home. It'd be silly to get home only to find what we have isn't cow or horse pox," Anna answered.

Valentin stopped his pacing in front of the vicar. "Herr Barneby, I'd like to buy that horse and any cow that is infected."

"Of course, Mr. Weber."

"Thank you, Mr. Barneby, but that won't be necessary," Anna interjected.

"Not necessary? And how are we supposed to get the cowpox back to Grantville?" Valentin asked.

"In a bottle. It's so much easier to transport than an animal the size of a horse or cow." Anna grinned. "You don't think I thought this up myself, do you? I'm just acting on instructions from Dr. Sims and Dr. Alexander. Oh, and we're to take our time getting back to Grantville. The Sanitary Commission wants us to distribute the vaccine and knowledge of how to vaccinate along our route home."

Domestic Violence
by John Zeek

Jürgen Neubert was not a happy man. His promotion to patrolman first class at the end of last year had just added to his responsibilities. Now the grass was turning green and the flowers were starting to bloom and here he was, stuck in the office doing paper work. Not even his new trousers could cheer him up.

The trousers were a replacement for the up-time uniform trousers that had finally worn out. Jürgen had been able to have the tailor sew them with a looser cut, more like what he was used to wearing.

The cause of his unhappiness was two-fold. First, and most importantly, being an investigator was not what he had expected. Every case, no matter how minor, seemed to land in his and his partner's lap. He looked down at the case file in front of him, and realized it was typical of the cases he and Marvin had been dealing with. It was a petty theft case. If the officer who responded to the first call couldn't solve the case on the spot, he and Marvin got a report. In Jürgen's opinion, Mr. Hudson's chicken was now resting comfortably in the stomach of a fox, but the man wanted a police report.

The second problem Jürgen had was caused by Chief Frost. Not that the chief had done anything to Jürgen, but because the chief had announced his retirement. Small town police departments are a lot like a family, so Jürgen was not looking forward to getting used to a new father. And then there was the problem of who was going to be the new chief. Rumors were flying; it seemed everyone had an opinion about who was going to step up to chief. Jürgen felt that his partner, Marvin Tipton, had the inside track. Marvin was the oldest of the up-time policemen and had been a policeman for over twenty years. And Marvin was a sergeant, the only sergeant who was not a watch commander, but still a sergeant. Jürgen realized that he was not qualified to be the senior investigator. So if Marvin moved up to chief, Jürgen would get a new senior partner and he wasn't sure he could work with someone else. It would be a difficult adjustment, and he doubted that he and a new partner would have the close relationship he had with Marvin. And now Marvin was in a meeting with the Chief and one of the watch sergeants, Preston Richards. This had to be it.

He looked at the stack of reports, then looked out the window at the leaves just budding on the trees. His mind started to wander. As he read the same sentence for the third time, Jürgen wondered if he could get a little time off to try out the up-time fishing rod he had purchased last week. His thoughts of trout jumping in the Saale were interrupted when he looked up and saw Mimi Rowland, the day dispatcher, looking out of the radio room into the hall where his desk sat.

"Jürgen, come here a minute, you should hear this. I have patrolmen Smith and Kramer on a missing child report."

Jürgen moved to join Mimi. Jonathan Smith, despite his name, was not an up-timer, but an Englishman. He and his partner, Wilhelm Kramer, had been mercenaries in Tilly's army before joining the police. Both had been on the night shift and had just transferred to days.

"What's the problem, Mimi?"

"Well, first off they're using a handi-talkie. Either there's a dead spot where they are or the batteries weren't fully charged, because I'm only getting one word in four."

Jürgen nodded. The handi-talkies were great in town, but without the booster in a cruiser radio they sometimes gave spotty communications.

Jürgen listened in as Mimi tried to talk to the patrolmen. "Base to Patrol Four, Base to Patrol Four, repeat your last traffic. I was unable to hear you."

"Squawk . . . Sputter . . . invest . . . reported . . . sputter . . . a kidnapping . . . hissss . . ."

"See what I mean, Jürgen? I think they want you and Marvin to investigate a kidnapping, but it isn't that clear."

"Do you have a location on them?"

"The original call came from the Cooper's, Mrs. Gladys Cooper. She wanted to report her granddaughter and grandson were missing. She was hysterical on the phone and didn't give any details, so I sent Smith and Kramer to check it out. Now the radio is on the fritz."

"Well, it seems like they can hear you, so tell Smith and Kramer we're on our way. I'll go get Marvin; he's in a conference with the chief."

Jürgen walked across the hall and tapped on the office door. From within, he heard the chief's voice, "Mimi, I told you no interruptions." Jürgen knocked again. "Come in."

When the chief saw it was Jürgen in the door he commented, "Oh, it's you, Neubert. I thought it was Mimi. What's so important that you need to interrupt our meeting?"

"Chief, we have a situation. Smith and Kramer are on a missing child report and we think they want to handle it as a kidnapping."

"A kidnapping!" Chief Frost turned to Marvin. "Tipton, you and Neubert get out there right now. I want to be kept informed. If you need more men for a search, I'll call in the night shift early. Now move it."

While Jürgen and Marvin ran to the cruiser and headed for the Coopers, Jürgen had to ask. "Well, did you take the job?"

Marvin never took his eyes off the road. "What job is that?"

"*What* job? What job has everyone been talking about? The new police chief when Chief Frost retires. *That* job."

Marvin chuckled. "Partner, the last time I checked the police chief was hired by the mayor and town council. It's not something passed on from one chief to the next."

"Marvin, I didn't just get into town yesterday. I know that the council is going to hire whoever Chief Frost recommends. Did he ask you?"

Marvin relented. He knew Jürgen was worried about a new partner. "No. I wasn't offered the job as chief. You need to keep it under your hat until the announcement, but Preston Richards is going to be the next chief."

"They should have offered you the job. You're the senior man in the department."

"Actually, I'm not. Oh, I've been a cop longer than Press, but I moved around a lot when I was younger. I worked a couple of years for Morgantown and a couple in Fairmont. I even did four years with the sheriff's department until the politics changed. So Press has been with the Grantville department about a year longer than I have. Besides, he has more education, two years of college and the F.B.I. course at Quantico. I did the F.B.I. course, but I never went to college."

"Oh . . . well, what was the meeting about then, if you're not going to be chief?"

Marvin chuckled again, "You're just full of questions. Chief Frost was just making sure Press and me

were on the same page. He's heard all the rumors going around, just like you have. He didn't want to leave any problems behind, so he wanted to know if Chief Richards and me could work together. And, by the way, we both better start thinking of him as Chief Richards from now on."

"What would Chief Frost have done if you had any problems working for Chief Richards?"

Marvin thought for a moment, "Well, I guess I did get a job offer. Chief Frost is going to open a consulting business, helping set up modern police forces for towns in the USE. He offered to take me with him."

"Oh."

"I turned him down. I like it here just fine."

* * *

The sight that greeted them in the Cooper's driveway was enough to drive the thoughts of the new chief out of Jürgen's mind. There was Gladys Cooper, all ninety pounds of her, chasing two burly policemen with a broom. Old Tommy, her husband, was hanging on to her from behind. Even though he was twice her weight, he was unable to restrain her. Every time Smith or Kramer stopped moving, Gladys would lash out with the broom. If it wasn't so serious a situation, Jürgen would have burst out laughing. Old Tommy had a bad case of black lung, and he could hear the old man wheezing from across the yard. From the looks on their faces, Smith and Kramer were about to lose their tempers.

Luckily for all concerned, Marvin was able to keep his laughter under control. "Smith, Kramer, go over to the car," he yelled. "Mrs. Cooper, put down that broom. You look silly. And you're about to give Tommy a heart attack."

Gladys stopped trying to get at the two policemen, but didn't put down her broom. And it was obvious she was still angry. "Marvin, I want those two fired. They insulted my granddaughter and they won't do their job. The poor little girl is missing and all they can do is insult her."

"Why don't you tell me what's going on? I'll deal with Smith and Kramer later." Marvin turned back to the car. "Jürgen, talk to those two and find out what they know. With that he started talking to the Coopers, and Gladys soon lowered her broom.

Jürgen went to talk to the other officers. Smith had an obvious red mark on his head and there was straw from the broom stuck on the shoulders of Kramer's uniform. Gladys must have scored more than once with the broom. "Men, what happened?"

"Jürgen, I don't know what set her off. She was telling us her granddaughter didn't show up this morning. Then suddenly she was trying to hit us with the broom." Smith shook. "The woman is crazy."

"Ja," Kramer commented, "I just asked if the girl might have gone off with a boyfriend, then, *whoomp*, she started hitting me."

Jürgen thought for a moment then asked, "Which girl is missing? They have three granddaughters."

Kramer whipped out his notebook. "Crystal Cooper. She's sixteen. She and her brother Zachary, who is fourteen, were supposed to be here this morning"

Jürgen saw why Mrs. Cooper had lost her temper. "Guys, you just came off night shift so I know you have heard of Tiffany Cooper."

Smith smiled and Kramer nodded and said, "I guess Tiffany is one of the other granddaughters. She is little better than a whore."

Jürgen nodded. "Ja. Tiffany is Crystal's sister, so when you asked if she had a boyfriend, Mrs. Cooper thought you were saying Crystal was the same as her sister. And do not use the word whore. She is not, according to the morals of the Americans. She's just a little non-selective in her bed partners."

Kramer looked at his partner thoughtfully; then he turned back to Jürgen. "But I never suggested that to the crazy woman. I was polite. I didn't know who her other granddaughter was."

"I believe you. Just stay here by the car, we might need you later. I think Marvin will calm them down, but let us deal with the Coopers."

Gladys was in fine voice when he walked up. "Crystal and Zachary always come to stay with me on Saturdays. They've been kidnapped. They wouldn't run off without telling me. Now, do something. I thought the police were supposed to help."

Jürgen was surprised at how Marvin stayed so calm. "Mrs. Cooper, we're trying to help, but we needed to get all the facts." Then Marvin turned and shouted, "Smith, put out a BOLO on the kids."

Soon Jürgen heard Mimi's voice over the speaker. "Base to all units. Base to all units. Be on the look out for two juveniles. One is Crystal Cooper, a sixteen-year-old female, five-four, 110 pounds, brown and green. The other is Zachary Cooper, a fourteen-year-old male, five-three, 120 pounds, brown and blue. Be aware that this is a potential kidnapping."

Marvin turned back to the Coopers, "Now we wait. I'll talk to Patrolmen Smith and Kramer. I'm sure they won't want to file assault charges against you."

Gladys was shocked speechless, but not her husband. Old Tommy reared up to his full height. "File charges against Gladys," he yelled. "Why, those krauts started it. Gladys was just defending Crystal's good name. I knew the world was going to hell when they put krauts on the police department. They don't understand Americans."

Something snapped in Jürgen. "Herr Cooper, Patrolman Smith is not German, he is English. And if you say the word kraut to me again, you better be referring to cabbage, or else I will file the assault charges."

Old Tommy stepped back, but Gladys said in a lower voice, "Officer Neubert, he wasn't talking about you. We know you're a good German. Everyone knows you could have shot my boy G. C. when you arrested him. I just wish you could have put that witch he is married to in jail."

"Frau Cooper, when you or your husband uses the word kraut to refer to any German, you are talking about me." Jürgen realized the old woman didn't think she was insulting him, but sometimes it was hard not to lash out.

Just then Marvin tapped his arm. "Another country heard from." Jürgen looked around and saw that Marvin was pointing toward two people clearly heading for the Cooper house. "The Craigs. Peggy is the other grandmother and Marty is Connie's brother."

Marty was the custodian of the middle school and one of the nicest people Jürgen had ever met. He'd gotten to know him while attending night school just after coming to Grantville. Peggy, he knew, was the chief cook of the school system.

The Coopers had also spotted them. "There she is, the witch's mother. Coming to gloat about how she does a better job of watching the kids than I do," Gladys stormed.

"Yeah, and she has her half-wit son with her. If you ask me I think they kept the after birth and threw away the baby," Old Tommy added.

Marvin gave a sigh. "Folks, we're not here to listen to you put down your neighbors."

But Old Tommy missed the look in his eye. "Marvin, it's true. Their daddy, Buford, must have been throwing bad seed. Look at what he got . . . an idiot and a murderess."

"That's right. That witch butchered Tommy Jr. like a pig. And you police did nothing about it. She even tricked G. C. into trying to hide her killing. I'm glad he threw her out."

Jürgen could tell Marvin had reached his limit so wasn't surprised when he said, "Tommy, Gladys, get on the porch and stay there. I'll talk to the Craigs." Then, tapping Jürgen shoulder, he added, "Keep them on the porch. The last thing we need is a neighborhood fight."

* * *

"Hey, Ape. Listen to this." Ape Hart looked up from the account book he was working on. His brother Monkey was standing at the end of the Club 250 bar listening to the police scanner. "What's up?"

"Listen. It sounds like someone has taken Connie Cooper's two youngest kids. The cops are having some radio trouble, but it sure sounds like a kidnapping. Marvin and Neubert just radioed they were at the Cooper's. Then some kraut was on, telling Mimi it was a kidnapping."

The scanner then confirmed Monkey's words. "Base to all units. Base to all units. Be on the look out for two juveniles. One is Crystal Cooper, a sixteen-year-old female, five-four, 110 pounds, brown and green. The other is Zachary Cooper, a fourteen-year-old male, five-three, 120 pounds, brown and blue. Be aware this is a possible kidnapping."

Everyone in the bar started talking at once.

Ape drained his beer. "Monkey, get on the phone and call all the boys who ain't here. Tell them to meet at the Cooper's." He climbed on a chair and yelled, "Shut up, everyone. We need to get organized. Me and Monkey are going out to the Cooper's to help. Who's going with us?"

A general cry of agreement came from the crowd. Followed by a rush of men headed for the bar to stock up.

Ape waved Monkey over. "I bet some kraut is behind this, so be ready for anything. Come on people, let's get moving." Ape noted Ronnie Murray, Francis Murphy and Curtis Maggard had full cases of beer as they headed for Monkey's truck. Good, he thought. Someone was thinking ahead.

* * *

After hearing what the Craigs had to say, Marvin turned to walk back toward the Coopers. As he passed the cruiser, he waved Smith and Kramer over. *They need to hear this* .

Gladys and Tommy watched them approach with expectant looks on their faces. "Well? What did the witch's mother have to say?" Tommy asked.

Instead of answering him, Marvin turned to Gladys, "Mrs. Cooper, did your daughter-in-law tell you anything about the children's plans for today?"

Gladys puffed herself up. "I don't talk to Connie. If I did, she wouldn't like what I had to say. She leaves notes in the mail box, like I don't know how to take care of kids. I know what the kids need better than she does, so I have Tommy tear them up."

"You should have read the one she left this morning," Marvin said. "Then you'd have known about the school field trip that Zachary has today. And, you'd have known that Crystal was going along to help Miss Jenkins fix lunch for the kids."

"But . . . but . . ." Gladys sputtered.

Marvin almost hoped the Coopers missed the disgust in his voice, but he really didn't care that much. "If you'd read the note, you'd have known this. And you wouldn't have wasted our time. In case you haven't noticed in the last year and a half, we're not in West Virginia any more. Grantville is ten times as big as it was and we have real work to do."

Marvin watched a wave of comprehension sweep across their faces. "Oh," he continued, "we'll run down to where they are having the field trip just to be sure, but I think we've cleared this case."

Marvin gathered the other policemen with a wave of his hand and started back to the cruiser. "Smith, Kramer, this is your case, but Jürgen and I will run down to the creek where the field trip was going. We can get there quicker and let you two get back to work."

"That is fine with me." Patrolman Smith untied his horse from the mail box at the end of the Cooper driveway. "And thank you, Sergeant, for getting the old woman under control. I was . . . It was hard to keep my temper under control."

Marvin patted Smith's shoulder. "But you did. I've known the Coopers for years and they still get me riled up sometimes, so I know where you're coming from."

Marvin turned to Jürgen. "Well, partner, let's go check on the field trip." He tossed Jürgen the car keys. "You drive. I'm so fired up, I'd break half a dozen speed limits if I did." Marvin slid into the car and grabbed the microphone. "Investigator one to base, show us and Patrol Four clear and in service. The children are on a school field trip. Repeat, no missing children, no kidnapping. They're on a school field trip."

Mimi's voice sounded relieved, "Clear, Investigator one."

"Where to, Marvin?" Jürgen asked.

"According to the Craigs, the class is on a field trip right where Buffalo Creek leaves the Ring of Fire. We should see them from the road." Then, just to stir Jürgen up, he added, "It'll give you a chance to talk to your girlfriend."

Marvin thought he detected a note of wistfulness in Jürgen's voice when he said, "I don't have a girlfriend."

"It must have been some other tall, German policeman I saw walking with Dawn Jenkins the other day." Marvin answered. "You sure looked friendly to me."

"Fraulein Jenkins helps me find things in the library. I was just helping her carry her books and walking her home."

"If you say so. But the two of you were in an awful close conversation."

This time Marvin was sure he heard the wistfulness in Jürgen's answer. "Ah, Marvin. She knows so much and is interesting to talk to."

Yep, he's got it bad, Marvin thought. "Jürgen, there's nothing that says you can't ask her out on a date. After all, you're an interesting guy yourself, when you try to be."

Jürgen shook his head. "No, Marvin, I cannot ask her out. She is a school teacher, an educated woman, and I am a simple farmer—and soldier—who became a policeman. Besides, she has a boyfriend. She told me she is dating Toby Snell."

"Toby Snell? If he's who I think, he's a short fellow and he's in the army right now. Is that the guy?"

"Never met the man. I don't know how tall he is, but it might be the same one, since Dawn said he was in the army."

"Well, are they engaged? If they aren't, you could ask her out. She might surprise you and say yes," Marvin offered. "You've met my wife Elsie. She was dating someone else when I asked her out the first time."

Jürgen seemed sad when he answered. "They're not engaged. But they are 'going steady.' Dawn explained what that meant to me. Marvin, I can't try to take a soldier's girl while he is out of town in the army. It just wouldn't be right."

"You're a good man, Jürgen," Marvin said. *Maybe a little too good.*

* * *

"They must be close." Jürgen brought the car to a stop.

Once they were out of the car, Marvin and Jürgen could see two horses placidly chomping on the new grass. Beyond the horses, a woman was seated on the ground and surrounded by children. Other children playing on the grass nearby. They had found the class field trip.

As they walked down the slight embankment, Marvin noticed that Jürgen was walking proudly. He was almost strutting, with his shoulders held high and his back stiff as a poker. Marvin shook his head. *Yeah. You got it bad, you poor guy.*

"Allo, Fraulein Jenkins," Jürgen called out.

Marvin saw Dawn jump a bit in surprise. Then he noticed the thirty or so young faces that surrounded her were smiling.

Dawn appeared a bit flustered when she answered. "Hello, Officer Neubert, Sergeant Tipton. What brings you out this way on this beautiful day?"

A couple of the young girls behind Dawn were whispering and pointing toward Jürgen. *Ah, leave it to kids to know what's going on before anyone else.* Since Jürgen seemed to be a bit tongue-tied, Marvin spoke up. "Miss Jenkins, we're sorry to interrupt but we have to check on a couple of your students. Are Crystal and Zachary Cooper with you?"

Dawn pointed to a group of three boys who were nearby. "There's Zachary with Aaron Craig and Gerd Schultz. Crystal is down by the creek, cleaning up the pot we used to cook lunch. And you're not interrupting. We're finished for the day. We were just waiting for the children's parents to come for them."

Marvin smiled. "Well, if you're sure the kids are with you, we can be on our way."

Jürgen interrupted. "We don't have to leave so soon. We should see Crystal. That way we can report that she is all right."

Marvin took pity on his partner. "Okay, Jürgen. I'll walk down and check on Crystal. Why don't you show Miss Jenkins and her class the police cruiser? Give them the same tour we gave the first grade class last week." Marvin found it hard to believe that Jürgen could smile any broader, but he did.

Marvin whistled one of his wife's favorite songs while he walked toward the creek. "Matchmaker, matchmaker, make me a match."

All thoughts of matchmaking were driven from his head by the voices he heard coming from behind a clump of bushes. A voice he clearly recognized as Wendel Schultz's said, "We shouldn't be doing this. We'll get into trouble." He was answered by a female voice which said, "Hush. If you don't slow down, you're going to mess up. Just like the last time."

Expecting the worst, Marvin stepped around the bushes. He was greeted by the sight of Wendel Schultz and Crystal Cooper standing on the creek bank with fishing rods in their hands. Crystal was reeling in her line and pointing to what looked like a large trout that was dancing on Wendel's. "Work him in closer to the bank, Wendel. But take it slow. We've already lost two hooks."

Marvin Tipton, you have a dirty mind.

Wendel started reeling in the line. "He's tiring out. Get the dip net." Crystal grabbed up the net and slid down the bank. Her and Wendel's jeans were wet and muddy; this wasn't their first fish. She plunged the net under the fish and soon held it aloft.

Marvin stepped up beside Wendel. "Now that's a nice fish. Have you two caught any more?"

His comment shocked Wendel enough that he almost dropped his fishing rod. "A . . . A . . . Hi, Sergeant Tipton," Wendel stuttered.

Crystal held the fish up proudly, her fingers through its gills. "Shoot, yes, Sergeant Tipton. You should see our stringer. We got five more. This is the biggest though."

"Sergeant Tipton, it's all my fault. I made Crystal help me catch the fish. You can arrest me, but she is innocent," Wendel said.

Crystal and Marvin stared at him in disbelief.

Marvin managed to ask, "What are you talking about, son? I'm not going to arrest you. There's nothing wrong with you fishing."

Wendel looked relieved, but doubtful, "Do you mean no one owns the fishing rights? We didn't ask permission."

"Son, I'm not the game warden, but under West Virginia law it's all right for a minor to fish in public waterways. If you're worried about it, go by the city offices and get a fishing license before you go fishing again. Right now, we'd better go up to the road and join the other students. It's almost time for you to head home."

Wendel ended up with everything heavy, the big pot from the lunch and the stringer of fish. Crystal carried the rods and reels, along with the dip net.

Marvin couldn't help overhearing Crystal's words to Wendel. "You dummy. You were trying to take all the blame and keep me out of trouble, weren't you?" When Wendel nodded, she continued, "That's about the nicest thing anyone has ever done for me." Her free hand came up and linked with Wendel's.

That song was running through Marvin's head again.

* * *

Jürgen had gotten to the part of the tour where the kids were taking turns being locked in the back seat of the cruiser. "I hope this is the only time I see you in the back seat." It was hard for the kids to take him seriously since he had a silly smile plastered on his face.

"Okay, Jürgen," Marvin called out. "Let's wind it up. I see some cars and wagons on the road and I'll bet they're the parents."

As they watched the children being loaded into their parent's vehicles, Marvin nudged Jürgen. "Did you offer her a ride home? It's a bit of a walk and I think we can spare the fuel."

"No. I asked and Dawn said she was going to ride home with Wendel. That's how she got here."

After the last child was picked up, Wendel loaded his charges in the wagon. In the back went Zachary Cooper, Aaron Craig and little brother Gerd. Marvin noted that Wendel did not look at all unhappy that having Miss Jenkins riding on the seat of the wagon caused Crystal to sit closer to him.

As the wagon pulled out of sight, Jürgen commented, "Marvin, what would you bet that Crystal moves over when they drop Dawn off?"

Marvin smiled. "Not one red cent, Jürgen. That little girl will stay right there. And Wendel will enjoy every minute of the ride. Come on. Let's head for the office. It's getting on toward quitting time. This has been one wasted day."

* * *

Marvin was correct in his prediction. Not only did Crystal stay in the middle of the wagon seat after they dropped Miss Jenkins off, she convinced Wendel to teach her to drive the wagon. Not that he minded. It gave him an excuse to put an arm around her to help guide the reins in her right hand.

It was just after they rounded the curve in the road and the Cooper house came into sight that they realized something was amiss. The driveway had four trucks and a wagon in it. Indeed, one of the trucks was half blocking the road.

Wendel took the reins back and slowed the horses. "Look at the crowd at your dad's house, Crystal. Do you think something is wrong?"

"Oh Lord," Crystal exclaimed. "I hope Dad and Grandma Cooper aren't fighting again. She's been on his case since Uncle Tommy died. Don't tell anyone, but I'm glad he's dead. He was always sneaking around looking at me, if you know what I mean. I was afraid of him."

Wendel guided the wagon past the parked truck and brought it to a stop at the end of the Craig's driveway. "Are you going to go over there?"

"I should. I haven't seen Grandma and Grandpa Cooper all week. Yes. I guess I have to go over. I'll take my share of the fish and use them as an excuse to leave as fast as I can."

"That sounds like a plan." Wendel tied the reins around the brake lever. "I'll get your fish out of the cooler. Gerd, hold the horses. I'm going to walk Crystal across the road."

Crystal sounded a bit doubtful. "You don't have to do that. You know how my grandparents think about Germans."

"I will just walk you to the door. They will never see me."

"Just to the door. Honestly, Wendel, you don't know how nutty they are. I love them, but sometimes they're both crazy. And since Mom moved out, Dad is getting almost as bad."

Wendel grabbed the stringer of fish out of the cooler and followed Crystal across the road. He caught up with her after a few steps and took her hand. They had just started up the walk when he noticed the crowd on the porch. Then a voice from behind pulled his attention to the men standing in the shadow of a large tree. "Hey! That's the Cooper girl. That must be the kidnapper." Wendel found himself surrounded by older men. The smell of beer and old sweat was almost overpowering.

"What?" Crystal shouted. "Wendel is just bringing me home from a school trip; he's no kidnapper."

A man Wendel recognized shoved his way into the circle. It was Ape Hart. "Get on up to the house, girl. Your grandmother is worried." Then he turned to Wendel. "We know how to handle this."

"No. I'm not leaving. Wendel didn't do anything wrong and . . ."

Ape roughly shoved her into the arms of another man. "Monkey, take her to the house."

Wendel decided that no one was going to treat Crystal like that. He spun the stringer of fish off his shoulder and slapped Ape across the face with it. When Ape fell back, Wendel spun the stringer around

and slapped it at the man called Monkey. Monkey let go of Crystal and tried to catch the stringer.

"Run to the house, Crystal. Run. I'll be all right." Wendel backed away from the enraged Hart brothers, spinning the stringer of fish over his head. When he saw Crystal had reached the Craig front door, he turned and slapped the fish in the face of the man behind him. This cleared him a path for a moment, and he broke from the circle and ran toward the wagon.

He'd almost made it to the center of the road when he felt hands close on his shoulders. He heard a voice say, "There's the other one by the wagon. Get him."

Wendel yelled to his brother, "Run, Gerd. Run." Just before two large men piling on him blocked his sight; he was rewarded by the sight of Gerd disappearing through the door of the Craig house.

* * *

Marvin and Jürgen had just pulled in to the station parking lot when the radio crackled to life. It was the voice of Jim Watteville, the night dispatcher, "Attention, all units. We have a report of a disturbance at the Craigs."

Marvin picked up the microphone. "Base, this is Investigator one. Put us back in service. We'll go check on the Craigs."

"Clear, Investigator one. All units, Investigator one is going to check on the Craig call. Stay alert for back-up."

"Drive, Jürgen." Marvin switched on the lights and siren. "I knew we should have stayed around the Cooper's a little longer."

* * *

Jürgen was amazed by what he saw at the Craig's house. There were thirty or forty people gathered in front of it and it looked like a small scale battle was about to start. But who was fighting? It looked like the "Rednecks" against the "Rednecks," since both sides had a lot of Club 250 regulars.

G. C. Cooper faced off with Ape Hart, and Slater Dobbs was face to face with Ronnie Murray. Then Jürgen saw Wendel Schultz in the middle of the yard, standing back to back with Marty Craig and surrounded by six older men.

Marvin grabbed the microphone. "Investigator One to base. We've got a mob here and they're fixing to tear into one another. Get us some backup ASAP. It looks like redneck central; every goat-roper in town is here."

"Help is on the way, Investigator One."

Marvin and Jürgen jumped from the car and strode toward the mob on the lawn. Jürgen could tell Marvin was tense and ready for action, but it didn't show in his voice. "Evening, guys," Marvin said when he knew the crowd had noticed their arrival. "Be careful there, Ronnie. You're standing in Effie Craig's flower bed. She'll pitch a fit if you stomp on them."

Jürgen admired Marvin's calm voice as he asked, "Now would some one like to tell us what this is all about?"

Ape Hart walked over. "Marvin, we're doing your job. We caught the man who kidnapped the Cooper girl."

"No, you damn fool." G. C. Cooper pushed through the crowd. "I told you there wasn't no kidnapping. She was at a school field trip. And even if there was one, that doesn't give you no excuse to manhandle my daughter." Cooper almost growled the last sentence as he stood toe to toe with Hart.

Jürgen could see this was about to get out of hand. He stepped between the two. "Herr Cooper, Herr Hart, this is getting us nowhere. You both need to calm down."

Monkey Hart stepped out of the crowd, "You're all lying. I heard it on the scanner. She was kidnapped."

"If you had listened to the scanner a little longer, you'd have heard that Crystal was on a school field trip." Marvin stepped up to cover Jürgen's back. "Have you asked Crystal if she was kidnapped?"

"Monkey, you know my mom isn't right in the head. She's as crazy as a bedbug. It would take a drunk idiot to believe her," Cooper said.

"I ain't an idiot," Monkey yelled as he threw a punch at G. C. He might not have been an idiot, but he was drunk. He missed and ended up sprawled at Cooper's feet. Cooper planted a solid kick in his ribs.

That seemed to electrify Ape. He brought up a punch from his waist that almost lifted Cooper off his feet when it made contact with his chin.

Jürgen drew his baton from his belt. A quick thrust to the ribs and a front spin put the baton in a perfect position to slide under Ape's arm. A quick step forward and a twist and Ape was in a bar hammer lock and incapacitated.

Jürgen glanced to his right and saw Marvin had also drawn his baton. Marvin was putting on a little show with a series of front and back spins that caused the crowd to draw back. "All right. Everyone move off. The show is over. Effie Craig wants you all out of her yard."

The crowd was just starting to disperse as four police cars, lights flashing pulled up in front of the Craig's.

"That was pretty sneaky, Neubert." Ape massaged his shoulder. "You hit me when I wasn't looking."

Jürgen took pity on the older man. "That's right, Herr Hart. You are a dangerous man. I do not think I could take you in a fair fight." Ape almost strutted when Jürgen walked him to the cruiser.

* * *

"I can't believe it. He won't press charges?" Dan Frost asked.

Marvin shook his head. "Nope. Wendel says he gave as good as he got. From the look of some of those fool's faces, I think he's right. That boy packs a mean punch and they were so drunk they could hardly stand up, anyway. So there are no assault charges against most of them. The only charges were filed by Effie Craig; the mob trampled her flowers. Oh, we filed disturbing the peace and assault charges on Ape, Monkey and G. C. We saw them throwing punches." Marvin laughed. "I did get Ronnie Murray for

public intox, but that's it."

"What about Wendel and the Coopers? You think that is going to be a problem?"

Jürgen smiled. "Well, Wendel was with Connie and Crystal when they bailed G. C. out. G. C. was talking about helping Wendel rebuild a junk car when they left."

Marvin laughed. "Chief, old G. C. was so happy that Crystal is dating a nice boy that I think he forgot Wendel is German."

Through A Glass, Darkly
by David Carrico

Magdeburg
March 1635

Lieutenant Byron Chieske dropped into the visitor's chair in Captain Bill Reilly's office with a grunt. Reilly looked up from his paperwork with his eyebrows raised in a mild question. "The day that bad?"

"No, just long. We had to bring Annie Grimmigwald in on assault charges."

"Old Annie? How come?" Bill was surprised. Annie was normally a quiet woman, content to turn enough tricks to get her evening gin at some dive of a tavern before she stumbled out into the night to find a nook to sleep in.

The two officers had been working with the Magdeburg city watch for over two months now. The nature of that work had made many of the city's streetwalkers known to them. The city council ignored them as long as the women were quiet and kept to certain parts of town. Bill and Byron didn't pay any more attention to them than they had to. There were usually more serious issues to deal with.

"She kicked the slats out of another prostitute. She kept screaming that the other woman had stolen her man."

"Who's got magistrate's duty tomorrow?"

"Otto Gericke, I think."

"Good." Bill was relieved. "Maybe he won't be too hard on her."

"Actually, I'm going to try and get the charges dropped. The other prostitute had a knife, so it might have been a self defense situation."

"Mm, yeah, I could buy that. Annie's usually not mean. Do what you can." Bill saw Byron nod. "Where's your partner?"

"Left him in our office filling out the report. I'll sure be glad when someone develops reliable carbon paper. This having to fill out triplicate reports by hand is a real pain. I keep hearing about typewriters in German, but haven't seen one yet." Bill shook his head at Byron's sidelong glance. They were available, but the city council kept ignoring requests to acquire one for their budding police department. "Speaking of Gotthilf, he reminded me again to see if you've gotten an answer yet from Grantville about the possibility of stolen silverware."

Bill started rummaging through the papers on his desk. "Um, maybe. I thought I did." The rummaging ended with a piece of paper pulled in triumph from the middle of a stack. "Yeah, here it is." He passed it to Byron.

"Okay . . . looks like someone actually dug back into the records for this. Several reports of vacant houses being broken into a week or so after the Ringfell . . . kitchens ransacked . . . pans and glassware left behind, but knives, tableware and plastic stuff taken, including Melmac dishes in some cases." Byron scanned through to the end of the report. "Thefts stopped after a couple of weeks. No known suspects." He looked up with a grimace. "And, of course, since the owners of the homes were left up-time, there's no one who can give any kind of descriptions. Not much to go on."

"You still think that guy you saw selling the stainless silverware was selling hot stuff?"

"Well, he was sure nervous about something when he caught me looking at him. He didn't even know I was a cop, but he was sure spooked." Byron changed the subject. "Any word yet on the guys the kids told us about? The two from Hannover?"

"No, and since their descriptions match half the men in the northlands, I wouldn't hold my breath if I were you." Bill remembered everything surrounding the Vogler case rather well—everyone who had anything to do with it did. He looked down at his desk. "Well, now that you know what you know, go find this peddler. Otherwise, I'm going to trade jobs with you and let you deal with this stuff."

Byron shot to his feet. "On my way." And that quickly he was out of the office.

The threat of the paperwork worked every time, Bill smiled to himself. Then he looked at his desk, and groaned. He had to get an assistant soon. He wondered if he could somehow snaffle Odogar out from under Frank Jackson. It would be worth the grief the general would give him just to get someone who could run this office.

* * *

Gotthilf set the last copy of the report on top of the stack and wiped the pen nib to clean it. Byron came in the door to their office just as he set the pen aside. The up-timer waved a paper in the air.

"Finally got the answers from Grantville about the silverware questions we asked."

Gotthilf perked up. He'd wanted to grab the street vendor when Byron saw him selling the tableware, but Byron had insisted on waiting for information from Grantville. "So now we go get him?" He bounced to his feet and checked for his pistol.

"So now we go question him, anyway," Byron laughed. "Whether we get him or not depends on his answers. Come on. I want to check on Willi, anyway."

Gotthilf grabbed his jacket, and in moments they were on the street in front of the building that served as the city watch headquarters. As usual, Byron's long legs set the pace, forcing the shorter Gotthilf almost to a trot to keep up. "Slow down, you great lunk," he gasped after they traveled a block.

"Sorry." Byron slowed his steps to more of a stroll, which allowed Gotthilf to walk at a more normal speed. "I keep forgetting just how sawed off you are." A fleeting grin crossed his craggy face.

"All the better to cut you off at the kneecaps," Gotthilf growled before he smiled in return.

The two men had been partners now for a few weeks. It was an unlikely match at first glance; the lanky up-timer and the short but strongly built down-timer. The relationship had been a bit testy at first; or at least it had on his side, Gotthilf acknowledged. The city watch of Magdeburg was a proud organization, and they had not taken well to the thought that others could tell them how to fulfill their duties. There had been friction at times between the watch and the military police and NCIS staff at the naval yards. Gotthilf was honest enough to admit that there was as much fault on the side of the watch as there was on the navy's, maybe more. But that hadn't made it any easier to deal with the two up-timer officers when Herr Gericke brought them in to help shape the city watch into something more of a police department in the up-time mold.

Gotthilf still wasn't sure why Herr Gericke had selected him to serve as the partner of the tall and laconic up-timer. The first few days had been pretty strained, particularly after Gotthilf made the mistake of speaking disparagingly about a young beggar child. He found out in a moment that the good-natured lieutenant was capable of anger and passion. But the case they had stumbled on as a result of meeting that child had cemented them together as partners. The young down-timer was wholly converted to Byron's point of view, and in turn began to act as leaven to the whole watch. By this point, only the most hidebound of the watch were continuing to resist the new methods.

"I have a question," Gotthilf announced as they turned a corner. Byron looked at him with one of his quizzical expressions—he had a whole arsenal of them, ranging from innocent to sly to out-and-out sarcastic disbelief. This one was just a simple raised eyebrows indication to go ahead. "Why do you call it silverware, when there is no silver in or on it?"

Byron grinned. "More sloppy up-time speaking. It used to be that tableware was made of silver alloys, but that was pretty expensive for most people's pockets. So then someone started silver plating cheaper metals like brass. Looked as good as silver for a lot less money—until you polished the silver plating off and the brass started shining through. But after a while someone decided to start making it out of stainless steel. No rust, no polish needed, and while it didn't take a shine like silver, it was good enough for most folks. But people had been calling the package of knives, forks and spoons 'silverware' for so long that the name just carried over to the stainless steel version. Anyone who was trying to be really correct would say 'flatware,' but in over ninety-nine percent of the homes in America, if someone said 'Get the silverware out and set the table,' what came out of the drawer was stainless steel."

"So what you saw the man in the green coat selling was not silver?"

"Nope. It was pretty definitely stainless steel—it's got a characteristic look to it—and from the brief glance I got it wasn't even some of the better stuff. But good, bad or ugly, I saw at least three pfennigs change hands, so he was getting a good price for that knife, fork and spoon set."

They were entering that section of town that had become a street vendors' haven. One side of the street had been burned down in 1631 when Tilly's troops had sacked Magdeburg. The resulting spaces where houses and buildings had been had mostly been cleared off, but little reconstruction was under way in this area yet. Every kind of vendor and peddler that could be imagined could be found in these open spaces, including some of the more unsavory types. In fact, this was where they had found the pickpocket that had led them to crack the Vogler case.

"So where was he?" Gotthilf started looking around.

Byron pointed. "There—about half a block down on the left."

They drew closer. "He's not there now," Gotthilf observed.

"No joke. Let's start asking questions."

* * *

After close to an hour of asking fruitless questions, Byron pulled Gotthilf back into the traffic moving in the street. "Come on. We're not getting anywhere. Let's go check on Willi." They started walking on down the street toward *Das Haus Des Brotes*, the bakery operated by Herr Anselm Ostermann and his formidable wife, Frau Kreszentia Traugottin. Anselm was the baker, and Frau Zenzi, as she was known to one and all, was the public face of the bakery, ranging from cajoling saleslady to shrewd bargainer to hard-faced punisher of theft in as many breaths. They had become the foster parents of young Willi, the almost totally blind eight-year-old boy who had, all unwittingly on his part, led the two partners to the discovery of the faginy ring operating in Magdeburg under the very noses of the city council and the watch.

At the bloody conclusion of the case, which had ended in the death of one of the children—a girl who was Willi's best friend—and the death of the fagin, one Lubbold Vogler, there had been red faces all around. Otto Gericke, *Burghermeister* and de facto head of the Magdeburg civic government, had not minced words. Nor had the senior pastor of the city, whose outright horror at what had occurred had turned to rage of Biblical proportions. Clerks had been sent scurrying to find the lists of the children orphaned in the sack of the city in 1631. Assistant pastors had been handed the lists and sent out at a run to verify the whereabouts and condition of each of those children. There was a feeling that thunderbolts were about to strike, and it did not ease for over a week until the last of the children and their foster parents had been located. Broadsheets and newspapers had kept the matter fresh for several days, until the latest news from the imperial court had driven it off the front pages.

The source of it all, young Willi, was up to his elbows in bread dough when Byron and Gotthilf were ushered into the back of the bakery. He had flour on his hair, on the cloth that covered his damaged eyes, on his eyebrows. Bits of dough were stuck to his chin and cheek.

The smile on Willi's face was a welcome sight to the two men. The recent changes in his life had left the boy depressed for some time. To see some happiness in him lifted them both up.

"Willi," Frau Zenzi announced, "your two favorite watchmen are here."

"Hey, Willi," Byron said. "How's it going?"

"Herr Byron, Herr Gotthilf!" Gladness rang in Willi's voice. "I'm learning how to knead the dough. Papa Anselm says that when I learn to do that, then he will teach me how to shape it for the oven."

"That's good," Byron exclaimed. They spent several minutes talking with Willi. He very proudly showed off what he had been taught, and the two men congratulated him profusely.

After a time, they said their farewells. Frau Zenzi followed them outside. "Truly, how does he do?" Gotthilf asked.

"Well enough," she replied. "He smiles more, and even whistles or sings a bit now and then. The voice of a cherub, he has."

"Don't let my sister-in-law, Marla, hear that, or she'll have him in a choir so fast that you wouldn't know what happened." Byron's voice was joking, but then his expression turned thoughtful. "Actually, I might mention it to her after all. If he's good, she might be able to find him a place, give him some training, like that. With singing, his eyes won't hold him back." Frau Zenzi frowned a little. "I'm not saying right now. Maybe never. But it's an option. Something to think about. Give some thought to what kind of future a blind boy can have, Frau Zenzi." She nodded slowly.

"Is he still having the nightmares?" Gotthilf asked.

"Not so much. And he asked to go to her grave, so we took him last Sunday." Her was his friend Erna, the one who had been killed.

"How did that go?" Byron had been wondering when Willi would make that pilgrimage.

"He cried, but it was quiet. He took the cloth off his eyes and tried to look around, but we could tell he saw nothing. My heart, it broke when he asked me to tell him what everything looked like." She wiped a tear from her eye with the corner of her apron.

"It sounds like he's getting better, then." Byron nodded to her in parting. "Take good care of him, Frau Zenzi."

"We will."

* * *

Harold Baxter set his stein down with a thump and dragged his sleeve across his mouth, then smoothed down his scraggly beard. The seventeenth century's widespread acceptance of full beards was a good thing in his mind; he'd always disliked shaving. He still had the straight razor his grandpa'd given him over forty years ago, though. Push came to shove, it wasn't a bad hideout weapon. It had gotten him out of more than one bar fight alive over the years, both up-time and down.

He let a belch roll out, and gave himself a three for it. Tone was a little dead. Then he looked across the table at the man who was fidgeting with his own stein.

"So, what do you want, Herr Albret?" Harold knew the other guy's name was Albrecht Lang, but he had trouble with the German "ch" sound, especially after a few beers.

"I need more of the *Tafelsilber*, *bitte*, Herr Baxter."

"How much more?"

"I can sell three packages tomorrow, if I have them."

Harold nodded. "Show me the money." He watched as Herr Lang counted the pfennigs to the table, one at a time . . . four, five, six . . . and slowly pushed them to Harold's side. His eyes narrowed; he pushed one of the coins back. "You suckered me once with a Halle pfennig, Lang. Not again. Goodsilver, or you get nothing."

"But that is all I have." Lang's nasal voice turned whiny, sending a shiver down Harold's spine.

"Shut up." Lang shut up. Baxter swept four of the pfennigs into his hand and dipped into a pocket of his

bush jacket, then pulled bundles wrapped in none-too-clean scraps of cloth out of another of the jacket's many pockets. "Here's two sets. I'll be here tomorrow if you get more money." Lang looked like he wanted to argue or plead, but a glare from the up-timer made him gulp and grab the last two coins off the table top along with the bundle. "And Albret?" The down-timer froze. "You try that trick with a Halle coin again, and your prices will double." Lang jerked his head in a nod, then fled without another word.

Harold sniggered, then spat into the fireplace. He'd always found the fact that Lang meant long in English funny, since Herr Albret was one of the scrawniest people he'd ever met. Nothing about him was long, except maybe his hair and his nose. The thought of hair brought a reflexive scratch of his scalp. He drew his fingers away to look at the louse he'd caught, then cracked it between a fingernail and the table.

No one else looked like they were going to approach him, so Harold decided to call it a day. He drained the last few swallows of beer from his stein, then shoved himself to his feet and walked to the door. Before the Ring fell, Harold had always prided himself on being able to walk a straight line, even when he'd taken on a full load of booze. He could still do it, he thought as he went out the door.

* * *

Two men across the room watched Baxter leave.

"That him?"

"Yes."

* * *

Byron looked across the street as they were headed back to the watch station. A young woman held her coat open for a moment to hide the hand that beckoned to him. He nudged Gotthilf with his shoulder. "C'mon." They stepped across the street to meet her.

Byron knew she was a street walker, but what was her name . . . oh, yeah, Leonora. Pretty name, he thought. She'd been pretty at one time, in a pale-skinned sort of way; pretty enough to perhaps live up to her namesake. No longer, however. For all that she was young, there were lines graven in her face that spoke of pain and wastage, lines that turned her visage into a portrait of experience and suffering with eyes full of desolation that wouldn't have been out of place on a woman three times her age.

"Don't smile at me," she said. "Act angry, please." Byron caught on immediately, and pasted a dark frown on his face. Gotthilf took a moment longer to understand, then his expression turned stern.

"You reached out to us," Byron said, shaking his finger in her face for those who watched. "What for?"

"You look for a man in a green coat, one who sells things from the up-time?"

"You know we do." Gotthilf postured by grabbing her shoulder.

"His name is Albrecht Lang."

"Ah." The two men stored the name away.

"Do you want to know who he gets his wares from?" Leonora looked down as if being chastened.

Byron had to struggle to keep his expression in place. "If you know who it is, you bet."

"An up-timer named Harold Baxter."

"How do you know that?"

"Albrecht arranged for me to spend a night with Herr Baxter." Leonora wrapped her arms close around her chest and looked away. "He hurt me."

A flash of rage went through Byron. "So, why are you telling us?"

"You were nice to Annie. And someone needs to stop Baxter. He will kill one of us some day—us or others."

"You're not the only one he's hurt?"

"No."

He wanted to have a talk with Baxter, Byron decided.

"Is there anything else you can tell us?" Gotthilf asked.

"No."

"Okay." Byron started shaking his finger at her again. "Don't do anything stupid, but if you need protection, come to the watch house and tell them my name. We're going to walk off now, so look dejected."

The two men walked away from the streetwalker and resumed their journey to the watch house. "Another victim," Gotthilf muttered.

"Yeah." Byron shoved his hands in his jacket pockets. "You know, I'm not religious, not like my wife and sister-in-law, but the more time I spend in this job, the more it seems like the concept of original sin just has to be true. I mean, look at us." He gestured around. "Every society the world has recorded history about had prostitution. And for every streetwalker who gets rich as a high-level courtesan or finds a loving marriage, a thousand or more die, old before their time, used, abused, diseased and usually wrecked by alcohol or worse. If man is so good and so perfectable, why does this crap happen over and over and over?"

"You had them up-time?"

Byron gave a short bitter laugh. "Oh, yeah, we had them up-time. And we were still arguing about what to do about them. Almost four hundred years later, and we weren't doing any better than your time does."

The rest of the walk occurred in silence. Both men were alone in their thoughts, each in his own way contemplating the difference between what had been and what was now.

* * *

Gotthilf bounced into the office he shared with Byron. "Good morning!" he exclaimed.

Byron winced, and waved at a chair. "Sit, sit, and be quiet until I finish my coffee."

Gotthilf grinned and sat. Bill Reilly had explained to him not long ago that Byron was in no way a morning person, and if he wanted to preserve tender portions of his anatomy from being chewed upon, he shouldn't approach Byron in the morning until after he'd had at least one oversized mug of coffee. From the looks of it, Byron was almost done with his first mug.

It wasn't long before Byron set the empty mug down. "Stop smirking at me, and let's go see the boss."

Gotthilf followed him to Captain Reilly's office.

"Hey, Bill."

"Captain Reilly."

The captain looked up from whatever he was reading this time, and groaned theatrically. "Oh, no. Both of you at once. What's happened now? Is the Penguin loose in Magdeburg?"

Byron laughed. Gotthilf, on the other hand, was bewildered, and it showed. His partner caught his expression. "Never mind. More crazy American stuff. I'll explain later." He turned back to the captain. "Bill, you ever had anything to do with a guy named Harold Baxter in Grantville?"

"Baxter . . . Baxter . . . name sounds familiar, but I can't tell you why. Why are you asking?"

"Because it turns out there may be something to this silverware thing after all, and if there is, he's probably involved in it."

"Baxter . . . Baxter . . . Oh, yeah, now I remember. He's Raelene Baxter's brother—she got left up-time. He was married to Sharlyn Douglas for a while, too. I think he's Brandi Dobbs' dad. I remember the divorce . . . pretty nasty. Dad used to say he was a mean cuss, and there was apparently some pretty strong evidence that he was abusive to Sharlyn and Brandi. After that, he moved out of town and raised fighting dogs . . . mostly pit bulls. I'd forgotten he got caught up in the Ring of Fire. He must have been in town to buy something."

"You don't know any more than that?"

"Nope. If it's him, he's about the same age as my dad, so I didn't really know him. Just some of the stuff from the rumor mill, you know. But I remember Dad saying that if it ever came down to a no-holds-barred no-rules fight with anyone, Harold was the one man in town he wanted on his side, 'cause there wasn't anything he wouldn't do in a fight."

Gotthilf swallowed. This Herr Baxter did not sound like anyone he wanted to get involved with. He looked to Byron, and saw that his partner was sober-faced; no funny expressions at all.

"If we need to know more, who should we talk to?"

"Maybe Frank Jackson. Like I said, Baxter's from my dad's generation, so he ought to be around sixty years old. He's maybe just a little older than Frank, so Frank probably knows something more about him."

On their way out of the office, Gotthilf looked at Byron."The Penguin?"

"Well, before I can tell you about the Penguin, we'll have to talk about Batman first."

"Batman?" *Fledermaus? Hieb?* All sorts of thoughts went through Gotthilf's mind.

"Batman. See, there's this comic series . . ."

Americans were crazy, Gotthilf decided yet again.

* * *

Baxter watched his last customer of the day walk away from his table. The backpack he'd brought with him was empty. Six settings of stainless steel, a couple good butchers' knives and two settings of Melmac had all sold. Those who bought from him knew better than to try and bargain any longer. Once he said his price, that was it. Early on a couple of guys had tried to bargain with him, but he'd showed them. Every time they argued, he raised the price. He snickered at the thought of their expressions.

He emptied his stein and waved for another. The thought ran through Baxter's head that he was getting into a rut. Maybe he needed to start looking for the dogs he had planned to buy. From the looks of it, he'd never have much more money than he had now. His stash of "unique up-time wares" was about to run out, and with Grantville bulging at the seams, he'd never be able to scrape up its like again. From what he could tell, even the garage sales in town were a mere shadow of what they used to be like. Seemed like whenever anything was offered for sale nowadays, down-timers would swoop down and carry it off, with only enough bargaining to salve their own pride. Nope, if he wanted to get his kennels started up, he'd have to get started, and right soon.

* * *

"Now?"

"No." Benedikt Schiffer looked to his younger brother Ebert—half-brother, actually—as the familiar thought ran through his mind that his brother wasn't much brighter than the boar he was named after. Of course, the thought continued, his mother was noted more for being soft and placid than for any great amount of mental strength. Benedikt had inherited their father's brains and his mother's hardness. "No, Eb, we need to wait a bit longer. Make friends with him first."

"Oh." Ebert turned his stein in his fingers. "I wish Lubbold hadn't gone and gotten himself killed."

"Me, too, Eb. And don't talk about him anymore."

"Why, Ben?"

"Because," Benedikt summoned all of his scant patience, "he did something bad. He killed a little girl, and if people find out we were his friends, they might get mad at us."

"Oh. Okay."

That American word was popping up everywhere these days, Benedikt thought, then turned his mind back to Lubbold Vogler. Vogler the mastermind, whose plan to link gangs in different cities so that stolen goods could be transported to different regions for resale died just as it was about to be put into effect.

Benedikt had come from Hannover with the final agreement of their folk, which was all that was needed according to Vogler, only to find him dead. Killed in a fight with city watchmen led by up-timers. Called themselves *Polizei* now, whatever that was supposed to mean. But to have everything—all the plans, all the contacts, all the names—resident only in Vogler's mind meant that it was all fuel for the flames of Hell. If the city men hadn't shot Vogler, Benedikt might well have done it himself. He ground his teeth until his jaw ached.

So now, now Benedikt was trying to find something with which to salvage this trip, and he had stumbled onto Herr Baxter peddling bits and pieces of the up-time. He took another glance at his target out of the corner of his eye.

* * *

Gotthilf looked to Byron. "Is Herr Lang in sight?"

"No." Byron muttered.

"What was that?"

"I said, you'd think it wouldn't be that hard to find one man."

"Like you told me, if it was easy, they wouldn't need us." Gotthilf smiled.

"Oh, shut up."

* * *

Harold looked up as two men seated themselves across the table from him. "I don't know you." Harold was a direct man. He didn't see much sense in dancing around—just get to the matter at hand. "What do you want?"

"Ah, but you are well known, Herr Baxter. You are the man with the many up-time things—small things, but things that are so very useful that many people want."

"You want them?" More directness.

"Perhaps, Herr Baxter, perhaps. And there may be other things we want that you might be able to help us get. But I forget myself, talking business before introductions. I am Benedikt Schiffer and this is my brother Ebert."

"Harold Baxter." Harold decided there was nothing lost by being polite, especially since they already knew his name, but he dropped his hand into his pocket to grab his razor just in case. "You boys ain't from around here, are you?"

It appeared to Harold that it took the other man a moment to figure out what he'd said. "No, Herr Baxter, we are from Hannover."

"That's a pretty fair distance from here." Harold spit into the fire. "You all didn't come this far just to talk to me."

Benedikt waved at the waitress, and held up three fingers when she looked his way. "We came to

conclude a business agreement, but by the time we got here, the merchant had died. We were seeking some other opportunity, when we happened to see you making your deals with the local peddlers. Your wares would be very welcome in Hannover, so we are interested in buying as much as we can."

Harold's mind began racing. These guys weren't from here . . . they might pay a premium for what stock he had left. There were bits and pieces of stainless and a couple of knives still in the footlocker he had stored at the goldsmith's, but the prize was a full set of stainless and two sets of Melmac that he hadn't had to break up yet. He should be able to hold them up for good money. Maybe his kennel was closer than he thought.

"Well," Harold drew the word out, "we might be able to do business, depending on what you want and how much you want to pay."

Benedikt laid a groschen on the table. "We have money. How much we pay depends on what wares you have."

Harold scratched his chin, thinking. "I'll want some silver—quite a bit of it for some of my stock—but maybe you boys can help me." Benedikt cocked his head and nodded for the up-timer to continue. "I want some breeding stock—dogs—fighting dogs, you understand?"

"Like they use in bear baiting?" Benedikt asked.

"What's bear baiting?"

The two brothers looked at each other with obvious astonishment. Benedikt turned back to Harold. "Bear baiting? Where a bear is chained to a post, and a pack of dogs is loosed upon him? It is good sport."

"Chained?" Harold went beyond astonishment. "Chained how?"

"By the neck, or by a hind leg. There is much cheering, and betting on whether the dogs kill the bear or the bear kills the dog."

Thrills were running up and down Harold's spine. "You're serious? They really do this? Where at?" He swallowed spittle.

"They did not do this in the up-time?"

"Are you kidding? I've seen dog fights and cock fights, but never anything like what you're talking about. The animal rights folks would have had to change their pants, they'd have been so upset. The old ladies in the churches would have screamed so loudly if something like that show was put on, the government would have shut it down so fast your head would be spinning. They'd have thrown everyone they found at it in jail, and lost the keys to the locks."

A bear-dog fight! Harold was salivating. It would be like something out of the old Roman days, he thought. Man oh man, he had to get in on this!

"So, uh, you boys know someplace where this happens?"

Benedikt got a knowing look in his eyes, like he knew he'd hooked a fish. Harold didn't care. If they could take him to a place where fights like that happened . . .

"This is not our first time in Magdeburg, Herr Baxter." Benedikt's voice was smooth. "There is a bear pit outside the city. We know where it is." He turned to Ebert and rattled something else off too fast for Harold to follow. Ebert stood and went to the bar. "Ebert will see if the bar man knows when a fight will be."

When he came back, Ebert rattled off some fast words in their version of German that Harold didn't catch. Benedikt asked a question, and Ebert nodded. Benedikt turned back to the up-timer with a smile that bordered on sly. "Fortune smiles on us. Tonight, Herr Baxter; there is a fight planned tonight."

* * *

Byron and Gotthilf had been searching for Albrecht Lang for a couple of days now, and even the normally ebullient Gotthilf was starting to show some signs of irritation. They walked along this morning, hands in pockets, with none of their normal conversation. For lack of a better destination, they were headed to the street where Byron had first seen the man, with the intention of once again questioning everyone in sight.

"I suppose that," Gotthilf finally said, "if nothing else, we might make ourselves so great a nuisance that someone will say something just to get rid of us."

"That's possible . . ." Byron stopped in mid-word and grabbed Gotthilf by the shoulder. "There he is—straight ahead and off to the left, next to that vegetable cart."

It took a moment for other people to move out of the way enough for Gotthilf to spot their target. "I see him. He looks like a rat."

Byron chuckled, leaned over and murmured, "I'll go around the crowd and come up on the other side of him. Count to a hundred, then move toward him."

One of the things that still sometimes amazed Gotthilf about the up-timer lieutenant was that he could slide through a crowd of people like a knife through water—barely a ripple showing his passage. He wasn't sure if it was an up-time thing, or a tall person thing, or maybe just a Byron thing, although if he had to pick he'd probably take the last. But after a moment, he shrugged and started counting.

". . . 98, 99, 100." Gotthilf tugged at his jacket, patted the pockets where his new badge and his pistol rested, and started toward the object of their search. "Herr Lang?"

"Yes?" An obsequious smile appeared on the pointed face of the peddler. "How may I help you, Herr . . .?"

Gotthilf pulled his badge out and showed it to Lang. "*Polizei*." Before he could get another word out, Lang whirled and started to run . . . right into Byron, who grabbed him, spun him around and hauled one hand up behind him until his elbow was almost touching his shoulder blade.

"Herr Lang," the up-timer pronounced, "we have some questions for you. Now, we can do this one of two ways: you can come with us politely and we'll buy you a beer afterwards, or we arrest you on suspicion of selling stolen merchandise and you can talk to us in the magistrate's court. What's it going to be?"

"I . . . I know n-nothing," Lang stammered.

"You are wrong," Gotthilf purred with a stark smile. His voice dropped to a murmur. "You know about Harold Baxter, and you really, really want to tell us all about him." Lang turned white, and would have dropped had Byron not been holding him up. "So let's go find that beer and you can tell us what you know."

* * *

Harold sat straight up in bed, then almost fell back again as someone drove a hot railroad spike through his temples. His stomach was calm, for which he would have thanked God if he believed in him. But his head felt as if someone was using the inside of it as an anvil to pound out horseshoes. He stood and stumbled to where his bush jacket hung from a peg in a wall. From one pocket he pulled a pill bottle, from which he shook a couple of APCs into his hand. Another of the many pockets produced a flat Jim Beam bottle with perhaps a finger's worth of amber liquid in it. The pills went into his mouth, followed by the last of the whiskey. Holding the bottle up in front of him, Harold said, "So long, Jim. I'm going to miss you." He screwed the cap back on the bottle and set it on the table. Something else that could be sold.

It wasn't long before Harold felt half-way human again. What did he drink last night? The memory came to him: oh, yeah—shots of gin chased with ale. He remembered drinking Ebert and Benedikt under the table after the bear fight.

The bear fight! His normally fulsome vulgar vocabulary failed him at the thought of what he had seen last night. The bear pit was really a pit, a big hole that had been dug in the ground, with seats that Harold could only call bleachers built up on both sides of it. Obviously, this pit had been here for quite a while and had regular enough action if the owners went to the extent of building the seating. A beer keg to one side and some guy selling sausages on skewers passed for a concession stand. Harold approved of the owners' smarts, and he was more than a little envious that they could operate so freely in the here and now. Well, it was going to be his turn soon.

The fight, now—well, that was the most fun he'd ever had with his clothes on, better even than the last time he beat a woman into submission until she let him do whatever he wanted with her. The thrill of watching a dozen dogs tear into that bear and the bear tear back was way beyond sex. The blood flowed until much of the bottom of the pit was littered with dog corpses and red mud.

It ended finally. The bear's ears were bloody ribbons, his front paws were mangled and his sides and back legs had had strips of hide torn off of them. Two dogs were left, both of which could have been ancestral stock of Rottweilers from the looks of them. They danced in and out, until finally the bear charged to the limit of the chain locked onto his left hind leg. That quickly it was over. The bear fell, and the two dogs were at his throat in black and tan blurs. Moments later, the weakening roars and bawls of the bear fell silent, to be replaced by the cheers of the crowd—those of them who hadn't lost money by betting on the bear, that is.

Harold came back to the present, grinning for all he was worth. He knew what he wanted to do, now. He wanted to buy some breeding stock from the guy who owned the two big black and tan almost-Rottweilers and breed some dogs. Give him two years with good stock and the training he could give the resulting pups, and he could start cleaning up.

Then he remembered what was supposed to happen this morning. He looked at his watch . . . only 9 a.m., more or less. Good, he still had time to get his stuff together before the Schiffer brothers showed up. Harold grabbed his jacket and headed out the door of his room.

It wasn't far to the goldsmith's shop. A few minutes later Harold stepped into the front door of *Meister* Alaricus Glöckner. He was met by Dieter, the master's son and oldest journeyman.

"Good morrow to you, Herr Baxter."

"Hi, Dieter. I need to pick up my footlocker."

"Pick up?"

"I'm taking it with me."

"Ah. A moment, please." He turned to an apprentice and murmured something that sent him scurrying for the back of the shop. "Will you be bringing it back?"

"Probably not."

Dieter frowned a little. Harold could see that he was sorry to lose the storage fees they had been assessing to keep his case in the safety of their strongroom. "Well, let me figure up the final charges, then."

The apprentice lugged the footlocker through the back door in the middle of the bargaining over the storage fee. Harold was feeling so good that he only put up a token resistance and paid over a silver pfennig, receiving two broken bits back as change. Just as he bent over to grab the footlocker handle, the back door opened again and a girl entered the shop.

"Didi, did you . . ." She turned pale, stopped and placed a hand on the wall.

"Did I what, Rosina?"

Harold straightened with the footlocker in hand, smiled at the girl and walked out of the shop. His smile broadened as people stepped out of his way.

* * *

Gotthilf watched as Byron pounded on the door of the room for the second time. Still no response. The up-timer looked around. "Doesn't look like he's here. You know the way to that goldsmith Lang mentioned?"

"Glöckner. I think so."

"Let's go, then."

* * *

"Do we go see Herr Baxter now, Benedikt?"

"Soon, Ebert."

"And will he give us the pretty things?"

"One way or another, Ebert. One way or another."

* * *

Gotthilf stopped in the middle of the street.

"What's wrong?" Byron raised an eyebrow.

"I turned the wrong way at that last corner. We need to go back that way."

The two men reversed direction.

"I thought you said you knew the way."

"I do, but I haven't come at it from this direction before."

"Where's a map when you need one?"

"Oh, shut up."

* * *

Harold set the footlocker on his bed, then reached over to close the door. He pulled a couple of keys from his pocket, opened the padlocks, and threw open the lid to the footlocker. A quick check verified that everything was still there; all the pieces he needed to tempt the Schiffer brothers. Closing the lid, he snapped the padlocks back and put the keys back in his pocket.

The bush jacket went back up on its peg. Harold stretched, then scratched his chin. The rasp of stubble and beard irritated him all of a sudden, so he decided to shave. It took a moment to unlock the small bag he had chained to the bed frame and pull out his soap and shaving mirror.

The mirror got set up on the mantle over the small fireplace. He poured a small amount of water in the basin on the table, and lathered up enough suds to cover his face. It wasn't as good as shaving cream, but it worked. Harold pulled the straight razor out of his pants pocket, opened it, and lightly thumbed the edge. Still sharp from the last time he had worked it over, so he walked over to the mantle and began to shave.

He mused as he scraped the blade over his cheeks, flicking the suds and bristles against the nearby wall. The razor and the mirror were all he had left of his grandfather, the man who had practically raised him. Old Grandpa Horace had been a hard man, but he'd made sure that Harold had grown up strong. The old man seemed to live forever, but when he died, all that Harold had wanted from his effects was the razor and the mirror. He remembered watching Grandpa shave on Saturdays: the careful stropping of the razor, the ritual of mixing the shaving soap in the mug and brushing it on the sunken cheeks and knobby chin, the watchful examination of the face in the small mirror and careful movements of the hand with the razor. He wouldn't say that he missed the old coot, but something had left his life when they put that pine box in the ground back behind the hill country house where he'd lived and died.

The mirror was very old now, and the silver backing was clouding and pulling away from the glass. Harold wouldn't use anything else though. Sometimes he thought he saw Grandpa Horace looking back at him from that tarnished image with an expression like those he used to have when he would take that razor strop to Harold. Sometimes he shivered, sometimes he laughed, but always there was a cold feeling to his spine.

There was a noise behind him. In the cloudy glass he saw the unlocked door of his room open—*stupid mistake*, Harold, he thought he heard his grandpa say—and Death step through.

* * *

Benedikt looked at the body of Harold Baxter lying at his feet, and cursed roundly and soundly and at great length. "Dead, just like Vogler," he said through clenched teeth, "and just as useless to us." He looked to where Ebert was holding up the length of copper rod, examining the blood and hair on it with every evidence of interest. "Ebert!" Startled, his brother looked to him. "Drop that."

"Okay." The rod clanged to the floor.

The room was a mess. Some of the furniture had been overturned; filth was everywhere. Benedikt looked around. "He said he would have the merchandise here this morning. Nowhere . . ." His eyes lit on the strange chest sitting on the bed. The smile that had started to blossom turned into a thunderous frown instead when he saw the locks on the chest. They had to be up-time work. A close look confirmed that, and also confirmed that they would be hard-pressed to open them. The chest, on the other hand, looked to be less strong.

"Ebert, bring that rod here."

"But Ben, you told me to drop it."

Deep breath. "Ebert, bring me the rod."

"Okay."

Just as Benedikt was about to take the rod in hand, there was *aclick-click* from the doorway.

* * *

Gotthilf muttered to himself as they turned away from Master Glöckner's shop. He assumed his expression was sour. It should be, to match his feelings.

Byron looked over at him as they started back up the street. "Hey, so we missed Baxter. They said he was going back to his room."

"But if I hadn't taken that wrong turn, we would have seen him on the street."

"It's okay, partner. If that's the only thing that goes wrong today, we'll be ahead of the game."

Gotthilf was still frowning when they arrived at the inn where Lang said Baxter lived. They found the innkeeper, who told them which room was the up-timer's, then inquired as to whether he was in some kind of trouble. "Because if he is, take him away. I'll miss his silver, but not his custom."

They had just started up the stairs, when they heard *clang* sound. Byron reached for his pistol, so Gotthilf followed his partner's lead. They soft-footed it up the stairs and down the hall to Baxter's room. It was no great surprised to find the door standing open. The sight of the body lying on the floor was a bit of a shock. It wasn't the first dead person Gotthilf had ever seen, though—working with Byron, it wasn't even the third or fourth.

He watched as Byron edged around to where he could see more of the room. Byron waved him over, so Gotthilf stepped over to stand beside his partner. They could see two blond headed men in the room, standing next to the bed, with one of them holding some kind of stick or club. When Byron cocked his pistol, Gotthilf did as well.

"Police!" Byron yelled, and they burst into the room. "City Watch! Up against the wall! Hands on the wall!"

They moved the shocked suspects away from the bed and over to a blank stretch of wall, where they forced them to face the wall and put their hands on it. Paying no attention to the babbling from one of the men, Byron stepped back over to the bed. "Hmm, up-time footlocker, has to be from Grantville. And it's got Harold Baxter's name stenciled on it, so . . ." Gotthilf kept his attention—and pistol—on the two men, but watched out of the corner of his eye as Byron turned to the corpse, ". . . this must be the illustrious Mr. Baxter. Let's see if there's anything to confirm that."

Gotthilf turned a little so he could see Byron roll the corpse to one side and pull something from a pocket on the back of the trousers. "One up-time wallet, complete with expired West Virginia driver's license made out to one Harold N. Baxter. Harold," Byron intoned, "you weren't very pretty at your best, but you're definitely pretty sad now that these two reshaped your head for you."

"We did nothing, I tell you!" one of the suspects shouted. "He was like that when we got here."

"Right." The sarcasm in Byron's voice was so thick it was almost visible to Gotthilf. "You just stopped in to see an old friend, and just happened to be holding what looks like the murder weapon when we came in. Tell that to the magistrate."

* * *

The magistrate! Benedikt's thoughts were whirling. If this had happened to someone else, he'd be laughing right now, but unless something happened soon it looked like he and Ebert were going to hang for a murder they hadn't committed. The irony of the fact that he had been fully prepared to kill Baxter almost sickened him. How could they get out of this? Even in his extremity, he wasn't thinking of letting Ebert take the blame alone. There had to be a way out.

"Baxter's dead," the tall one repeated. Then came the interruption.

"Baxter's dead, just like Vogler," Ebert recited.

Benedikt watched as the two watch men first stared at Ebert, then turned to stare at each other. Seizing the moment, he pushed off from the wall and caromed into the short one, sending him flying into his taller partner. He grabbed his brother's arm. "Run, Ebert!"

* * *

Gotthilf rolled off of Byron and looked up in time to see the last of the suspects going out the door. Byron sprang to his feet and sprinted after them. Gotthilf looked around for his pistol, and saw it on the floor near Byron's .45 automatic. He grabbed both and ran for the stairs.

He saw Byron leap from the top of the stairs, and arrived in time to see him land on the talkative suspect just as he was about to make the turn for the final steps and run for the outer door. They sprawled on the

landing, and the suspect yelled again, "Run, Ebert."

Gotthilf hurried down the steps, but couldn't get past the two men wrestling on the landing. He looked up, expecting to see the one named Ebert running out the door. Instead, there was a loud *crack* as the man wrenched the end banister post loose from the stairs and lifted it, obviously intending to use it as a club.

"Stop!" Gotthilf yelled. "Stop!" He raised his pistol. The large man ignored him, lifting the post.

The sound of his pistol firing surprised Gotthilf, and again it fired. He hadn't been conscious of firing the double-tap that Byron had drilled him in. Two red dots appeared in the chest and abdomen of his target, and began to spread. The post dropped from hands that seemed to lack strength. The big man staggered a step, said, "Ben . . ." and collapsed on the steps leading up to the landing.

"A little help here, partner," Byron yelled. Gotthilf shook off his shock, stepped down another step and leaned forward to point his revolver between the eyes of the other suspect. "Care to make it three bodies?" Byron asked.

With that, the man went limp, head twisted toward the other suspect, tears running down his cheeks.

* * *

After additional police arrived to take charge of the two suspects, living and dead, Byron and Gotthilf returned to Baxter's room. The disarray, the filth, the twisted corpse, all seemed surreal to Gotthilf, especially on the heels of what had already happened. Byron had him stand in the doorway to keep others out while he tried to gather what little evidence there might be besides the copper rod with clotted blood and hair.

"He hasn't been dead long," Byron pronounced. "No signs of rigor mortis yet. The blood on his face is still a bit tacky, even. Hello, what's this?" Gotthilf watched him pick something out of the corpse's right hand. "An old-fashioned straight razor. Not exactly the weapon I'd choose for a fight to the death, old man, but it looks like you got surprised, and you use what you have, I guess. Got any of that waxed paper, Gotthilf?"

He shook himself, and pulled a couple of sheets of the stuff from a pocket and handed them to his partner.

"Thanks." Before wrapping the razor in a piece of the paper, Byron looked at it pretty closely. "Hmm. Well, I don't see any cuts on your face, old man, so the blood I see here must have come from whoever you were fighting with." Byron stopped in mid-wrap. "Gotthilf, did you see any cuts on those two?"

He thought for a moment. "No, no cuts or blood before they went down the stairs."

"Hmm. Okay, that's odd."

Byron started back to the body, then stopped dead in the middle of the floor. He pulled a large pair of tweezers from a pocket, bent down and picked something up with them. "Gotthilf, come see what you make of this."

It was a piece of flesh, flat, not too thick, smooth on two sides with mostly rounded edges except for the raw edge that cut in a diagonal. "I don't know," Gotthilf replied after looking at it closely. "What do you

think it is?"

"I think it's an earlobe," Byron said. "And I think it was cut from the ear of Baxter's attacker with this razor." He muttered something.

"What?"

"It looks like our boy downstairs may have been telling the truth. They may not have killed Baxter. No cuts, no mutilated ears." He wrapped the piece of ear in another sheet of the waxed paper.

Gotthilf felt as if he had been pole-axed. "I shot an innocent man?"

"No." Byron wheeled and stared at Gotthilf intently. "You shot a man in defense of your partner. Make no mistake about it. If he'd hit me with that piece of oak, I'd be a body downstairs on the floor instead of what's his name—Ebert. They may be innocent of Baxter's murder, but they're guilty of something, I'd stake my life on it. In fact, I already have, and I owe you for the fact that I'm still breathing."

Gut churning, Gotthilf relaxed a little. "All right. But if they didn't do it, who did?"

"This was a crime of passion," Byron said. "Look at Baxter." He pointed to the corpse's head. "It's all beaten in. Someone beat him well past the point of his death. That only happens when there's a relationship of some kind. Someone who knew him."

"Okay," Gotthilf focused his thoughts on the issue. "So who knows him? Lang," he answered his own question.

Byron frowned. "I doubt it. First of all, I don't think the man could muster this much passion about anything." Gotthilf nodded. "And second, we've had someone watching him all day, remember?" Gotthilf nodded again with a rueful expression. "How about Leonora or one of the other streetwalkers?"

Gotthilf thought for a moment, then shook his head. "No, she was too afraid. And even if she wasn't, she'd have used a knife—any of them would."

Byron started muttering to himself again. Gotthilf's focus wandered, until it lit on the copper rod, now slightly bent, lying on the floor. The blood and hair proved it was the murder weapon. Copper . . . copper . . . copper . . . He stiffened, then headed for the door. "Come on. We may be too late."

* * *

For once, Byron had to hustle to keep up with his shorter partner, whose legs were churning and driving him down the streets. Gotthilf gasped out enough of an explanation as they ran for Byron to understand his reasoning and where they were going. They slowed to a walk when their destination came into sight. Gotthilf grabbed Byron's sleeve and pointed to blood drops on the threshold and a blood smear on one of the door posts, about the height where someone would rest a hand. Byron clapped his partner's shoulder in congratulations, then pounded on the door.

"Police! City Watch!"

No response.

Another thunder of fist on door. "Police, *Meister* Glöckner. We know you're in there. You really don't

want us shouting our business to the entire neighborhood." And the neighborhood was definitely paying attention.

After a moment, the door opened to reveal the glowering visage of *Meister* Alaricus. "Come in, then, if you must."

"I'm afraid we must." Byron brushed by him, Gotthilf following close behind. Once inside, Byron pointed to Gotthilf.

"*Meister* Alaricus, be so good as to call your apprentices and journeymen into the shop, please."

"Why?"

"Just do it," Byron said in a voice of iron.

The master's glower intensified, if that was possible, but he stepped through a curtain and rattled off a list of names. Within moments, several boys and youths were present. Gotthilf went to each, tilted their heads this way and that. No cuts, no mutilations. He stared at the master's head. No cuts, not mutilations. He started to glance at Byron in bewilderment, but then a thought occurred to him.

"*Meister*, be so good as to call your children in, if you please."

The goldsmith's complexion now verged on dusky purple. "I will not! The impertinence of this! Explain yourselves, sirs. I will complain to the *Burghermeisters* about your conduct, indeed I will. I . . ."

"Papa, enough." From another door way came a figure of a man, head wrapped in bandages, supported by a girl. From their faces, they were the goldsmith's children.

"Dieter, I forbid . . ."

"Papa, enough. I will not lie, nor will I allow you to lie for me."

"Dieter Glöckner, I presume?" Gotthilf asked.

The man sat on a stool, and his "Yes" was shaky.

"I suspect that if I unwrap those bandages, I will find a severely gashed ear with a missing lobe. Am I correct?"

Everyone in the room looked surprised. "Yes," admitted the young man.

"We found your earlobe." Gotthilf pointed to Byron, who fished the waxed paper packet from his pocket and showed it to everyone. "We found it in the same room where Herr Harold Baxter was beaten to death. Before his death, however, he managed to wound and mutilate his attacker with a razor. That attacker was you, wasn't it?"

"Yes."

"Tell us about it."

Dieter took a deep breath. His sister wrapped her arm around his waist to support him. "Baxter raped

Rosina. He threatened to kill her if she told anyone. I found out today, after he came to collect his chest that was stored here. She was so upset on seeing him, that I dragged it out of her."

"So you went to confront him."

"Yes. I wanted him to marry her, or at least provide some kind of compensation. Everyone knows he's been making money selling up-time goods to vendors, and spending next to nothing. He must have a pile of silver."

"Tell me about the rod."

Dieter looked a bit surprised. "Baxteris . . . was . . . a hard man. Everyone knows that. I was afraid that when I spoke to him, he might attack me. So I took a copper rod with me."

"To defend yourself if you needed to."

"Yes."

"Tell me what happened."

"I just wanted to talk to him at first, but with every step I grew more and more angry. By the time I arrived at his room, I wanted to kill him. So . . . I did." With that admission, Dieter sagged on the stool. His sister stood by him, tears streaming down her face, pale and wan, but nodding her head in affirmation.

The audience to the confession all seemed stunned. For a long moment there was silence.

Gotthilf at length cleared his throat. "*Meister* Alaricus, have you sent for a doctor?"

The master shook his head.

"Do so. We will allow his wounds to be tended before we arrest him."

* * *

The rest of the day passed in a blur for the partners: getting the confessed murderer tended to and transferred to custody, writing reports, gathering other information to be ready for the magistrates. By evening, Gotthilf was numb from everything, which was at least partially a good thing.

"Come on, partner," Byron said from the office door. "I'm buying."

"No," Gotthilf sighed. "I'm buying. The first round, anyway."

They made their way to The Green Horse. Gotthilf walked up to the counter and threw a coin on the top. "Ale. Two. Large." They made their way to the same table in the dark corner they had sat at on the night the Vogler case broke. Gotthilf took the seat with his back to the wall, and they applied themselves to the ale.

He broke his silence once, when Byron brought the third refills back to the table. "It shouldn't be that easy to extinguish a man's life. May God never let it be easy forme. "

"Amen to that, partner," Byron replied.

Two days later

"This is where your brother's buried." The short policeman pointed to the patch of raw turned earth.

The Magdeburg *Polizei* had taken turns interrogating Benedikt Schiffer yesterday until they were satisfied they knew everything that could be dragged out of Benedikt about Lubbold Vogler and his schemes. Yesterday had ended with an appearance before the magistrate, one Otto Gericke, who had pronounced judgment after all facts had been made known.

"Herr Schiffer, thinking about committing a crime is no crime before this court. You will have to answer to God for that. And since the *Polizei* will not charge you with resisting authority, and in light of the unfortunate death of your brother, you are free to go after observing the following judgments.

"First, if you had been a better brother to your brother, he might still be alive.

"Second, you are free to go, as long as you leave Magdeburg and never return."

This was Benedikt's last stop before leaving. The two *Polizei* officers who had arrested him had accompanied him to the grave. "Good luck, Herr Schiffer." With that brief farewell, they turned and walked back to the city.

Benedikt's vision clouded as he looked at the grave. If he hadn't panicked, Ebert would still be alive. If he hadn't been obsessed with taking money instead of earning it, his brother would still be alive.

He looked up to the gray heavens. "God, I'm not much of one for prayer, but if it is possible, charge my brother's sins to my account and receive him unto Yourself."

Benedikt knelt and placed a hand on the grave. "Sleep well, Ebert."

He rose and dusted himself off, then clutched his coat closed against the March chill and began walking north.

Letters From France
by Kerry Offord

Jena, Winter 1631-32

Henri Beaubriand-Lévesque watched the strange vehicle drive past. It was one of the up-timer horseless carriages everyone called an "APC." It was simply enormous, and noisy. Henri concentrated on absorbing all the details of the machine so he could draw it later.

The vehicle had all but disappeared from view when he felt a small hand tugging vigorously on his hand. "Papa! Papa! Come, you must look at this."

Henri let himself be dragged along by his excited daughter. "What's so important, Jacquette?"

"There on the wall, the poster."

There was a poster fixed on a display board on the grocery shop's wall. He let Jacquette's hand go and approached it. It advertised seminars on "the Philosophy of the Essence of Lightning" that claimed to demonstrate and explain the up-timer's science of electricity. A person couldn't be in Jena for long without hearing about the people from the future and their advanced understanding of the sciences. Henri's curiosity was excited. Just what was this "Wondrous Lightning Generator"? And what was an "Amazing Lightning Crystal"? He reached out to guide his daughter. "Come, Jacquette, let's see if we can secure places at one of these seminars."

They entered the shop and approached the shopkeeper. "*Mein Herr*, I noticed the poster outside advertising seminars on the up-timer electricity. How does one find this Dr. Gribbleflotz?"

The shopkeeper reached for a folded pamphlet and passed it over to Henri. "This will tell you everything you need to know, sir."

"Thank you." Henri started to read the pamphlet.

"Papa, come, over here."

Jacquette was gesturing for him to come to a pile of packages. "What is it now, Jacquette?"

Jacquette held one of the packages up so her father could read the label.

"Gribbleflotz Sal Aer Fixus?" Henri held the package up and asked the shopkeeper, "Is this the same Gribbleflotz?"

"Yes, sir. His cooking powders are becoming very popular. Pfannenschmidt's bakery, just on the corner, offers a selection of delightful cakes and biscuits made with them. You should try the cakes." The shopkeeper kissed his fingertips. "Delicious."

"Thank you, sir. Maybe I will." Henri folded the pamphlet and placed it in his pouch before taking Jacquette's hand and leaving the store.

Once outside, Jacquette tried to lead her father toward the bakery. "Papa, can we go to the bakery now?"

Henri looked down at his daughter. She had her "butter wouldn't melt in her mouth" look. It reminded him so much of his wife he knelt down and hugged her. "Of course, and we might even sample some of this new cake."

A few days later, after the seminar

Henri placed an arm around his wife. "That was very brave of you to volunteer to let Dr Gribbleflotz charge you up with his Wondrous Lightning Generator, Sarah."

Sarah Beaubriand-Lévesque smiled and leaned into his chest. "I didn't feel brave when Dr Gribbleflotz asked if I would stand on the platform."

"But you did it. What was it like having the electricity pass through you?"

Sarah passed a hand through her still messy hair. "I didn't feel a thing, but didn't I look a fright with all my hair sticking out like that?"

Henri shook his head. "You could never look a fright, love. Isn't that right, Jacqueline?"

"You looked funny, Mommy."

"Thank you very much, young lady." Sarah sniffed in mock offense.

Jacqueline giggled. "But you did look funny, Mommy. Can we have more cake?"

"Of course, we can. Henri, I've been thinking, there could be a good business opportunity introducing the cooking powders back home."

"Sarah, I'm a wool merchant. Why would I want to make cooking powders?"

Sarah smiled and batted her eyelashes at him. "Because I asked you to?"

Henri tried to frown. "That's not fair, Sarah. You know there is nothing I won't do for you." Sighing heavily, Henri gave Dr. Gribbleflotz' laboratory a final look. "I guess it won't hurt to ask what price Dr. Gribbleflotz puts on his formulas."

A couple of days later, outside Dr. Gribbleflotz' laboratory

"Well, that was an expensive meeting. I don't think it was fair of Phillip to leave the bargaining in the hands of his housekeeper."

Sarah made a sound remarkably similar to a snort.

"Well, it wasn't fair. You'd have struck a much better deal if you'd been bargaining with Phillip."

Sarah laughed. "Maybe Ursula and I should have left the two of you to bargain between yourselves, Henri. You certainly became friends very quickly."

"Ah, but that was a meeting of minds. Phillip enjoyed showing me his electricity experiments. He's even promised to help get me a lightning generator of my own so I can hold similar seminars back home." Henri sighed. "I'm sorry that we'll have to spend over a week in Grantville. I hope you'll find something to do while I study the methods at Phillip's Spirits of Hartshorn facility."

"Hopefully they'll have some good shops and maybe something for the children to do. But we head for home immediately afterwards, you hear me, Henri?"

"Of course, dear. The sooner we get home the sooner I can start producing Phillip's cooking powders, and the little blue pills."

Sarah raised her eyebrows. "And, of course, you can try your hand at making lightning crystals."

Henri flushed a little. "Yes, dear. And I can try my hand at making lightning crystals."

Grantville library, a fortnight later

Henri pushed his chair away from the table and stood up to stretch. It was time to finish for the day. He flexed his tired hands and looked down at the meager progress he'd made in copying the article on rubber from the encyclopedia. Sighing heavily, he started to collect his writing instruments and his notes and returned the volume to its place on the shelf. Rubbing his tight neck muscles, he made his way out of the library, waving to the library assistants as he passed them.

It was bitterly cold and there was snow on the footpath. Henri wrapped his coat tighter and, being careful where he put his feet, he made his way to the small hotel where his family was staying. At the rate he was copying articles they'd be in Grantville for at least another week. He shuddered, not from the cold, although freezing droplets had found their way down the back of his neck. No. He shuddered at just how much money Sarah could manage to spend during another week in Grantville. Not that he begrudged Sarah all of her purchases, not when he was wearing the results of one of her early forays. A pair of walking boots, with rubber soles. Custom made by Calagna and Bauer of Grantville, and using salvaged car tire rubber for the soles. Sarah had made friends with a number of the locals and been invited into their houses. There were lots of things she had decided she just had to have in the house back in France. Although what she needed with a sewing machine, Henri had no idea. Her maid Marie did all of the household sewing.

Henri finally stumbled into the family's suite. Sarah rushed into his arms and kissed him. That raised his suspicions immediately. She hadn't welcomed him home like this since they left Jena. Gently he pushed her away so he could look around the room. He was pretty sure he knew why Sarah was suddenly so affectionate, and then he saw it. The children had new toys. Pierre a set of blocks, and Jacqueline. . . she had a couple of dolls. Henri swallowed. He had a horrible feeling about those dolls. "Sarah, are those dolls Jacqueline is playing with 'Barbies'?"

Sarah bowed her head. "Yes."

Henri threw his wife a suspicious look. He knew she knew he had a soft spot for the way she looked at him through her eyelashes. "And Pierre? What did you buy him?"

"Just some building blocks."

Henri glared. He'd just seen the plastic bucket the building bricks had come in. Those were up-time plastic building blocks. Between those and the Barbie dolls, Sarah must have spent a small fortune. Not that he begrudged the children having toys, but did she have to spend that much on them? "Sarah, I'm not made of money. What with buying those licenses from Phillip, and the cost of our stay in Grantville, we could find ourselves short of funds before I finish collecting the information I want from the library."

Sarah looked up, and smiled. It was an impossibly smug smile.

He'd seen that smile before. It usually meant she was extremely proud of herself for some reason. "What have you done now, Sarah?"

"I bought some books, Henri, from a most charming American woman." Sarah giggled. "She asked if I

was English."

Several up-timers had mistaken Sarah for an Englishwoman because of the fluency of her English. They'd had to explain she was from Jersey, one of the English islands not far off the coast of France, and that she grew up speaking both French and English. "And?"

Sarah led Henri into their room. Lined up against a wall were a couple of boxes and two piles of books. Henri's jaw dropped. Even from the door, he was pretty sure what those books were and stepped over to them. "A set of the Encyclopedia Britannica?" He picked one of them up and looked at it. "The fifteenth edition? Just like the one at the library. How did you manage this?"

"Jacquette made a new friend. Roseanne Warren is a girl her own age, with a younger sister and a brother Pierre's age. Their mother invited us around so the children could play together. Of course I made your apologies, telling her that you were busy in the library making notes from the encyclopedia. She asked if you'd be interested in buying a set of your own." Sarah sighed. "It's very sad, Henri. Her husband was left 'up-time,' leaving the family near destitute."

Henri placed the book back on the pile and turned to hold his wife. She was from a seafaring family and knew only too well how the loss of a father could leave a family destitute. "How much did you spend?"

"Twenty thousand dollars."

Henri barely managed not to roar. "Twenty thousand dollars! That's too much."

"That's what Tammy said, but she needed ten thousand just to stop the bank selling her house. So she threw in a couple of boxes of her husband's books and her children added some toys for Jacquette and Pierre." She looked imploringly up at Henri. "Say you're not angry, Henri. Please."

Henri sighed. His wife knew him too well. She knew there was little he wouldn't do for her. He pulled out a handkerchief and blotted her tear-filled eyes. "I'm not angry, Sarah. You've done me proud. With my own copy of the encyclopedia, we can think of heading home. It's a pity it's not an eleventh edition, but I understand there are only two copies of that in the city."

"When Tammy and I were having tea at Cora's I overheard that Schmuker and Schwentzel were selling subscriptions for a new encyclopedia they were planning to publish using a mixture of up-time and local knowledge."

Cora's was a coffee shop where rumors and gossip flourished. It had been a discussion at Cora's that had first sent him to the library in search of information. The topic of Dr. Gribblefoltz and his ten dollar aspirin had come up. The general consensus was that he was taking the people of Grantville for a ride, as aspirin was surely very easy to make. All you had to do was find the recipe in one of the library books. With thoughts of the small fortune he had paid Phillip for those licenses, he'd been very happy to discover there was a lot of difference between what the various books said and the detailed instructions Phillip had sold him. The books had very general terms. Phillip's instructions explained how to manufacture the various products in economic quantities. "Then, if you haven't already purchased a subscription we must do so immediately."

Sarah smiled. "They'll still be there tomorrow."

Henri thought he could drown in Sarah's eyes. Yes, she was right. Tomorrow would be soon enough. Right now, making sure the door was shut was more important.

Fall 1633, Granville, France

Henri finished reading the latest section the printers Schmucker and Schwentzel had sent of their new encyclopedia. He could only marvel. Within another couple of years, he would have his very own set of the most comprehensive encyclopedia ever printed. He settled back in his chair and looked out the window. As far as the eye could see there were green fields dotted with sheep. He let his eyes move closer to home, to rest on a young ram grazing in the next field. He'd been surprised that Madame Richards had been willing to sell a male merino lamb so early in her breeding program. Well, maybe not a purebred merino ram. Madame Richards had been emphatic that although the mother was an up-time merino, she couldn't be sure of the sire. This would be the ram's first full breeding season. Henri had high hopes that the ram would improve the quality of the wool his flock produced.

"Henri! Henri, have I got a cargo for you, my boy."

The booming voice jerked Henri's attention away from the young ram. He turned to see Sarah and her Uncle George standing in the doorway. Henri scrambled to his feet and rushed to greet him. "George, you rogue! How have you been? Sarah was just saying that we haven't seen you since before Phillippe was born."

"I've been busy, Henri. So many ships at sea, so little time. Anyway, I've persuaded my crew that you'll give us a good price for part of the latest cargo we've managed to score. Jean, bring it in."

"I think it's some of that 'rubber' you told me about. It's squishy. You are still interested in rubber, aren't you, Henri? You haven't suddenly discovered there was something new you wanted to investigate?" George actually looked worried at the thought.

Henri shook his head. "No, I'm still interested. Are you sure it's rubber?"

"I came across a Portuguese ship." George had done well in the family business. Piracy, or as Sarah preferred to call it, privateering. "According to the logbook, its last stop was in Belem, at the mouth of the Amazon. Didn't you say that there are rubber trees there? And the manifest lists the stuff as *caoutchouc*. That's just another name for rubber you said."

"Let's have a look at it then."

George moved himself and Sarah out of the way as a stocky seaman walked in with a canvas wrapped bundle in his arms. It appeared to be heavy.

Henri knew better than to expect Jean to leave; he was probably the crew's representative. So Henri ignored him and unwrapped the bundle to reveal a large block of, well, rubber. He gave the amber colored block a brief examination. It certainly looked like what he expected raw rubber to look. He poked at it. It felt sort of spongy. Convinced that the block was in fact rubber, he turned to George. "What's your price?"

"I have two dozen of those blocks. Since you're family, I am willing to sell the lot of them to you at the totally reasonable price of two hundred forty livres."

Two hundred forty livres was probably an order of magnitude more than the crew had expected to get

for the strange cargo. "Ten livres each! It certainly didn't cost you that much."

George shrugged. "How do you put value on a man's life, Henri? We deserve some reward for the risks we take." He turned to Jean. "Right, tell the men to start unloading the rubber. Henri is good for the money."

Jean smirked and left. Henri wasn't surprised by the smirk. He'd more or less just bought the rubber without trying to bargain the price down. But then, this was the first shipment of rubber Henri had heard of, and he could afford it. His bleached woolens were doing very well, and his soda factory was almost a license to mint money. The glassmakers were beating down his door to get his pure soda ash. Then there were the other products. The cooking powders hadn't sold as well as he'd hoped. That was why he'd switched to making soda ash in the first place. However, the demand was slowly increasing, and the aspirin had always sold well.

"Well then, George, if we've finished with business I'm sure Jacquette, Pierre and Phillippe will be happy to see you."

Winter, 1633-34

Henri smeared the soft rubber solution over the sheet of cloth, then picked it up by the top corners and placed it in the special chamber he'd built. He closed the chamber and checked that the fire was going and the steam was flowing into the chamber.

While the sheet of material impregnated with rubber vulcanized, Henri wandered over to his latest line of research. Back in Jena, Phillip had shown him up-timer books where balloons were used to contain gases. Henri thought he might have managed to make such a balloon. He had discovered the method after sticking a finger into rubber reconstituted by using turpentine and ether as solvents. It had formed a thin layer. Henri had tried to be patient about letting it coagulate, but in the end he had torn the thin rubber balloon when he took it off.

Rather than use his hand, the next time he used a piece of iron bar. By repeatedly dipping it into the mixture he'd achieved a coating of rubber that was strong enough to roll off the iron bar after it coagulated. That hadn't vulcanized very well. In his next attempt he left the balloon on the bar while he vulcanized it. That balloon had lasted long enough to be used in the exploding balloon experiment. Now he was trying to determine how much sulfur and other additives had to be used to make a good balloon.

Henri touched a finger to the latest balloon. It was ready to be vulcanized. Just a light dusting with powdered talc, and then it would be ready to put into the vulcanizing chamber. The iron bar really wasn't the best thing to use. It had just been the first thing to hand that he could use instead of his finger. He really should find time to talk to the local glass maker about making a glass form, something that would start the balloon in a spherical shape. Keeping it hollow would let him fill it with hot steam to speed the vulcanizing process. If that worked, he could think about making a bigger balloon. Maybe even something that could lift a man.

* * *

Henri had just removed his latest balloon from the vulcanization chamber when he heard familiar heavy footsteps. Sarah's uncle George had been a regular visitor lately. The man was fascinated by the balloons Henri was making. "Come on in, George."

"How's the research going, Henri?"

Henri pointed to the latest specimen. The iron rod was about the thickness of his thumb and about a hand span long. The rubber covered most of its length. He unrolled it and blew into it. He let it expand to several times its original size before releasing the air. "What do you think?"

George barely attended to Henri's little demonstration. Instead he took possession of the iron bar. Then he did something that surprised Henri. He pulled a purse from his belt and removed something. It wasn't until George presented the iron bar with the lamb intestine preventative unrolled over part of its length that Henri started to understand George's fascination with his new rubber balloons.

George was all smiles. "A nearly perfect fit. How many of these long balloons can you make?"

"How many do you want, George?"

"Thousands. Tens of thousands."

"George, you may be a sailor, but you'll never use that many."

George laughed. "Not for me, Henri. To sell. Many a ship's captain would be happy to have cheap preventatives. Your balloon preventatives will be cheap, won't they? It's not like they have to be custom-fitted, is it?"

"You can't start a business without a supply of raw materials. Where am I supposed to get a supply of rubber?"

"The same place you got that first shipment, of course."

"George, you can't run a business using pirated raw materials."

"Why not? The Dutch have managed quite well using pirated sugar."

Henri shook his head. "That's different, George. There are hundreds of merchants carrying sugar. But how many have you heard of carrying a shipment of rubber?"

"Just the one." George looked horrified. "But that means we'll have to *buy* the rubber." Then he grinned. "Ah well. If we must buy it, I know just the man to ask. A Portuguese merchant based in St. Malo." He looked over at the balloon. "Do you want that?"

Henri studied the balloon. "I was thinking of making several more and sending them to my friend Phillip in Jena. Why?"

"I was thinking maybe I should conduct one of your 'scientific' tests. Just to see if it works, of course." George reached over, picked up the balloon and placed it in his purse. Then he rolled the other preventative off the iron bar and put it in his purse, too.

Henri sighed. "A scientific test needs a sample greater than one."

"That's okay, Henri. If you're going to make more for your friend, you can make enough for me. I'm quite happy to be the test subject." George smirked. "I'll even do a comparison test."

"I'm sure you will, George. I'm sure you will."

George reached for the pen at Henri's desk and quickly wrote out an address. "Put a rush on those, would you? I'm going to have a busy few weeks."

Henri watched George leave his laboratory, chortling with glee. Then he looked over at the iron bar. *Oh well. The sooner I start, the sooner George can . . .*

He reached for the bar, burst out laughing, then stifled it. The last thing he wanted to do was explain all this to Sarah.

Stretching Out, Part Two,
Amazon Adventure
by Iver P. Cooper

Belem do Para, Estado do Maranhão (northern Brazil), Late 1632

Like an arrow falling from heaven, the cormorant plunged into the waters of the Para. For a few seconds it was lost from sight. Then it emerged triumphantly, a fish in its mouth. Two gulls spotted the capture and winged over, no doubt hoping to snatch the meal away. Before they could carry out their designs, the cormorant gave the fish a little toss in the air, and swallowed it. The would-be hijackers swerved, and headed out toward the sea.

Henriques Pereira da Costa, watching this drama from the docks of Belem do Para, hoped that his own dive into the unknown would be as successful as the cormorant's.

He heard a cough, and turned. It was his servant, Mauricio. "We're packed and ready to go." Mauricio hesitated, then added, "May I see the fabulous map again?" Wordlessly, Henriques passed it over.

Mauricio studied it carefully, then handed it back. "It's got to be a fake, boss. I asked around, and no one has explored beyond where this river"—he pointed to the Rio Negro—"comes into the Amazon."

"M-m-my family has assured me that I can stake my v-v-very life upon its accuracy." Henriques had an unfortunate tendency to stammer under stress. It had been mild at first, but had worsened after his parents' deaths.

"Trouble is, you will be staking your life on it . . . while they're home, safe and sound in Lisbon." Henriques was the Da Costa family's factor in the town, which lay near the mouth of the Para, the river forming the southern edge of the Amazon Delta.

"Bu-, um, -bu-. . . ." Henriques' stammer was one of the reasons he was stuck here in Belem, rather than enjoying the high life of a successful plutocrat in the capital. Instead of collecting expensive artwork and mistresses, he was looking for drogas do sertão—products of the hinterland—that might one day have a market in Europe. Most recently, pursuing a strange material which his relatives called "rubber."

"Speak English, or Dutch, boss, no one here will care." Henriques' stutter disappeared when he spoke a foreign language. Even one of the Indian jawbreakers.

Henriques nodded. "But there are those rumors . . ."

"Right. Like the Seven Cities of Cibola . Or El Dorado and the Lake of Manoa . Or the Kingdom of Prester John . Or . . ."

Henriques made a fist, and shook it. "Will you let me finish?" Mauricio subsided. "Rumors of a town called Grantville, which has visited us from the future."

"If true, showing poor judgment on their part."

"Well, even if the story is false, I have my orders. Find the rubber trees, teach the natives how to tap it."

"And your family knows how to tap it, even though they don't know where the trees are?" Mauricio's eyebrows flickered.

"Perhaps they found the trees in the Indies already? Or perhaps it's more knowledge from the future."

* * *

"Coming aboard, Mauricio?"

Mauricio jumped into the canoe. The boat rocked for a moment, then steadied. Mauricio nervously checked to make sure that his neck pouch hadn't slipped off in mid-leap. What it held was more precious than gold: his letter of manumission, signed years ago by Henriques.

Mauricio had been born into slavery. His mother had been one of the housemaids employed by Henriques' parents, in Bahia . In his childhood, he had been one of Henriques' playmates. Henriques' handwriting was a disaster—sometimes, even Henriques couldn't read it—and Mauricio had been trained to be his scribe.

Henriques' father, Sergio, was a physician, the usual choice of occupation for a Da Costa who was temperamentally unsuited for the business world. He had one of the largest libraries in Bahia , and it was Mauricio's second home. Mauricio mastered Latin, and Greek, and even Hebrew. Not that there was much need for any of those languages in the rough-hewn society of Brazil .

Sergio's will had instructed Henriques to make Mauricio *acurtado* , a slave who had the right to earn his freedom by paying a set price. Henriques instead freed Mauricio outright. "I hope you can now be my friend, instead of my slave," he had said. The words were burnt into Mauricio's memory, as deeply as a slaver's brand had bitten into his mother's skin.

* * *

The canoe, perhaps forty feet long, had eight Indian rowers and a "bowman." The middle of the boat was roofed over with palm fronds to provide a somewhat flimsy shelter. Henriques was glad to be on his way. In town, his stuttering was a recurring source of embarrassment. In the wilderness, he could relax.

Henriques knew the Amazon about as well as a white man could. He was *acriollo* , a man born in Brazil but of European descent, and he had been among the first settlers in Belem . Henriques had frequently canoed up or down the main river and its tributaries, and he had lived in some of the native villages for months at a time. Mauricio occasionally joined Henriques, but mostly remained in Belem to look after Henriques' interests there.

It started to drizzle. Mauricio held out his hand. "I thought you said it was the dry season." It was an old

joke between them.

Henriques delivered the customary punchline. "The difference is, in the dry season it rains every day, and in the wet season, all day."

Whether in appreciation or mockery of the witticism, the drizzle became a shower. Henriques dived for the shelter, Mauricio following.

* * *

"I don't understand," Henriques muttered.

"Huh?" Mauricio had been watching a giant river otter playing in the water. He looked up. "Don't understand what?"

"Why none of the Indians we have questioned have heard of the rubber tree. I would have sworn that they knew every tree within ten miles of their villages." Henriques and Mauricio had visited the tribes of the lower Xingu River: the Tacunyape, the Shipaya, the Juruna. The explorers had been shown some trees which produced sap of one kind or another, but none of them matched the description of the rubber trees.

"So it doesn't grow on the Xingu. Perhaps we'll have better luck on the Tapajos."

"We're in the shaded area of the map, where the tree is supposed to be found."

"Perhaps we don't know what to ask for."

"We asked them to show us a tree which weeps when it is cut. Because, uh . . ."

"I know. Because the first letter from Lisbon said that rubber is also known as *ascaoutchouc*. From the Quechua words *scaa* 'wood,' and *ochue* 'tears,' that is. . . ."

Henriques finished the thought. "The 'weeping tree.'"

A lot of good a Quechua name does you," Mauricio said. "It's the language of the Incas, who are, what, two thousand miles west of here?"

"Even if it's a rare tree, you would think that some Indian would try cutting it down," Henriques said. "See if it was good for building a dugout canoe, or at least for firewood. And then see it bleed."

Mauricio brushed an inquisitive fly off the document. "Sure, but that might have happened a century ago. And they don't remember it, because they don't use it, what's that word . . . latex . . . for anything. The latex is old news."

His expression brightened. "Of course, they might still know of the tree. Maybe they use its leaves to thatch their huts. Or—"

"Um . . ."

"Or, they eat its seeds. Or—"

"Uh-uuummm . . ."

"I know, it's sacred to their Jaguar God, so it's forbidden to speak to strangers about it."

"Mauricio!"

"Yes?"

"Shut up."

Henriques brooded. Clearly, he thought, merely asking for a "weeping tree" wasn't good enough. But Henriques' superiors, or the mysterious up-timers, had provided more than just the map. He also had received drawings of the rubber tree, and its leaves and seeds. And even a sample of rubber. So he had thought he had *some* chance of success.

"Shit!"

Mauricio gave him a wary look. "What's wrong. "

"I have been going about this all wrong. The drawings are meaningless to the Indians we've been talking to, their artwork is too different.

"What we need to do is make a model of the leaves and seeds. Out of clay, or mud, or something. Life size, if possible."

Mauricio waited for Henriques to continue.

Henriques crossed his arms.

"Oh," said Mauricio. "'We' means 'me.'"

* * *

It had taken months, but they found the trees, trained and recruited rubber tappers, and went to work. The rubber tapping operation was nothing like a sugar plantation. The rubber trees were widely separated, perhaps one or two in an acre, and paths, often circuitous, had to be hacked out to connect them. Each tapper—*seringuero*—developed several routes, and walked one route each day. A route might connect fifty to a hundred trees.

Henriques and Mauricio made periodic trips to collect the rubber, and bring the *seringueros* their pay, usually in the form of trade goods. And they also took advantage of the opportunity to spot-check that they were following instructions.

"Are we there yet?" Mauricio asked.

"Almost. Yes. Pull in over there." It was a short walk to the trail.

Mauricio stood quietly, studying the man-high herringbone pattern carved on the nearest rubber tree.

Henriques joined him. "Something wrong?"

"I was just thinking, it's like the Amazon writ small."

"What do you mean?"

"Look. You have the diagonal cuts. Those are like the tributaries. And they feed into the vertical channel, the main river. First on one side, then on the other."

Henriques considered Mauricio's metaphor. "And the cup at the bottom, where the latex collects, that's the ocean." He walked over to the trunk, and felt the cuts. "We have a good tapper, here. He's getting flow, but the cuts are still pretty shallow. We won't know for sure until next year, but I don't think he's harmed the tree significantly."

"We really need something better than knives and hatchets for making the cuts the right depth."

"I agree. In fact I said so in the letter that went home with the last shipment. But I have no idea what sort of tool would do the job."

"Are we done here?"

"Well . . . I want to talk to this *seringuero*. Perhaps give him a little bonus. Word will get around, and the other tappers will try to emulate him."

They waited for the tapper assigned to this route to appear. Even though they knew the direction from which he would be coming, and were watching and listening for him, they had little warning. One moment, there was nothing but the green of the forest, and the next, he was standing ten feet away, appraising them.

They greeted him, and he relaxed. They offered the Indian some water, and he took a quick swig and set to work. He deftly cut a new set of diagonal grooves, slightly below the ones cut the time before, and rubbed his finger over them.

Henriques complimented him on his work, and handed him a string of glass beads. The *seringuero* held them up in the sunlight, laughed, and fastened them around his upper arm. He gave the two Belemistas a wave and headed on to the next tree on his route.

The visitors returned to their canoe and paddled on. That evening, they were able to witness the climax of the *seringueros'* daily routine.

"Here, look," one said, handing them a large gourd. He had made a second round of his trees in the afternoon, collecting the latex from the cups. Henriques dipped his finger in the milk to test its consistency, and passed it on to Mauricio. Mauricio rolled his eyes, but dutifully accepted the vessel. He made a pretense of drinking from it, which greatly amused the Indian.

It was time for the next step. The Indian dipped a wooden paddle inside, coating it with the "milk." He then held it in the smoke of a fire.

"This is exciting," Mauricio said. "Like watching paint dry."

The first coat of latex slowly hardened into rubber, and the tapper put the rubber-coated paddle back in the gourd. He repeated the process, building up the mass, until it had reached the desired thickness for a rubber "biscuit."

He then pried it off the paddle, and handed it to Henriques. Henriques nodded to Mauricio, who handed the Indian some brightly dyed cloth.

"Time to call it a night," Henriques said. Mauricio agreed.

Henriques pointed. "There's a good place for you to hang up your bed." Mauricio walked over, hammock in hand, to the trees which Henriques had marked out. He tied it to one trunk, and was ready to fasten it to the other, when he suddenly stopped short. A moment later, he was hurriedly untying the hammock.

Henriques was laughing.

"Very funny," Mauricio commented. "I haven't been in the rain forest as often as you, but I don't fall for the same trick twice." One of the trees in question was notorious because it often served as a nest for a breed of ants of malignant disposition. It was commonly used in practical jokes on greenhorns.

Mauricio sniffed haughtily. "As punishment for your crime, I am going to read you the poem I wrote last night."

* * *

The men were getting bored. And irritable. There had been two knife fights a day for the past week. Benito Maciel Parente knew something had to be done.

"Time for *acoreira*," he announced. His people were delighted. They so enjoyed hunting. As they readied their canoes, one man accidentally knocked down another. What a few hours earlier would have led to another duel, was laughed off. Clearly, Benito had made the right decision.

It took a bit of time to find a suitable village. At last they found one which, according to his scouts, was in the throes of a festival. The kind that involved imbibing large quantities of fermented drink laced with hallucinogens.

Benito watched as one villager after another collapsed to the ground. At last he waved his men forward. Their first target was the place where the Indians had stacked their bows. They cut the bow strings and threw the weapons into the fire. Then they started shooting. The snores were replaced by screams.

Benito nodded approvingly. "Kill the fathers first, enjoy the virgins afterward," he reminded his band. They didn't need the reminder; and half their work was done already. They laughed as they chased down the women.

* * *

The Da Costa family had helped finance some of the sugar mills in Bahia, and it made arrangements for the sugar boats, en route to Lisbon, to stop in Belem and see if Henriques had any rubber for pickup. Those ships came up the coast monthly . . . assuming they weren't picked off by Dutch privateers near Recife. And the captains didn't mind the stopover too much; it wasn't out of their way and they could take on food and water.

The visits had increased Henriques' popularity in Belem. The town mostly exported tobacco, cotton, and dye wood, but not enough to warrant regular contact. There was some sugarcane grown in the area, but

it was used locally to make liquor. So Belem was a backwater compared to Recife. Before rubber tapping began, a whole year could go by without a vessel coming into port.

Henriques was under orders to expand production, but to do that he needed to find more rubber trees, and more Indians to milk them. He hoped that the town leaders, who were mostly plantation owners, would help him now. They had looked down on him for years as *amateiro*, a woodsman, and a small-time merchant. The stuttering hadn't helped, either.

* * *

"Henriques, I am astonished," said Francisco de Sousa. He was the President of the Municipal Chamber of Belem. "I never would have expected a bachelor, in Belem no less, to have such an elegant dinner presentation."

"Th-th-thank you, *Cavaleiro* Francisco. It is in large part my late m-m-mother's legacy."

"I particularly like your centerpiece," his wife added.

"It is a family . . . heirloom." The piece in question was a massive flowerpot.

Henriques had hired extra servants for the occasion. They brought in one serving after another. First came *mingau* porridge, followed by *afarinha* -sprinkled *pirarucu*, caught earlier that day. There were Brazil nuts, palm hearts, and mangoes, too. The meal ended with a sweet tapioca *tortilha*.

"So what are you doing with those Indians?"

Henriques had known this question would come, and had rehearsed his answer with Mauricio, to make sure he could deliver it smoothly.

"There is a tree which produces a milky sap. They tap the tree, a bit as you would a pine tree to collect turpentine. The sap hardens into a substance which is waterproof, and can stretch . . . bounce." *Grrr*, Henriques thought. *I almost made it through my spiel I hate B's.*

"Bounce?"

"Wait." He left, and returned with a rubber ball. He dropped it, and it returned to his waiting hand, much to their amazement.

"So, there's a market for this?"

"Somewhat. The rubber can be used to make hats and b-b-boots to protect you from the rain. And I understand that it can be applied in some way to ordinary cloth so that the fabric stays dry, but I don't know how that's done.

"I could produce and sell more, if only I had enough tappers."

"Perhaps I can help you there. I can demand labor from the Indians at the *aldeia* of Cameta. We just need to agree on a price."

* * *

"What are you doing here, B-B-Benito?" Henriques had seen Benito Maciel Parente junior, followed by several of his buddies, saunter into the village clearing. Henriques kept his hand near the hilt of his *facão* .

"Just paying a friendly visit to these Indian friends of yours, H-H-Henriques," Benito sniggered. He had scarred himself like a native warrior, but he was no friend to the Indians. Like his father and his brother, he was a slaver.

"You've been making life difficult for folks, Henriques. I hear you're paying your tappers *tenvaras* of cloth a month. It's making it tough to get Indians to do real work."

"*Tenvaras* isn't much, Benito." A vara was about thirty-three inches. The largesse had not entirely been of Henriques' choosing, although he was known to be sympathetic to the Indians; he had specific instructions about wages from Lisbon .

"It is when the Indians are accustomed to working for four.Or three.Or two."

"Or none, in your case."

"Yes, well, it's my natural charisma. Anyway, dear Henriques, you want to watch you don't end up like Friar Cristovão." Cristovão had preached a sermon against settlers who abused the Indians, and he had been shot afterward.

"I assure you, that I am extremely careful." Henriques' own men had in the meantime flanked Benito's party. Benito affected not to notice, but several of his men were shifting their eyes back and forth, trying to keep track of Henriques' allies.

"So I thought I'd have a palaver with the big chief here. Mebbe he's got some enemies he'd like to ransom." If a Portuguese bought a prisoner condemned to ritual execution, he was entitled to the former captive's life; that is, he had acquired a slave.An "Indian of the cord."

"You know the Tapajos don't ransom. How many times have you tried this?"

"Aw, can't hurt to ask. And look at this bee-yoo-tiful cross I brought the chief, as a present. Hey chief, you want this? It would look real sweet right in the center of your village."

The chief gave Henriques a questioning look. Henriques shook his head, fractionally.

"Sorry, no," said the chief. "It is too beautiful for our poorvillage, it would make everything else look drab."

Henriques thought, *Good for you* . The cross was a scam. If the cross fell, or was allowed to fall into disrepair, then it was evidence that the tribe opposed the Catholic Church, and war upon it would be just. Leading, of course, to the enslavement of the survivors. The Tapajos were a strong tribe, and the slavers so far had been leery of attacking them, but that could change.

"Well, I can see I'm not welcome here today," said Benito. "I'll go make my own camp. But remember, Henriques, there's always tomorrow."

* * *

"*Whump!*" Henriques ducked, just in time, and took cover. He looked around, trying to spot the

shooter. As he did so, one part of his mind wondered what had been shot at him. The sound hadn't been quite that of a bullet, or an arrow, or even a slingshot. More like a grenade exploding, although that made no sense at all.

It happened again. "*Whump!*" Suddenly, he realized that the Indian tappers were completely ignoring the sound. With the exception of one, who was laughing his head off.

Henriques rose cautiously. "What's making that sound?" Laughing Boy pointed upward at the fruits hanging from the rubber tree, and then down at the ground. It was thus that Henriques discovered just how the rubber tree spreads its seeds.

His superiors in Lisbon would be very pleased. Henriques had received precise instructions to collect seeds, if he found them, to pack them in a very particular way, and to ship them by the fastest possible means. And they had sent him the packing materials, and a special elixir to put on the seeds to protect them.

Henriques set the Indians to work collecting the seeds. He didn't dare wait for the monthly Pernambuco sugar boat run up the coast; he would have to hire a fishing boat to take his perishable cargo to Lisbon immediately.

Belem do Para, Early 1634 (Rainy Season)

Henriques fumbled with the door, and stepped into his home. He stumbled. Looking down, he saw that he had tripped over a cracked vase.

It was no ordinary vase. It was Henriques' magnificent flower pot. When it wasn't gracing his dining room, it reposed in a case in his foyer. His housekeeper, apparently, had taken it out to clean it, dropped it, and then fled the house.

Henriques blanched. His reaction had nothing to do with the cost of the piece, or even its sentimental value.

Did she see the secret compartment? he wondered.

He was hopeful that she hadn't. He studied it carefully. What he found wasn't good. The vase wasn't merely cracked; a piece had broken off and been reset. Lifting it off again, he could see into the compartment. Unless the woman were completely devoid of curiosity, she would have looked inside. And what she would have seen would have been far too revealing. *Ab'samin* spice box. A small goblet. And, most damning of all, a miniature *hanukkiya*. The housekeeper was *acaboclo*, a half-Indian, and had certainly received enough religious instruction at *analdeia* to know what that signified.

It was the *hanukkiya*, a silver candelabra, which was missing. And that led to some fevered speculations. Had she taken it as evidence, to show to the authorities? If so, his hours were numbered.

Henriques thrust his *facão* into his belt sheath, and barred the door. He loaded a musket, and set it close by.

The soldiers would be sent to arrest him. There was no inquisitor in Belem, but an inspector would be sent from Lisbon. Henriques would be questioned, tortured. He would be called upon to repent his

heresy, and he would refuse. Eventually they would classify him as a recalcitrant, and the Inquisition would recommend his execution. He would don the black *sanbenito*, tastefully decorated with pictures of flames and devils, and be paraded to the place of execution. He would be tied to the stake and—

Wait a moment. Perhaps she was she planning to melt it down, knowing that he wouldn't dare report a theft?

Of course, even if cupidity had triumphed over piety, he was in trouble. Unless she could convert it to an innocuous ingot herself, she would have to recruit an assistant, who might alert the Church. And even if she didn't arouse any suspicion, life wouldn't be the same. She might blackmail him, or denounce him if he did something to displease her.

As a secret Jew, Henriques had known that his life might come to this turning point. It was time to get moving.

There was a knock at the door. Henriques put the musket on full cock. "Who's there?"

"Mauricio."

"Are you alone?"

"Yes." His voice sounded puzzled, not nervous or fearful.

"Bide a moment." Henriques uncocked the weapon, and set it down again. He unbarred the door, took a quick look at the street past Mauricio, and pulled his servant into the room.

"What—"

"Bar the door, again," Henriques said. "I am glad you returned in time." Mauricio had been off on an errand to Cameta.

Mauricio fiddled with the door. "I hope you have a good explanation."

Henriques started throwing provisions into a sack. Cassava bread. Beef jerky. Acai fruit. "I have to flee for my life. Actually, we both do."

"What's wrong?" Mauricio asked. Henriques told him.

Mauricio raised his eyebrows. "I certainly don't want to see you get burned as a heretic. But why exactly do I have to flee? Can't you just, oh, tie me up so I can swear that I wasn't complicit in your crimes?"

"Sure. But they would probably put you to the torture anyway, you being my long-faithful servant and all.

"Even if they didn't, the Church will seize my assets. And where would that put you?"

Mauricio blanched. Under Portuguese law, an ex-slave could be re-enslaved by the creditors if his former master went into debt.

"Is there a ship about to leave for Lisbon?" Mauricio asked. "We could board it, and outrun the bad news. Once in the city, we could lose ourselves in the crowd, perhaps sail someplace outside the reach of the Inquisition. France, perhaps."

Henriques shook his head. "A sugar boat came through two weeks ago." They didn't have a regular schedule, but they came up the coast once a month, on average. There was no reason for another to appear within the next week.

Henriques pried up a floor board, probed underneath with a stick. In Amazonia, you didn't search a dark opening with your hand. Not unless you were fond of snakes. He pulled out a pouch, which held money and jewels. He might need to bribe someone to make good his escape.

"Could we reach Pernambuco? Or Palmares?" There was a Dutch enclave in Pernambuco. And, further south, in Palmares, there was *amocambo* of runaway slaves.

"We'd never make it by sea, both the wind and the current would be against us." That was, in fact, why Maranhão had been made a separate state, reporting directly to Lisbon, in 1621; it was too difficult to communicate with Salvador do Bahia in the south. Coasters did go as far south as São Luis, the capital of Maranhão, but taking one would just delay the inevitable. The authorities in Belem would send word to São Luis, and the latter was too small a place to hide for long.

"And the overland route is completely unexplored. Nor would the map from the future aid us there."

Mauricio had started collecting his own possessions. Mostly books. "Then why not sail north? There are English, and Dutch and French, in Guyana and the Caribbean. We might even get picked up enroute by a Dutch cruiser."

Henriques was sure he was forgetting something important. Ah, yes, a hammock. You didn't want to sleep on the ground in the rain forest. Not if you didn't like things crawling over your skin. Or burrowing into it. Hammocks were a native invention, which the Portuguese had adopted. And that reminded Henriques of a few other native items he needed. He gathered those up, too.

"Henriques, are you going to answer me?"

"Going north is what the garrison would expect us to do. And before you ask, they would be equally on guard against the possibility that friends would hide us, and smuggle us onto the next sugar boat to Lisbon."

"So, what are we going to do? Did the people from the future teach your family how we might turn ourselves invisible?"

"In a way. We will flee into the Amazon, lose ourselves among the trees of the vast rain forest. Go native. At least for a time."

Mauricio wailed. "But I'll run out of reading matter!"

* * *

Captain Diogo Soares shook his head. His good friend, Henriques Pereira da Costa, a Judaizer! He could scarcely credit it. Perhaps it was a mistake, a dreadful mistake. Although Henriques' flight was certainly evidence of guilt.

Diogo leaned back in his chair. Even an innocent man, if he thought he was to be the target of an accusation of heresy, might flee. Especially one with enemies, who might try to influence the inquisitors.

Everyone knew that Henriques had enemies. The younger Benito Maciel Parente, for example.

The captain's superiors thought that Henriques had boarded a southbound coaster. A fishing boat had been commandeered, and was heading down to São Luis already, to stop what boats it found, and also warn the authorities. The governor of Maranhão could also send *aguarda costa* back up the coast, and make sure that Henriques hadn't tried sailing north, to Guyana.

Nonetheless, Diogo's sense of duty demanded that he consider other possibilities. Such as Henriques taking refuge with one of the Indian tribes. One of the Tapajos tribes, perhaps. It was fortunate for Henriques that Benito was off on a slaving expedition, as Benito would be delighted to bring Henriques out of the rain forest, dead or alive. Probably the former.

But Diogo was obligated to cover that avenue of escape. Exercising appropriate discretion as to who he sent, of course. "Sergeant, call in all the soldiers who are on punishment detail."

In due course, the sergeant returned, followed by six soldiers whose principal point of similarity was a hangdog expression.

"Ah, yes, I recognize all of you. And remember your records. Which of you *degradados* is senior?"

One of them slowly raised his hand. The others edged away from him.

"You are Bernaldo, right? I remember you, now." Bernaldo winced. "You will be in command of this little patrol. You are hereby promoted to corporal in token of your good fortune. You are to go out into the Amazon and arrest Henriques Pereira da Costa, who has been accused of heresy."

"But how will we find him, sir?"

"Did your mother drop you on your head when you were an infant? You are looking for a lone white man in a canoe. Or perhaps in one of the Indian villages. Or wandering a trail. It shouldn't take long to locate him. Sail to Forte do Gurupa first, put them on alert." The fort, which guarded the south channel of the Amazon Delta, had been captured from the Dutch in 1623.

"How long should we look for him?"

"If you come back in less than six months, you better have him with you. Or you will be on your way to where Brazil and Maranhão send *their* undesirables. Angola."

They slowly filed out. "Good," said Diogo to the sergeant. "That solves more problems than one."

* * *

"I still think we should make a sail," Mauricio said. "It's not easy for the two of us to row upstream. With a sail, we can take advantage of the trade wind." He let go of the paddle for a moment, opened and closed his hands a few times to limber them up, and took hold of the wood once again.

"And you brought the cloth after all. You can cut some branches and vines for the mast and stays."

Henriques shook his head. "A sail will be visible from a great distance. And the natives don't use sails."

"Not before Europeans came. But a few do."

"Not enough, just those who are in service. It would still draw attention. Even if the searchers didn't think it was our sail, they would approach the canoe, to ask if we had been seen, or perhaps to recruit more rowers. If they got close enough—" Henriques drew his finger across his neck.

"Then why don't we just head upriver with the tide, and lie doggo in a cove the rest of the time. We need to conserve our strength."

"It will be easier soon. We'll leave this channel, then cut across the *varzea*, the flooded forest."

Henriques wiped his forehead. "We're lucky that we had to make our escape during the rainy season. If this had happened a few months later, we would have been limited to the regular channels, they could catch us more easily.

"And there's less of a current in the *varzea*, too."

"Also, less in the way of anything to eat. The land animals have fled to high ground, and the fish are hiding in the deep water."

"We have enough food to get us to a friendly village."

"And another thing. It's easier to get lost in the *varzea*."

"I never get lost."

* * *

"Okay, we're lost."

* * *

The good news was that Henriques and Mauricio had made it back to the main channel of the Amazon. Hard to get lost; you always knew which direction was upstream.

The bad news was that they had emerged, closer than Henriques had planned, to the fort at Gurupa. They had to worry about being spotted, not just by Portuguese troops, but also by the Indians who traded with the fort. They might pass the word on. And they would be a lot harder to avoid.

* * *

"You, there!" shouted Corporal Bernaldo. He was addressing a lanky Indian, sitting in a small canoe, and holding a fishing rod. His companion seemed to be asleep. "Speak-ee Portuguese? Have you seen a white man? About so tall?" He stood up, and gestured, almost losing his balance. The Indian shook his head.

"Ask him if he has any fish to sell?" one of his fellow soldiers prompted.

"You have fish?"

The Indian pulled up the line, showing an empty fishhook.

"Ah, let's stop wasting time, we've got plenty of rowing to do." They continued upstream, and rowed out of sight.

The apparent sleeper opened his eyes. "I thought they'd never leave," Mauricio said.

Henriques smiled. "Well, you were a cool one."

"Cool? I'd have shit in my pants . . . if you had let me wear my pants, that is."

Henriques and Mauricio had hidden their European clothes, and Henriques had painted himself with black genipapo. The vegetable dye not only made him look like a native, at least from a distance, but also protected him from insects. Both wore loincloths, which observers would assume was a concession to European morality, but which would in fact conceal that they didn't follow the native custom of having their pubic hair plucked.

Now that the pursuit was in front of them, they could take it easy for a while. But *not too* easy. There were other soldiers, after all.

* * *

Corporal Bernaldo and his men, with six impressed Indian rowers, strained at the oars of their longboat, fighting against the current. They had set aside their helmets and cuirasses, so their heads were bare, and their torsos protected only by leather vests. These exposed the sleeves of their shirts, cotton dyed with *redurucum*.

As the western sky darkened, they beached their craft and wandered inland, looking for a suitable campsite. They couldn't see more than fifteen feet or so in front of them, so it wasn't an easy task.

They gradually became aware of a rumbling sound.

"Sounds like rapids," Joam suggested.

"Perhaps it's an elephant," said Antonio.

"There are no elephants in the Amazon."

"That's what you think."

The Indians became agitated. Bernaldo tried to figure out what they were talking about, but their excitement made them more difficult to understand, and Bernaldo was the sort of person who felt that if you couldn't understand his question, the solution was to repeat it, louder.

After a few verbal exchanges which satisfied no one, the Indians fled.

"What's was that all about?" Joam asked.

"What do you expect?" Bernaldo shrugged. "They're cowardly savages."

Antonio wondered whether the natives knew something that they didn't. He also knew better than to say anything.

They could now hear a clicking sound.

"Giant crickets?"

"What's that stench? Some kind of skunk?"

Several dozen white-lipped peccaries burst out of the undergrowth. They were pig-like animals, each about two feet high and about fifty pounds. They weren't happy to discover the Portuguese party. Had they not been clicking their tusks to warn other creatures to get out of their way? The herd included several youngsters, which made the adults especially temperamental.

Peccaries are also known as javelinas, because of their formidable weaponry. They charged. Manuel stumbled, and was gored to death. Antonio and Joam tried scooting up the same tree. Antonio, already on edge, had made his move earlier, and made it up without difficulty, but Joam lost his hold, and slid down. An angry male swung its tusks, slicing open his leg. Joam screamed, but was able to get hold of Antonio's outstretched hand, and was pulled out of the immediate danger. The other three soldiers were on the periphery of the peccaries' axis of march, and they simply ran out of the way.

It was hours before they were reunited. The survivors congratulated each other on their narrow escape.

"Where are the Indians?" asked Bernaldo.

Antonio was studying the river bank. "More importantly, where's the boat?"

"*Dios mio!*" Plainly, the Indians had decided to row off without them. The five survivors were stranded in the rain forest.

* * *

Despite his perilous situation, Henriques was happy. According to his reckoning, today was a Friday, and at sunset he intended to celebrate the Sabbath as best he could. He had improvised Sabbath candles from the stems of a resinous plant, and he had allowed a fruit juice to ferment to make wine. He would have to use the concavity of a stone as *akiddush* cup.

He had no bread, let alone challah, unfortunately. But he had *atortilha* made from manioc flour, and that would have to do. The Lord would understand when Henriques uttered the prayer, "Blessed are you, Lord our God, King of the universe, who brings forth bread from the earth".

"So, do I pray, too?" Mauricio asked.

"Sure."

"I don't know. Is it a good idea for me to call God's attention to us? You're a heretic, after all."

"Mauricio. . . ."

"He might send an angel to tell those idiot soldiers where to find us."

"Mauricio. . . ."

"Or perhaps he'll just hurl down a lightning bolt." Mauricio darted a quick look at the threatening sky.

"Or—"

Mauricio's mouth was open, and Henriques deftly thrust *atortilha* where it would do the most good.

* * *

"Just a little further," Henriques said.

"Are you sure you know where we're going?"

"Of course I'm sure."

"That's what you said about the 'short cut' through the *varzea* ."

"This is different." Near the mouth of the Maicuru, they had made a detour north, to find a small hill overlooking the Amazon. There, in a patch of upland forest, Henriques had prudently secreted a cache of trade goods and other useful items. Just in case he ever had to make a run for it.

"I wonder if this hill of yours should be considered an outlier of the Serra de Tumucumaque. According to that fabulous map of yours, the source of the Maicuru is there, about one hundred miles to our north.

"You know, perhaps we should backtrack to the Paru. We could cross the mountains over to the Litani, and the Maroni, and end up in what the map called French Guiana . Not that the French are there yet."

Henriques grunted. "Keep walking, I want to reach the cache by nightfall." The sun was just setting. And night came quickly in the tropics.

"Or perhaps," Mauricio continued, we should head up the Trombetas and the Mapuera, cross the Serra do Acarai to the Essequibo , to Dutch territory."

"Serra up, serra down," Henriques muttered. He stopped for a moment to adjust his *warishi* , his backpack. Mauricio walked past him; they were on a well-defined game trail.

"According to the maps," Mauricio said, "they can't be much more than three thousand feet high. That can't be hard, can it? Hannibal took elephants across the Alps , after all.

"Not that I've ever climbed a mountain, mind you. Unless this hill counts. Have you, Henriques? Climbed a mountain, I mean?" Henriques didn't respond.

"Henriques?" Did you hear—"

"Freeze!" Henriques shouted.

Mauricio froze.

"Don't move your arms, or your head. Not even a muscle. You can move your eyes . . . slowly. Look a little above, and slightly to your left."

Mauricio scanned the foreground. Then he saw it, *ajararaca verde* , a leaf-green colored viper, perhaps two feet long, hanging from a branch nearby. Close enough to grab. Not that grabbing a

fer-de-lance of any kind was one of the options Mauricio was considering.

"Very slowly, put your left toe back . . . not so far . . . now slowly, bring your heel down, without bobbing your head. Good, now, same with the right. Keep your eyes on the snake at all times."

The fer-de-lance, untimely awakened by Mauricio, was eyeing him suspiciously.

"Can't you kill the snake?" The words were mumbled; Mauricio was trying not to move his jaw as he spoke.

"With a machete? While it's hanging on a tree? Not a chance. Need to club it on the neck, while it's on the ground. With a long club, mind you.

"Keep up your little dance backward, please."

Gradually, Mauricio inched away from the serpent.

"Okay, you can relax."

Mauricio fainted. Henriques poured a bit of water on his lips and forehead. After a few minutes, Mauricio revived. "How did I miss it?"

"In the rain forest, you can see perhaps fifteen feet ahead. But you can cover that distance in ten seconds, even at a walk. You can't afford to relax your vigilance, even for a moment."

Mauricio, his spirits somewhat restored, harrumphed. "You're just looking for an excuse to keep me from talking."

* * *

Benito Maciel Parente grinned. "So dear Henriques is a pig-loving Jew. Well, it is my duty, my *sacred* duty as a son of the church, to bring him home and teach him the error of his ways. Or perhaps the other way around, yes?"

His fellow thugs laughed. Benito had just returned to Belem from a slaving run down the Tocantins, and in town there was much gossip about Henriques' disappearance, and the stymied search for him.

"We'll take three boats, I think. Might as well do a little enlistment of native labor, while we're up the Amazon. Be ready to leave at the crack of dawn, tomorrow."

* * *

"Sing, Mauricio."

"I thought you didn't like my singing."

"I don't. But you have a loud voice, and that's what we need right now."

"How come?"

"We've never been in this part of the *sertão*. This is a well-marked trail, almost certainly leading to a

village. We want them to know we're coming."

"But wouldn't the Indians sense us? Being wise in the ways of the bush, and all."

"Let me rephrase that. We want them to know that we know that they know we're coming."

"I am not sure that was an improvement. You are as clear as a philosopher."

"If they think we're trying to sneak up on them, they'll think we are up to no good. And either flee, or prepare an ambush for us. Whereas, if we approach them openly, they'll assume we've come to trade."

A couple of dogs came down the trail and barked at Henriques and Mauricio. They stopped, and left the dogs sniff them. Then they continued walking, and the dogs, still barking occasionally, followed.

The village was just a circle of conical huts. Various animals milled about the central clearing, but no people were there. Occasionally, a head would look out of a hut, then pull back in.

"Hey, that was a pretty girl, over there," Mauricio exclaimed. "Hope she comes out again."

And, a moment later, "Ugh, look at that crone. Hope she's not the mom, wouldn't want her for a mother-in-law."

Henriques didn't respond; he was studying the village. "Mauricio, we need to leave. Now."

"What about trading for food? What about getting better acquainted with the young ladies?"

"Didn't you notice? There are only women in this village."

"Hey, you're right. Wow, *we* found the village of the Amazon women warriors. The ones Father Carbajal wrote about. And Sir Walter Raleigh. There are only two of us, so we will certainly enjoy favors of their queens. For a whole month. And—"

Henriques grabbed Mauricio by both shoulders and forcibly rotated him about-face. "What it means, dear Mauricio, is that their men are off on the warpath, and we really, really don't want to be here when they come back."

* * *

Henriques and Mauricio made it safely back to their canoe, and pressed on. They felt safe enough, at this point, to erect a makeshift sail, so they could travel more quickly. It didn't seem likely that they were still being pursued.

A few days later, they saw a large canoe overtaking them from the south. They hastily took down their mast, but it was a false alarm. The canoe was crewed by Manao Indians. The Manao were great traders, and one of the dominant tribes of the region where the Rio Negro fed into the Amazon. They traded with the Omagua in the west, and, occasionally, the Munuruku on the Tapajos in the east. Rumor had it that they also ranged to the north, up the tributary which Henriques' map called the Rio Branco, but no Portuguese had gone that way before.

Henriques raised his hands, palms open, signaling peaceful intent. The Manao greeted him, and, politely, asked his business in their region. He said that he was looking to trade and, perhaps find a path to the

Great Water in the north. He gave them a few beads, and they offered him some*cachiri* .

They invited Henriques and Mauricio to follow them to their village; they were returning from a trading run up the Madeira , one of the tributaries on the right bank of the Amazon. That night, they camped together, on an island, and Henriques questioned them about what tribes lived there, and what goods they had to offer.

Mauricio eagerly asked them whether they had seen any women warriors there, and they told him that it was a nonsensical idea. "No more*cachiri* for you," one suggested kindly.

Mauricio whispered to Henriques. "Perhaps these Manao haven't traveled widely enough. Someone else at the village may have heard of the Amazons. After all, Acuna and Raleigh reported them. "

Henriques was unimpressed. "Perhaps Father Cristobal de Acuna and Sir Walter Raleigh were a pair of bald-faced liars."

Summer, 1634

Henriques raised his eyebrows. "You sure you want to go through with this?"

Mauricio continued painting himself for the ceremony. "Coqui told me that I have to, if I want to marry Kasiri. Or any other of the village girls, for that matter."

Henriques knew who Kasiri was. Wherever she walked, she was followed by a crowd of admirers. Including, most recently, Mauricio. Henriques did have to admit that Mauricio seemed to have eclipsed the former favorite. The lure of the exotic perhaps.

As soon as Mauricio discovered that Kasiri's name meant 'moon,' he had started composing poetry in her honor. Fortunately, it was all in Portuguese.

These ruminations only occupied a fraction of a second. "Uh, huh," Henriques said. "Kasiri's older brother really wants to help you get inside her loincloth. Right."

"He's always been polite to me."

"Are you sure you understand what this ritual involves?"

"I just have to let them put a few ants on me. And not complain. No big deal, I've had ants crawl onto my hammock and bite me. Thanks to you. If ants are so bad, why did you try to get me to hang my hammock on that 'greenhorn' tree?"

Henriques decided not to answer with the truth, which was that after years in the wilderness, he had acquired the native taste for practical jokes. "Have it your way. At least you're doing the ant ceremony, not the one which uses wasps. Remember, it's all a waste if you cry out in pain, or flinch away."

Mauricio went off to join the other initiates; in other words, to dance and get drunk, not necessarily in that order. The village maidens brought them gourd after gourd of *cachiri* , which was made from fermented manioc root. And encouraged their dancing and drinking with flirtatious looks and gestures. At first Mauricio was self-conscious about being in the company of youths little more than half his age. But

the*cachiri* soon took care of that problem. Well before the three days of ceremonial boozing were completed.

* * *

On the third day, Henriques went off with the party that was to prepare the*marake*. The Indians had picked out, in advance, a likely ant colony, and their first task was to drive the ants out into the open. They blocked all save two tunnels, and blew tobacco smoke into one of them. That did the trick. The ants emerged and were carried, on top of leaves or sticks, to a calabash. They were dumped inside, and found themselves awash in an infusion of roucou leaves. This dulled them satisfactorily.

One of the shaman's apprentices used a parrot feather to carefully position each of the two hundred or so somnolent red ants into the mesh at the center of the damp*marake*, their heads all facing the same direction. It dried, tightening the mesh about them, before they recovered. The apprentice gingerly carried the armed*marake* back to the chief's hut, where it would remain until noon.

* * *

Mauricio felt like he was flying through the air as he danced in the big circle. *I wonder what they put in the*cachiri*?* "I am a bird," he shouted. "*Akokoi*, a hawk." He looked at Kasiri. "Shall I swoop down on you?" he cried. She giggled. Her brother, Coqui, also seemed amused for some reason.

The initiates were called into a line, standing in front of a great trench with bark stretched across its entire length. They rhythmically beat upon the bark with sticks, summoning the Sun God.

At noon, with the sun at the zenith, the oldest woman in the village tottered forward. She picked up the *marake*, and pointed at Mauricio.

"You first. Arms up, feet apart." He complied, still in a hallucinatory daze.

She raised the *marake*, and put the business end against his cheeks for a few seconds. Then his arms. His dreamy expression started to show signs of uncertainty, but fortunately he didn't show any pain. His chest. The outside of his thighs.

"Did they warn you that some initiates die in this ordeal?" she asked. He didn't respond.

She paused. Then, very deliberately, she put the *marake* against the inside of his left thigh. She gave the back a tap, and then held it in place. Ten seconds. Mauricio's eyes widened. Twenty seconds. Each ant bite was a lance of fire, mortifying his flesh.

"Kasiri is supposed to marry my grandson, did you know that? Her grandmother and I had it all planned out, when they were both little. You, a stranger, of no great wealth or skill, are trying to spoil our plans."

Mauricio's eyes were tearing now.

"I can't help feeling abit . . . resentful."

Thirty seconds. His breath was unsteady.

"Of course, if you fail the test, there's no problem."

Forty seconds.

"And I take this *marake* away, and the pain will be over."

Mauricio didn't notice it, but there was angry muttering in the background. And suddenly he heard Kasiri's voice, strident with rage, but he couldn't understand what she said.

The old woman pulled the *marake* away. "Passed," she acknowledged regretfully. "Next."

Mauricio looked at Henriques. "See, that was nothing," Mauricio declared. Then he fainted.

* * *

It had taken a week for Mauricio to recover from the vicious bites. His only consolation had been the solicitousness with which Kasiri had applied oil to the inflamed areas of his body. Still, he had had to be real careful how he walked until the salves did their work.

Mauricio and Kasiri, arm in arm, strolled down the sandy beach where her people went bathing. They passed a small stand of palm trees and, abruptly, Coqui stepped out in front of them.

They halted. Coqui, his lips compressed, arms akimbo, watched them silently. Mauricio waited for Coqui to say something. Kasiri, for once, was also quiet.

Suddenly, Coqui started hopping about, bowlegged, his hands on the inside of his thighs, yelling "ahh, ahh, ahh." After a minute of this, he exclaimed, "You very funny. You now my friend, Ant-Man." He walked off, laughing.

* * *

"Wake up, Mauricio." Mauricio didn't stir. Henriques gave the hammock a push, and it started swinging wildly, to and fro, dumping Mauricio to the ground.

"What the hell, Henriques!"

"Time to pack. A trading party came back from down river. Said that they saw a whole fleet of canoes coming upstream. Best guess is that they'll be here soon, perhaps tomorrow or the next day."

"*Anentrada*?" That was the term for an expedition whose principal purpose was purchasing or capturing slaves.

"They did ask whether the Manao had any captives to sell. But what they were most interested in, was whether any white man, alone or accompanied by a black man, had been seen recently."

"Uh-oh. Did the Indians spill the beans?"

"They couldn't, this party had left the village way before we left Belem. But there's more. They described the leader."

"And?"

"He's our old pal, Benito Maciel Parente."

"I'll start packing."

* * *

Mauricio broke the news to Kasiri. "So I have to flee at once. I love you, but I don't want to put you in any danger. So I guess this is goodbye—"

She slapped him. "Don't be stupid. I'm coming. And you're letting me come, or I'll kill you myself." She squirmed out of his embrace and started ordering her family around, collecting the supplies which would do them the most good.

The plan was to go up the Rio Branco and the Takutu. The latter did a hairpin turn, and then ran parallel to a Guyanan river, the Rupununi. The markings on the map suggested that the ground there was relatively flat. In fact, the Manaó told him that there was a lake that appeared and disappeared there. It sound a bit improbable, but Henriques was willing to grant the possibility that the land between the two rivers flooded during the rainy season. In any event, Henriques hoped to ride the Rupununi down to the Essequibo, and ultimately to the Dutch settlements at the mouth of that waterway.

Somewhat to everyone's surprise, Coqui announced that he would join them. "I don't like any of the local girls. Perhaps I'll have better luck upriver."

* * *

The going had been slow. During the rainy season, the water level of the Amazon and its tributaries rose, eroding the banks, and toppling forest giants. When the waters began to recede, the trunks were left behind, hindering navigation.

From time to time, Coqui and Kasiri would leave them and scout their backtrail, to see if they were being pursued.

Henriques and Mauricio, left alone once again, held the canoe steady against the current, studying the latest obstruction. They could get out of the canoe, thus lightening its load, and try to push the canoe over or under the log. They could try to shift the log out of their way. Or they could beach the canoe and portage around.

Like the Indians, they didn't much like the idea of getting into the water. There were caimans, electric eels, stingrays and piranha to worry about. Not all in the same place, of course. And when the waters were high, piranhas usually were a problem only if you were bleeding, or acted as if you were in distress.

On the other hand, the vegetation on shore looked especially nasty, with plenty of long thorns. They would have to cut their way through, and that would be extremely slow and arduous. And a giveaway to anyone following them.

"I guess we're going to get wet," Henriques said. They probed the bottom with their paddles, then gingerly lowered themselves into the water. They each grabbed a side of the canoe and started moving forward, shuffling their feet to minimize the stingray hazard. They looked back and forth, studying every ripple to make sure it wasn't the wake of an inquisitive caiman.

At last, they reached the obstruction. They tentatively rocked the offending log, their attention still divided between it and the river surface. The response was an angry drumming sound.

"Down!"Henriques took a quick breath, and submerged himself.

Mauricio saw what appeared to be black smoke coming over the log, and heading straight toward them. Wasps.Hundreds.Perhaps thousands.Enough to kill them both, several times over.

"Shit!" he agreed, and followed suit.

Henriques had flipped the canoe, and they both swam underneath, putting their heads in the breathing space it provided. The canoe slowly floated back downstream, away from the angry insects.

After some minutes, Henriques poked his head out of the water. No wasps attacked, so he rose further. Mauricio copied him.

"Why did you overturn the canoe? We're going to have a devil of a time finding all our belongings. And some will be ruined, for sure."

"We had to use the canoe so we could just breathe quietly in place. If you swam underwater, in a panic, your flailing about might have attracted piranhas." He paused. "Some things will float down to where we are now, and in an hour or so, it'll be safe to go back and look for the stuff which dropped to the bottom. Provided we don't rock the log, of course."

"How come we didn't hear the buggers? Or see them flying into and out of their nest?"

"Those were *Acaba da noite* , night wasps. We disturbed their beauty sleep."

"Jeesh.They should have a sign, 'Night Workers.Day Sleepers. Do Not Disturb.'"

* * *

"Trouble," Coqui announced. "Some of the bad people are coming up this river."

"How many?"

"Many." Henriques cursed the inadequacies of the Manao counting system.

"How big is their canoe?"

Coqui thought about this. "It makes two of this canoe."

"Okay, so call it eight of them.

Mauricio piped up. "How soon will they be here?"

"One day, perhaps."

"Too close for comfort," Henriques said. "They have a heavier canoe, so the logs will slow them down more than they do us. But they have more oarsmen, so in clear stretches, they'll be faster."

"If they come as far as the wasp nest log, Henriques, they'll see where we cut around. Then they'll be sure we're up here."

"We need to set up an ambush."

"I know," said Mauricio. "We can half cut through a tree, then, when they reach the vicinity of the wasp nest, fell it. It drops on the log, and rouses the wasps. And they sting the bastards to death."

Henriques sighed. "Have you ever felled a tree before? Can you imagine how hard it is to control where it falls in a forest like this one, dense, with lianas everywhere? And if the wasps didn't kill them all, then the wasp swarm would be between us and the survivors."

"We'll try to kill them with arrows, not wasps."

* * *

Henriques, Coqui and Mauricio had bows, but Mauricio wasn't a particularly good archer. He was a good shot, but the musket which they had carefully preserved over the months and leagues of their flight was now entertaining the local fish life. Kasiri only had a knife, and so she had been cautioned to stay back.

The slaver's canoe came into view. Coqui gave a bird call, to warn the others to engage, and then fired. His arrow took down the rear man, who was steering. Henriques' shot killed the poleman in front. That threw the crew into disarray. Coqui picked off another.

The slavers were returning fire now, and Henriques party had to take cover. In the meantime, the slavers beached their canoe on river left. That was Henriques and Mauricio's side. There, on the strand, another of Benito's men fell, with one arrow in his chest, and another in his left arm. The others ran into the bush.

Coqui, on the right bank of the river, grunted, and set down his bow and arrows. "Wait here," he warned Kasiri. "Stay out of trouble." Coqui, armed with a blowgun, and the steel hatchet Mauricio had given him, went downriver, and around a bend, then swam across, out of site of the pursuers.

Henriques and Mauricio had dropped their missile weapons; there were too many leaves and branches in the way. The slavers likewise realized that the time for musketry was passed; they drew their machetes.

The slavers were at a disadvantage; they hadn't walked this ground before. Henriques and Mauricio took advantage of their ignorance, making quick attacks and then disappearing. In the slavers' rear, Coqui aimed his blow gun at the rear man, the dart hitting him in the neck. He slapped, thinking it an insect sting. A moment later, he collapsed.

Coqui picked out his second victim, and fired. But the second one cried as he fell, giving warning to the others. One turned, and Coqui had to leap quickly out of the way of a machete swing. There was no longer any question of reloading the blowgun. And the hatchet was a good weapon, but not the equal of a machete. Coqui backed up rapidly, a move which would have been dangerous for anyone lacking his wilderness senses. The machete wielder followed and, in his haste, stepped in an armadillo hole, turning his ankle. Coqui finished him off.

One of the surviving slavers decided he had enough, and fled down river on foot, running past the boat. Coqui hesitated, then decided he couldn't take the chance that the man would summon reinforcements. He gave chase.

Henriques and his last opponent gradually shifted deeper into the forest, out of sight of the others.

Mauricio and his foe wandered onto the beach. Both were tired, and bleeding from small cuts, but neither had been able to strike a decisive blow. They circled each other warily.

One of the slavers struck down on the beach earlier was not dead, as Mauricio had assumed. As soon as Mauricio back was to him, the injured man slowly crawled to where his musket had skittered earlier in the action. It was still loaded. He only had one good hand, so he braced the musket on a rock.

Mauricio's more obvious foe could see what was happening, and did his best to keep Mauricio's attention directed forward.

The musketeer took aim at Mauricio's back . . . then slumped, an arrow in his neck.

Kasiri was holding her brother's bow in her left hand; a fresh arrow was already in her right.

Mauricio's other foe was taken aback, and just stood, open-mouthed. Kasiri's second shot killed him.

A few seconds later, Henriques struggled out of the bush, and gave Mauricio a nod. Henriques grabbed a leaf and wiped his blade clean.

"Where's Coqui?"

Kasiri crossed the river and told them she had caught a glimpse of him heading down river, pursuing the last of the slavers.

"We better not take chances. Grab a musket, Mauricio, and I'll get my bow." They all concealed themselves, not knowing if more slavers might be on their way.

Soon, Coqui returned, smiling. Until he saw Kasiri, still holding the bow.

They were soon screaming bloody murder at each other.

Mauricio gave Henriques an anguished look. "What are they saying, Henriques? You know their language better than I do. They are talking too fast for me to make out more than one word in three."

"He's angry at her, because she used his bow."

"I'm not complaining! She saved my life."

"He says, 'Picking up a man's bow makes a woman sterile, everyone knows that'. And that means that she can never marry, because by Manao law, a man and woman cannot marry until she is pregnant."

"What about Raleigh's Amazons? They use the bow, according to legend." Coqui turned to look at Mauricio, his face suddenly a frightening mask. He shouted an insult, and brandished his hatchet. Kasiri shoved him and did some shouting of her own.

"Ouch, you shouldn't have mentioned that. He remembers now you that you spoke of them publicly once. He thinks that Kasiri must have overheard, that you put the idea of female archery into her head. Thereby ruining her marital prospects."

"He also says that the story of the Amazons is complete nonsense, that the 'stupids'—meaning the Spanish—must have seen one of the tribes whose men wear their hair long."

Henriques paused to listen to Kasiri's response. "And *she* said that she made her own little bow years ago and has been sneaking off and practicing with it for years. And then *he* said that explains why she hasn't ever gotten pregnant, despite, uh, never mind."

Mauricio said, "I'll settle this."

He confronted the quarreling siblings.

"So, Coqui, you think she's unable to bear children." The Indian nodded.

"Well, perhaps that means that only with an Indian father. But I'm not Indian."

She ran over and hugged him. Then dragged him off into the bushes.

* * *

"Brother, when my tummy comes out, so you know I am right and you are wrong, I expect you to make me a real bow, not the toy I had to sneak around with." The "real bow" was six feet tall, and used eight foot arrows.

"You mean if your tummy comes out."

"I said, when."

"Fine. When. In the meantime, I'm going hunting."

* * *

"Stop tickling my toe, Kasiri. Kasiri?" Mauricio awoke to find a vampire bat feeding happily on the appendage in question. Mauricio started kicking, to persuade it to move along.

Kicking while in a hammock isn't recommended. Mauricio tumbled to the ground, and a well-nourished vampire bat flitted off.

Fall 1634

It was an awkward time to attempt to cross from the Takutu to the Rupununi. A few months earlier, the area was completely flooded, forming Lake Amuku, and Henriques and his companions would have had an easy time canoeing across. A few months later, at the height of the dry season, and they could have abandoned their canoe and just walked across the savannah. Unfortunately, this was the transition period. Paddle and carry; paddle and carry.

Visibility was surprisingly poor, given that they were in flat country outside the rain forest. The Rupununi savannah was pockmarked with "sandpaper trees," each six to ten feet high, and appearing every twenty yards or so.

When they spotted it, they were already too close. What they had seen was a mound, a few feet from the edge of a creek. As Amazon dwellers, they immediately recognized it as a caiman's nest. The question that came first to mind was, where's Momma? Unlike, say, turtles, crocodilians were quite protective of their young.

Very, very softly, they set their canoe down on the ground. Kasiri climbed one of the trees, so she could see over the bank. After a few minutes, she spotted it. "*Jacare acu*. Big one. Close."

The black caiman. The largest crocodilian of South America. Unlike birds, caiman didn't just sit on their nests. But if they left them, they didn't go far off. Any suspicious movement, or sound, would be investigated. And momma's motto was, "bite first, ask questions later."

They signed to Kasiri. "Leave?"

"No. Too close. Wait." She would tell them when the caiman had moved far enough away that they could slip off unnoticed.

The three males kept watch on the mound. If the mother laid down on her nest, and went to sleep, that would work, too. They could pass, at a respectful distance. Even if their passage woke her up, she probably wouldn't charge. Probably not.

What's going on now, thought Henriques. He had seen a disturbance on the side of the mound. It's too early for them to hatch, I thought.

A tegu, three feet long, emerged in a puff of dirt, a black caiman egg in its mouth. It did a little victory dance.

The last spasm of dirt movement had not gone unheard. Mighty Mama threw herself out of the creek, and saw the dastardly lizard. She—all fifteen feet of her—charged.

The tegu fled. Straight toward Henriques and his companions. With Mighty Mama in hot pursuit.

Mauricio gallantly, and rapidly, decided to join Kasiri. He started climbing; Kasiri extended a helping hand. Coqui ran, at right angles to the track of the approaching behemoth, and then found himself a tree of his own.

Henriques hesitated for a minute. Could he grab the tegu and throw him back toward Mighty Mama? That would make a nice distraction.

It was also an insane idea. Henriques sprinted, picking the direction opposite Coqui's.

The tegu ran past Mauricio and Kasiri's tree. Mighty Mama, still intent on the thief, ignored the humans' scent and kept running. The tegu was normally much faster, but it refused to let go of its prize, and that slowed it down.

Mauricio and Kasiri looked at the departing beasts, then at each other. In silent accord, they dropped to the ground and ran forward, in the party's original direction. Mighty Mama, they hoped, was sufficiently distracted at this point.

The following day, the rest of their party showed up. First Coqui, then Henriques. Of course, there was one problem. No canoe. They had to circle back and, very stealthily carry it off. It helped that they knew

where the nest was, and, equally important, where Mighty Mama liked to lurk. This time, Mighty Mama was indeed asleep on her nest, and they took pains not to disturb her.

It wasn't long before they wondered whether it had been worth the effort. The Rupununi fed into the Essequibo, as predicted. What they didn't predict was what the descent of the Essequibo would be like. As the river dropped out of Guyana highlands, there had been a succession of falls and rapids. Most of which had to be portaged. In Kasiri and Coqui's home country, they would have just left their canoe upriver and taken someone else's canoe at the end of the rough water section. They couldn't be sure that this convenient custom applied in the Guyanas, unfortunately, so they had to carry their canoe whenever they couldn't just unload it and line it down.

Eventually, they reached the calmer waters of the lower Essequibo and were able to paddle with fewer interruptions.

Soon, Fort Kyk-Over-Al came into sight, looming above Cartabo Point. It was really a glorified watchtower, with barracks, a magazine, a storehouse, and a few private rooms. It overlooked the confluence of the Essequibo with the Mazuruni and the Cuyuni.

Henriques' party beached their canoe, and approached the fort. A bored-looking guard called down for him to identify himself. "I am Henriques Pereira da Costa. We come from Belem do Para, in the Amazon."

The guard's boredom vanished. "Wait here!" He came back a moment later with several other Dutchmen.

"I am Commander Van der Gies of the Zeeland Chamber of the Dutch West India Company. You say you came from up river, but ultimately from Belem do Para?"

"Yes, we found the connection from the Amazon to the Essequibo."

He was congratulated on this great achievement. The Dutchmen ignored Mauricio, assuming he was a slave. And of course the Indians were equally uninteresting to them.

Mauricio fidgeted. Henriques realized, suddenly, that Mauricio might be uncertain of how their return to civilization would affect his status. Kasiri also seemed ill at ease, sensing Mauricio's discomfort. Coqui, on the other hand, appeared oblivious to their emotional turmoil.

Henriques interrupted the Governor. "Forgive me. Allow me to introduce my fellow explorer, Mauricio . . . my half-brother."

* * *

To Be Continued

So You Want to Build the Internet:
IP Communications in 1633
by Charles Prael

The internet, as we all know, is a complex beast. It depends on a wide variety of technologies to deliver a wide variety of information over a large number of different computing devices. So, how feasible is it to build an internet in the 1632 Universe? Less difficult than you might think, depending on what you're

after. To make those decisions, we need to look at what resources are available on several fronts. Before going too far into this, you might also want to review "So You Want To Do Telecommunications In 1633?" in *Grantville Gazette*, Volume 2.

Resources Computers

In 2003, a number of folks worked to put together a computer resource survey for Grantville, to provide some definition of what kind of computational resources might be available to the residents of Grantville who had been cast into the past. That survey can be found here:

<http://homepage.mac.com/msb/163x/faqs/computers.html>

Several assumptions (at least one of which proved to be too conservative) were made governing how many and what types of computers might be available. A few starting points can, however, be noted. First, don't expect to see anything introduced after February of 2000. That allows a couple of months for just-released technology to reach Grantville (which, you should note, is not necessarily going to have the latest and greatest hardware, either—historically West Virginia lags behind the rest of the country in tech adoption). Second, expect to see a lot of hand-me-down computers—older models, such as 386s, 486s, Pentium Is—that kind of thing. The one assumption that was, in fact, too conservative was that the Mannington schools had made a concerted effort, in the late 90s, to provide up-to-date computing hardware for the teachers to use with their students. As a result, there were more then-modern computers than expected—mostly Celerons and Pentium IIs, with a mix of Pentium IIIs.

Also worth noting is that there were more, older "scrap" computers than expected. Hold onto that thought, because we'll be getting back to it.

Routers

One of the big issues in building a network is routing capacity. In that sense, Grantville was sorely lacking. A grand total of 2 T-1s (with associated CSU/DSU hardware) have been identified within the radius of the ROF. By authorial fiat, a total of 4 early-model 802.11b wireless routers are also present—and no, these don't have the firmware that allows them to be used as long-distance bridges.

But, if you think back a few years to the early days of the Internet, you'll find that "routers" were not much more powerful than then-extant computers. Which means, if you think about it, that you're talking about something with the horsepower of a 386 or a 486. Hold that thought as well, because we'll be getting back to this issue.

Backbone

This is where you wind up with a real problem. Because, except for the in-town cable, and the 7 miles of fiber optic running under the CSX rail line, there just isn't anything useful—you'll have to make it all, using existing resources. Except, you don't. The groundwork has already been laid for you, if you know where to look. A few data points to consider:

- A few years ago, just to prove that they could, a datacomm company who shall remain nameless decided to demonstrate the robustness of their product by running an Ethernet networking connection over 8 strands of barbed wire. Just to finish proving the point, someone later ran an Ethernet link over a one mile section of barbed wire.

- At about the same time, a group in Norway actually implemented what had been henceforth a joke: IP over carrier pigeon. Using a printer, a scanner, and a carrier pigeon, they successfully established a network link between two computers, including a network segment delivered solely by carrier pigeon. The latency was, as you might expect, atrocious. Nonetheless, they were able to pass network data across the link.

- Ham radio operators routinely operate IP networks over high-frequency radio networks, worldwide.

- Most modern telephone service is delivered over a two-wire pair—what's known in the industry as unshielded twisted pair (UTP). If you look at a modern phone wire, however, you will find that it normally has two pairs of wires. What's interesting about this is that 1990s-era 10Megabit Ethernet (10BaseT, in industry parlance), will run quite nicely using two pairs of wire.

So, what does all this mean? Well, for starters, it means that if you are (a) willing to be a little unconventional in your methods, and (b) willing to accept reduced capability, you can build quite a bit of network with materials ready to hand. In fact, if you want, you can build out most of a small town with the equivalent of a 1990s office network. Getting outside of the town will be much more of a challenge, however.

Building the Network: Routers

Once you've decided to build the network, you need to have some form of router. A router is, really, just a computer that plays the role of traffic cop—it directs network traffic hither, thither, and yon. It's worth noting that Linux distributions since the 1990s all contain core routing software within the operating system and within the packages that are distributed. It's simply a matter of setting it up. It's also worth noting that a fully-fledged Linux router, using a stripped-down version of the operating system, will run in as little as 8 MB of memory space. Remember those 386s and 486s I mentioned? Well, a well-equipped 386 might have a whopping 8 MB of memory. Just about enough to act as a router, if needed. All we'd need was the right individuals, and some time to configure and program a router package, which could then be duplicated. So, that's one problem solved. But. . . now that we have routers, what network do we route traffic on?

Building the Network: the Backbone

If you did your homework, and read Rick Boatright's excellent article in *Grantville Gazette*, Volume 2, you'd realize that there will, very quickly, be quite a lot of telegraph wire being generated, and pulled around the countryside. What, then, is telegraph wire? Well, it's either iron or copper wire, with repeaters. A telegraph is really just a device that sends an analog signal of dots and dashes separated by blank space across that wire. Hmmm. Dots and dashes you say? Sounds an awful lot like 0s and 1s—binary bits. So, why not find a way to take advantage of all this iron wire being put up around Europe—and push IP network data across it instead of manually-driven telegraph key data?

In addition, you might have noticed the comment above about radio data communications. Since most of the radio traffic in the 1632 universe is Morse code (also known as CW—continuous wave), you run into the same objections to sending computer data via radio as you do to sending that computer data via telegraph line. Solve the problem of how to connect a computer to a telegraph line, and you can use that same solution to connect computers via radio—at least so long as you can establish radio communications. Which bring us to our next problem.

Building the Network: A Telegraph Modem

A modem (modulator-demodulator) is, at this point, a handy term for any device that interfaces between a computer and an outside network. The reality, of course, is that a modem is a fairly specific device term—if you're a techie.

In our case, however, what we need to build is a device that allows a computer to talk across a telegraph line. Fortunately, it's actually not all that hard to build such a device, or to control it from a computer. Using a simple combination of the computer's serial or parallel port, some custom programming, a solenoid, and an otherwise-standard telegraphy key, you can get the computer to "talk" to the telegraph line. In reality, automated telegraphs were commonly available by the end of the 19th century. In our case, the only difference is how we choose to control it.

Of course, once we have a design for a telegraph modem that works on a telegraph line, that we can build using 1630s-available materials, we also are only one step away from having the ability to send data over a radio link, using exactly the same implementation. Only the transmission medium differs.

After hammering this particular design out over a period of time, it appears that a telegraph "modem" capable of about 60 bits per second is possible by the early 1634. Further, it appears that multiple telegraph modems can be controlled from a single computer, up to a maximum of about 6. Using multiplexing technologies, and assuming that only 4 channels are used, a rough equivalent to a 300 baud modem can be implemented. Combined with modern data compression algorithms (everyone remember .zip files?), we can get an effective network speed of close to 1 kilobit for highly-compressible data (like those text-file emails we mentioned) over the main trunks, and about 200 bits/second over a single-line side connection. This gets us a networking/email capability approximating what you would see in the early 1980s.

Network Architecture

Now that we know what kind of potential capabilities we have, we can start working on what kind of network to build.

Metropolitan Networks

We know at this point that, using regular telephone wire and existing computers, we can build a 10 Megabit network covering a small town—for example Grantville, Magdeburg, or downtown Prague. Since most of Grantville is wired for telephone, it would be entirely possible to connect the bulk of the

town into a single large-size Ethernet network. Not great, not perfect, and certainly something that would give the IEEE fits—but it's entirely possible. Any other town that's wired using similar capabilities will wind up being capable of running a similar network. Further, we can go a bit further out using modern modems over telephone wire—that only gets us 56 Kilobit networks, but that's a lot better than the alternative.

Regional Networks

Outside of these towns, we'll be forced to fall back to slower networking capabilities, either using modern modems or using the telegraph modems we discussed above. This also means that connecting between the various cities will be rather slower—in that range of 60-300 bps that we discussed above.

So, What Does the Internet Probably Look Like in 1634?

Based on all this, there are three "classes" of internet by 1634.

The best network (Class A) is going to be the network that exists in a small, defined area like Grantville. There, the Internet will look and act a lot like in our world, in the year 2000. Perhaps not all the bells and whistles—no popup advertising, for example—and the content might be a little more limited. But it will still be there, and it will be roughly as fast as any office network of the 1990s.

The next best network (Class B) will be those computers a bit too far out from the central network core to run any form of Ethernet communications, but still close enough to reach the network using a regular telephone modem. They'll be able to get a dialup connection. For these users, network speed will vary depending on distance of the telephone connection. Anecdotally, however, I've been told that the residents of Skagway, Alaska can get 14 Kilobit connections, dialing out over 40 miles of 1940s-era telephone cable to Anchorage.

Finally, we come to the Class C network. This is going to be dependent on the IP-over-telegraph connection. It may not be fast (certainly not at 300 baud), but it will work, and it will move data around. Slowly, perhaps, but it will still work.

Great! What Can You Do With It?

The first, and most important thing to realize, is that at best, the Internet in 1634 will have capabilities that don't even measure up well to those available in the early 1970s. In terms of computing hardware, the systems available to Grantville are actually much more capable than the 1970s mainframes. But the network? There, you're looking at something that's less capable. That being said, you'll be handling less traffic—less business—than 1970s networks were dealing with.

Which means, once all is said and done, that a fairly large number of 1970s approaches will make a great deal of sense as applied to Grantville's Internet. Here's a few examples:

- Email: Since email is a relatively low-impact communication form, it will be readily available and adaptable to the network we're discussing.
- Batch data processing: There are a huge number of operations where you would send in a set of

data for computation to a "mainframe," then work from the results. Bank account processing, construction engineering number crunching, even fluid dynamic calculations for airplane and ship designs (the equivalent of a wind tunnel or water tank test).

- EDI: An early form of ecommerce, Electronic Data Interchange used text message files to accomplish a huge amount of electronic commerce traffic—mostly business-to-business or business-to-government. But there's a fair amount of this kind of thing that will be of use in the USE's government, and in dealings with and between the various larger commercial entities.

What won't you have? Well, you might have web servers in each city, but you certainly won't be connecting to them across those trunks—downloading a single web page would swamp the connection.

Similarly, moving large files across the network will probably be relegated to "on a disk, with a courier" rather than going out online. You might note that this echoes something done by a group of guys working at Terraserver recently. Rather than paying for several T-3 (45 Mbit) connections, they started shipping 2 Terabyte servers around through Federal Express—sneakernetting, to use an old industry term. It turned out that this solution was much cheaper, as well as being much quicker. In our case, we'll have to use something other than Federal Express—a railroad courier, perhaps, or a plane from the USE Air Force—and a rather smaller disk—perhaps a 100Mbit ZIP disk.

So, How Fast Is This?

One question that's been asked is, how fast is this system going to be, in real terms? Allow me to illustrate.

Let's say that Mr. A, in Grantville, wants to send email with a 8kb text document (about 3 pages, single-spaced) to 4 people in the USE using this system. Mr. B is also in Grantville. Mr. C is in Rudolstadt, on the other side of a telephone modem. General D is in Magdeburg, on the other side of the four-telegraph-line trunk. And Herr Doktor E. is in Jena, on a single-line telegraph connection.

Expected Transmission times:

Mr. A to Mr. B (Grantville-Grantville, 10Mbit ethernet): less than a second

Mr. A to Mr. C (Grantville-Rudolstadt, 14Kbit dialup): about 6 seconds

Mr. A to General D (Grantville-Magdeburg, 300 bit trunk with compression): about 45 seconds

Mr. A to Doktor E (Grantville-Jena, 60 bit branch with compression): about 4 minutes

Wait! What About the Old Computers?

Remember all those old computers we mentioned, that were essentially scrap? It turns out they're still useful. At one level, they're useful in the "something is better than nothing" realm—even a 1980 TRS-80 is still vastly more powerful than a notepad and pencil for calculation work.

But there's another realm where they also have a useful life—as access terminals to high-end computers. The simple reality is that a single, circa 2000 Pentium 3 Xeon server has as much or more computational

horsepower as a circa 1990 Cray C90 supercomputer. That same 1980 TRS-80 would provide a useful front-end terminal to that Xeon server, allowing additional users to get their work done, and providing them with access to a much more powerful machine than the TRS-80 would be by itself.

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Grantville Police Department

by John Zeek

In 2000, the Grantville Police Department was a typical small town police department. It consisted of a chief and five patrolmen, and a sworn juvenile officer. A study of the books *1632* and *1633* and a visit to the Grid reveals their names and ages.

Police:

Dan Frost (47; chief of police)

Ralph Onofrio, Jr. (42; police officer)

Marvin Tipton (49; police officer)

Delores (Agnew) Francisco (29; police officer)

Ricky McCabe (23; police officer)

Preston Richards (34; police officer)

Bernadette Adducci (44; juvenile officer)

Unlike many small town departments, Grantville has its own dispatchers. Most departments depend on the county sheriff's office. But Grantville was once a larger town than it was in 2000, so the radio system is a leftover from the glory days. There is also an office file clerk. Again, a trip to the Grid shows us the names and ages of the dispatchers and clerk.

Dispatchers and Clerk:

Mimi (Rowland)Carson (26; dispatcher)

Angela Baker, (27; dispatcher)

Jill (Duvall) McConnell (28; dispatcher)

Jim Watteville (28; dispatcher)

Vera Mae (Markins) Sanderlin (65; files and records management)

The Ring of Fire trapped two county officers who lived in Grantville, so they were added to the force and to the newly established court system. Again from the grid:

Julie Anne (Abruzzo) Drahuta, Child Protection Officer)

Fred Jordan (33; Deputy Sheriff) Assigned to liaison with other law enforcement.

As well, Maureen (Burns) Grady (35; VA social worker) joined the force as a child protection officer before moving toMagdeburg .

As soon as Grantville started to attract new down-time residents, the department was forced to expand by adding officers. Six were mentioned in *1632*, none by name, but later stories in the *Grantville Gazette* have added nine names to the official canon.

Named Down-time Police Officers:

Jürgen Neubert

Emil Zollner

Jonathan (Jonnie) Smith

Horst Stoltz

Gunther Wiener

Wilhelm Kramer (aka Wilhelm der Neger)

Erika Fleischer

Hans Shruer

Hans Shultz

The last three may or may not have been among the first six down-time officers, but they were in the department by December 1634. Unlike the other named policemen, these three were apparently not former soldiers. Also mentioned in 1632 were eighteen police trainees, which might explain where they came from. Erika Fleischer and Jürgen Neubert were on the bus driven by Hans Richter during the Croat raid and Emil Zollner has been trained as a dispatcher.

Another trip to the grid and a little deductive reasoning leads us to discover that some up-timers were also added to the police department at roughly the same time. In addition, there are army members attached to the police department for training as MPs. Between 1631 and 1633 the following up-timers were added to or trained by the Police Department. These are the people mentioned either in the grid or stories. There may have been more.

Ed Jordan (68; recruit training supervisor)

Melanie (Burroughs) Richards (child protection officer)

Carolyn Kay (Carpenter) Atkins (66; jail matron and in charge of the kitchen)

Steven Ennis (22; military, MP)

Lyndon Johnson (21; military, MP)

Ned Harris (21; military, MP)

Jonathan Lund (22; military, MP)

Elizabeth Pitre (22; military, MP)

Blake Haggerty (17; military reserves)

Wilhelm (Bill) Magen (18, military reserves)

The police department will continue to add officers and dispatchers as the city expands. The standard recommended size of a police department is one officer for every five hundred citizens. Grantville is going

to continue to grow, but the 1632 Tech Manual estimates that the town will top out at about 20,000 residents. Still, Grantville is going to face many of the problems of a "boom town," so it is going to need a larger police force.

As the department expands, the largely informal rank structure of the old force will be replaced with a formal rank system. While the Grantville, WV police department could get by with a chief and five policemen, Grantville, State of Thuringia-Franconia, is going to need more supervisors and watch commanders and more officers. Gone are the days when the chief was called out to supervise every trouble call. The previously mentioned 1632 Tech Manual discussions suggest a department size of forty sworn officers.

A rank system with a chief commanding four watch commanders who are sergeants would work until the police force reached over a hundred officers. Grantville isn't likely to need more than forty officers. There would be a uniformed investigator who would be a sergeant. The rank of corporal would be used for field supervisors or training officers. Police officers would be divided into patrolmen and patrolmen first class, depending on their training and experience. Noting the presence of women officers, the terms patrolwoman and patrolman would be used interchangeably where appropriate.

Equipment

In 2000/1632, we were informed that Chief Frost drove a Jeep Cherokee as his official vehicle. It is safe to assume that at least one of the other police cars was a four-wheel drive, since Grantville is a mountain community and the police department did have commitments outside of town before the Ring of Fire. There would be at least two other police cars, probably standard sedans. Both the Jeeps and the sedans are equipped with radios and there is a supply of portable radios (Handi-Talkies). The officer's personal cars would have CB radios and police band scanners and possibly police band radios. Those personal cars can be used to expand the motorized patrols.

Like most police departments, Grantville has a supply of batons. The twenty-four-inch side-handle baton was chosen. At least two officers of the department are certified trainers with that baton. As is true of any police department, there is a supply of saps, blackjacks and even brass knuckles—either purchased over the past years or confiscated from drunks and petty criminals. One item that will grow scarce and then non-existent is chemical mace or pepper spray.

The police department is well-equipped with firearms. The standard side arm is the Barretta 96 in .40. These were department supplied, and there are a couple of extras. In 1999, the department had changed to the auto-loader from the Smith and Wesson Model 13 revolver in .357Magnum . Since the trade-in on the revolvers (10) was low, they were placed in storage and were available for issue in 1631. Department policy allows officers to carry personally owned weapons, if the weapon fires the standard caliber and the officer qualifies with it. Many of the officers follow this policy. Mention has been made in canon stories of Glock pistols and a Colt Python revolver. The policy on personal weapons would account for these.

The official issue shotgun is the Remington 870 pump in 12gauge . Before the Ring of Fire, these were issued one to a car with four in storage, for a total of eight. Again, many officers carry a personally-owned shotgun.

The department did not have a SWAT team, but we can assume that one officer was SWAT-trained and a part of the county SWAT team. The department has some rifles in storage for issue if needed. These

rifles are one Ruger Mini-14, a Colt AR-15 and a Remington 700. The Ruger and the Colt are in .223 and the Remington in .308. Many rural and small town police officers like to carry a rifle in the trunk of their cruiser, if department regulations permit. The Grantville P. D. seems to permit this. These "trunk guns" range from the trusty lever-action deer rifle in .30-30, to hunting rifles in .30-06, to the old M-1 carbine in .30caliber . In other departments it is not uncommon for a policeman who is a groundhog hunter to carry his groundhog rifle in his police car. Why would Grantville be any different?

The Grantville P. D. had some personal body armor in 2000, but it was a very limited supply. A federal grant in 1997 had been used to purchase a vest for every person on the force. When the department expanded, there were no extra sets. What was available were twenty Vietnam era "flack jackets" that were in storage. Hot, heavy, late-sixties flack jackets that had been given to the department back in 1975, and stored ever since. These were issued, but many officers refuse to wear them because of the weight. Most of the former mercenaries, though, like them.

The Grantville P. D. in 2000 had a standard uniform with dark blue trousers and either a dark-blue long-sleeve shirt for winter wear or a white short-sleeve shirt for summer. The department issued two pair of trousers and four shirts, twolong-sleeve and two short-sleeve every year. Jackets were also issued. The expansion of the P.D. presented some problems with uniforms. There were not enough to completely outfit the new officers and the down-timers were used to a looser fit in clothing. Both problems will solve themselves as the uniforms wear out and are replaced by clothing of local manufacture and tailoring.

Changes

In early 1634, Preston Richards became police chief, replacing Dan Frost who retired to act as a consultant to cities and towns in the USE that were starting modern police forces. Of course, Chief Richards will have a different style of leadership than Chief Frost, but at first there will be little change in the day-to-day working of the police force. Chief Richards is a younger man and will put his stamp on the department before he retires.

From story evidence and practical guessing, it becomes obvious that the police will have more foot patrols and mounted police. The cars and SUVs will not last forever. So, riding will be added to police training. Wagons or light buggies might also be added to the police vehicle list.

Another change that will take place is in the standardization of handgun calibers and the impact weapons of the patrolmen. As the department expands, up-time pistols and revolvers are going to become harder to obtain. There is no source for those side handle batons, which are made from a plastic compound, but a wooden side handle is not that hard to make. It will just break more often. So look for more locally-produced weapons to show up on policemen's hips. Cap-and-ball revolvers, and even single shots, will become more common than up-time revolvers and autoloaders. Wooden batons, both straight and side-handle, will become more common than high-impact plastic side-handles.

In 1635 the P. D. Looks like this:

Preston Richards, Chief since 1634

Vera Mae Markins, Clerk, Files and Records Management

Carolyn Kay Carpenter, Jail Matron and Head Jailor

Mimi Rowland, Head Dispatcher

Ralph Onofrio Jr., Sergeant, Watch Commander

Un-named, probably a down timer, Sergeant, Watch Commander

Un-named, probably a down-timer, Sergeant, Watch Commander

Marvin Tipton, Sergeant, Head of Investigations

Ed Jordan, Police Recruit Training Supervisor

Estes Frost, Jr., Corporal, Training Officer

Horst Stoltz, Corporal, Training Officer

Jurgen Neubert, Patrolman, First Class Investigator

Jonathan "Jonnie" Smith, Patrolman, First Class

Erika Fleischer, Patrolwoman First Class

Matt Prickett, Patrolman First Class, Juv. Officer

Melanie Burroughs, Patrolwoman First Class, Child Protection Officer

Marcus Giamarino, Patrolman First Class, liaison with other law enforcement

Patrolmen and Patrolwomen: Karl Maurer, Hans Unknown, Gottlieb Unknown, Wilhelm Kramer, Hans Schultz, Hans Shruer, Heinrich Steinfeldt, Gunther Wiener, Emil Zollner, Blake Haggerty and Wilhelm Magen, an M.P. training with the Police Department.

Dispatchers: Angela Baker, Jill Duvall, Marlene Unknown, and Jim Watteville on the night shift. Besides being a patrolman, Emil Zollner is available as a substitute dispatcher.

There are at least ten, maybe more, police officers, and one more dispatcher. No jailors have been mentioned in any story, but there should be at least four.

It appears that Chief Richards is acting as a watch commander as well as handling the responsibilities of being chief. This will change when he has a trained officer able to take a sergeant's slot.

In the future Chief Richards will also have to add at least one more corporal as a training officer and two more investigators. The Grantville P. D. will continue to grow to meet the needs of the citizens. Also, Ed Jordan is getting a little old at 71 to be an active training supervisor, so there is one more problem for the new chief to consider.

By 1638, the Grantville P. D. will become quite different from the small town police department it was. It will also be the most advanced police department in the USE. As former chief, it would not be surprising if Dan Frost recommended that the departments he is consulting with send some officers to Grantville for training. This would put the Grantville stamp on most, if not all, the police departments that

did so. It is not too far-fetched to imagine that a national, or at least a state, police academy will be formed in or near Grantville, even if the capitol of the State of Thuringia-Franconia were to be moved.

Flying the Virtual Skies:
by Sean Massey

A Brief History and 1632 Perspective on Flight Simulation

For almost as long as there has been flight, there have been simulators to assist in training would-be pilots in the art of flying. They have evolved from primitive mechanical trainers to electronic cockpits.

With Grantville leading the creation of an air force in the 1632 universe, there will be a demand for flight simulators. The need won't be immediate, as there are few planes in service with the United States of Europe, but as more are built, and more combat losses occur, simulators will take an important role in training new pilots.

The standard method of pilot training is placing students in the cockpit with an instructor and teaching them to fly "hands on." In 1633, this method was used to train Hans Richter and the first batch of Air Force pilots. But with few flight instructors, fewer aircraft, and many potential pilots, simulators are sure to become one aspect of the Air Force's training program.

Pilot Training Before Simulators

The first attempts at training pilots occurred in aircraft, usually gliders, on the ground. Would-be pilots would be placed in the aircraft, exposed to a headwind, and be given the chance to get the feel of the controls.

In the early 1900s, there were many attempts at building artificial simulators. The first artificial trainer was developed in 1910 and consisted of little more than two sections of half-barrels. These were moved manually to simulate the motion of an aircraft.

Another notable attempt was the Saunders Teacher. The Teacher was an aircraft mounted to a joint. Like the glider training methods, it was faced into the wind, and the Teacher's controls responded to the aerodynamic forces. The Teacher and similar devices never caught on due to the unreliable nature of the wind.

World War I, the 1930's, and World War II

The outbreak of war in 1914 created a great demand for pilots in the growing air corps of Europe, and along with it, a greater demand for better training methods. Aptitude assessments of potential airmen were instituted, and novel methods of training, such as short-winged aircraft that weren't capable of flight and mounting an aircraft to an overhead gantry or railway cars were tried without success. A few electro-mechanical devices were tried, and the most successful of these was the pneumatically-powered Link Trainer in 1929.

In the late 1920's, instrument flight training became a higher priority, and trainers were developed or modified to accommodate this. The first instrument trainers required an instructor to manually control the

simulation, but later simulators had instruments that were operated by mechanical or pneumatic methods.

To assist with instrument flight training, a course plotter was developed in the 1930s. This device traced the flight path of the trainer on a chart and allowed instructors to manually control signals from navigation aides.

The Link Trainer, combined with the course plotter, was the star of the era. In the late 1930s, it had received sales from Great Britain, the Empire of Japan, and American Airlines. By the eve of World War II, it had become the instrument trainer of several major air forces.

When World War II began advances in aircraft technology increased the need for cockpit training. Trainers were equipped with mock-ups of aircraft instrument panels and fuselages. Later in the war, radar trainers were added to the simulators to create Aircraft Interception Trainers. Other features were added for gunnery instruction and torpedo attack training.

The Link ANT-18, known to many pilots as the Blue Box, became the most popular flight simulator of its era. Over 10,000 were built, and they were used in every flight school in the United States and Allied nations.

One new simulator developed during the war was the Celestial Navigation Trainer. This trainer, which began development in 1939, was designed to train bomber crews on celestial navigation and improve nighttime bombing accuracy. The trainer had room for the pilot, navigator, and bomber. Navigation training was accomplished by a combination of radio aids and the use of a constellation of stars that moved based on the aircraft's supposed location. In addition to this, a series of photographic plates were suspended below the simulator for bomber training.

The Electronic Era

The shift away from mechanical simulators began around the same time as the Link Trainer was developed. The first mention of electronic flight simulators was in 1929, but practical developments didn't begin until ten years later with the development of an electronic analogue computer at MIT.

The first electronic flight simulators were put into service in 1941 in Great Britain. They were primarily used for Aircraft Interception Radar trainers.

Following World War II, simulators moved away from motion systems to fixed-base systems. It was argued that the pneumatic motion systems could not simulate the forces a pilot experienced in flight correctly, and while the Link company disagreed, they eventually produced fixed-base trainers.

Commercial airlines adopted electronic simulators about the same time that the military did. Curtis-Wright delivered the first Boeing 377 Stratocruiser simulator to Pan-Am Airlines in 1948. This became the first full simulator owned by any commercial airline. This simulator lacked visual and motion features which gave it a feeling of being unreal, but it was used to train flight crews for emergency situations.

The electronic simulators of the 1940s and 1950s used analogue computers. Analogue computers are a form of computers that use either electrical or mechanical methods to model a problem that needs to be solved. The reliability of analogue computers was limited, and the operations of simulators were consequently limited to twelve hours. Another problem with analogue computers was inflexibility; they

couldn't run several different programs as can a digital computer. Unfortunately, digital computers of the time didn't have the processing ability to handle real-time simulation.

By the 1970s, the digital computer, now fast enough for simulation support, had replaced analogue computers in simulators for airlines and the military.

When Link sold the electronic simulator to the United States Air Force in 1949, it didn't include a system for simulating motion. At the time, Link had argued that it was necessary for pilot training, but his customers disagreed. This trend would continue through the mid-1950s.

Redifon, a British simulator manufacturer, was asked to build a simulator for the Comet IV that included a system for simulating pitch motion. This led to the development of more advanced systems that eventually simulated all six degrees of freedom.

Modern simulators come in many varieties. Simulators for commercial airliners and larger military aircraft tend to be large, cab-like structures that are equipped with full-motion systems and full cockpits while simulators for smaller aircraft such as fighters and helicopters tend to be fixed-base simulators without motion.

Simulators and the Home Computer

When many people think of consumer flight simulator software, the program that first springs to mind is Microsoft Flight Simulator. It is the most visible of the flight simulators available today, but it's not the only one. There is a large market that has everything from virtual airlines to programs that allow budding pilots to fly the latest fighter aircraft. One simulator even allows users to fly over the surface of Mars or in outer space.

The first consumer flight simulator, Flight Simulator 1.0, was released in January of 1980 for the Apple II and Radio Shack TRS-80. It was developed by Bruce Artwick, and the program would later evolve into Microsoft Flight Simulator.

Two types of consumer flight simulators exist. General Aviation Flight Simulators are programs that model civilian aircrafts and flight. They include a wide variety of aircraft, including some military models, accurate weather simulation, air traffic control, and thousands of airports and landing strips around the world. Many of these simulators also allow users to add additional content such as new scenery and aircraft. Some popular civilian flight simulators include Flight Unlimited, X-Plane, and Microsoft Flight Simulator.

The other type of flight simulator is the combat flight simulator. These usually seek to recreate at least one, but sometimes many, military aircraft while allowing the user to engage in combat missions in a variety of time frames. Some popular programs in this category are the Jane's line of combat simulators, the Microsoft Combat Flight Simulators, and Falcon 4.0.

The levels of realism in these programs can vary. Simulators that focus on a few aircraft can be much more realistic than a simulator with many aircraft, although this isn't always the case. Many combat simulations eschew realism in favor of entertainment value—although, again, this isn't always the case. Falcon 4.0 (1998), a jet combat simulation focusing on the F-16 Falcon, has a strong focus on realism and actual air combat tactics.

Several flight simulators can be modified. Scenery can be changed or added to the game to add regions or increase the realism of the game. Users can also create real and fictional aircraft and control panels for the game, greatly expanding the air fleet available to simulator pilots. There are some extensive communities on the Internet that are dedicated to creating content to enhance these simulators.

There are two up-time examples of consumer flight simulation software being used for training. The first instance was in January of 2000 when the United States Navy announced that they would be issuing a modified version of Microsoft's Flight Simulator 2000 to cadets in the Naval Reserve Officer Training Corp. The second example occurred in February of 2002 when the United States FAA approved a full-motion simulator package based around the X-Plane simulator for Commercial Pilot Training.

Microsoft Flight Simulator and X-Plane

Microsoft Flight Simulator and X-Plane are worthy of their own section. They are both general aviation simulations and very capable flight simulator packages. They are also the two best consumer flight simulator packages available that could be used to create a simulator as the scenery, aircraft, and flight dynamics can be modified for increased realism. X-Plane includes tools to modify the simulator with the program while Microsoft makes software development kits (SDK) for its flight simulators available on the Internet. As of April 2000, only a few of the Flight Simulator 2000 SDKs were available, not enough to create a trainer for the Gustav or the Belle.

The fundamental difference between Microsoft's offerings and X-Plane, besides price, is flight dynamics. Like many flight simulators, Microsoft uses pre-calculated tables to determine how an aircraft will perform at various speeds. X-Plane handles aerodynamics differently. Instead of using data tables, X-Plane uses a blade-element theory to calculate the forces acting on the aircraft by breaking down the three-dimensional model. Blade element theory is a series of calculations that were used to model the behavior of propellers.

The primary version of X-Plane as of March 2000 was X-Plane 5, and it retailed between \$75 USD and \$199 USD depending on the source you find. At the same time, there were two versions of Microsoft Flight Simulator—Flight Simulator 2000 Standard (FS2000), and Flight Simulator 2000 Professional (FS2000P). FS2000 and FS2000P were very similar. Both required high end computers. FS2000 retailed for about \$29.99 USD with the professional version selling for \$25 USD more.

One of the primary complaints for FS2000 and FS2000P was the minimum requirements for the software. While Microsoft's requirements stated that a 166 MHz Pentium was all that was needed, many users found that they could barely use the program with a 400 MHz Pentium II unless they had a 3D Accelerator card. While X-Plane had similar hardware requirements, it also included a "Classic" version of the simulator for users who didn't possess top-of-the-line computers.

What Grantville Has—And How They Could Use It

The town of Grantville came back with some flight simulators. These would be the more popular computer simulation programs such as Microsoft Flight Simulator and some combat flightsims like Jane's Fighters Anthology (1997), Falcon 4.0 (1998), and Microsoft Combat Flight Simulator (1998). It's also possible that a copy of X-Plane could be available despite a hefty price tag.

There are a variety of control systems available for computerized flight simulators. Joysticks range from simple two-axis two-button jobs to complex 3-axis flight sticks with programmable buttons and a throttle control. Flight yokes, which attempt to simulate the controls that a pilot would find in most civilian aircraft, may be available in Grantville, but there will be very few of them.

It should be possible for the residents of Grantville to produce their own electronic controllers to use in flight simulators by scavenging parts from video game controllers. There should be some old Nintendo and Atari video game system controllers that can be used to hack together simple joysticks, flight yokes, and rudder pedals. It would require someone with knowledge of basic electronics to build the devices and computer programming to develop the software drivers.

While simple controls should be possible to construct, there probably won't be any custom gauges or displays for any simulators that the air force builds. These are possible with up-time technology, but they require special interfaces and software between the computer and the instrument panel. While one could be hacked together, the resources would be better spent on other projects, such as building radios.

A 1632 Perspective: Why does Grantville need FlightSimulators

Grantville will need flight simulators to supplement the air force's training program. The first ones will most likely be based around a computer flight simulator program as it is simpler to model the plane in the software than it is to create a mechanical simulation platform similar to the Link Trainer. But, as the air force grows and the number of available (and functional) computers shrinks, mechanical training methods will need to be devised.

The main benefit of flight simulators will be as procedure trainers. Procedure trainers are used to teach pilots how to react to specific situations by following a checklist. The computerized flight simulators like Microsoft Flight Simulator include the ability to create instrument and mechanical failures with the benefit of teaching pilots how to react to those situations.

Without high-quality instruments in the aircraft, most pilots will be restricted to visual flight rules (VFR), and as of the Ring of Fire, the technology does not exist in Grantville that would allow for this type of flight simulation. When those instruments are created and added to new and existing aircraft, flight simulators will become useful for instrument flight training.

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My Name is Legion:
by Iver P. Cooper

Copying the Books of Grantville

No down-time visitor can fail to be amazed by the libraries of Grantville. In 1633, Maestro Giacomo Carissimi, writes that the high school has "a library that seems to come out of long-forgotten myths. A fabulous place for the number and for the stunning quality of many of the books." (Toro, "Euterpe, Episode 3," *Grantville Gazette*, Volume 5). That library, by the way, was open twenty four hours a day, a testament to the level of interest in its holdings. (1632, Chap. 24).

Even the book collections of individual up-timers should impress. At least one large personal library is mentioned in canon; the "Congden library": "The room was practically a library in its own right. Outside of a narrow bed, every wall except one was covered with shelving. Cheap shelving, naturally—Freddie wouldn't have allowed anything else. But the books resting on those shelves weren't particularly cheap. No fancy first editions, of course, and only a few of them were hardcovers. But every shelf was packed with paperbacks of all kinds, ranging from children's books George must have gotten as a little boy all the way through dog-eared copies of a history of the American civil war by someone named Foote and a thick volume on the principles of astronomy." (1633, Chap. 17) Another noteworthy collection is the set of military history and wargaming literature assembled by the "Four Musketeers" (Eddie Cantrell and company) (Weber, "In the Navy," *Ring of Fire*). George Blanton has his son Dave's survival books (Jones, "Anna's Story," *Grantville Gazette*, Volume 1),

While the printing press greatly increased the affordability of books, and the number of copies in circulation, that didn't mean that large private libraries were commonplace in the early seventeenth century. Book ownership varied greatly, of course, depending on wealth, occupation, religion and location. Generalization is dangerous, but I would guess that about half of the European down-timers own no books at all. (A substantial percentage of artisans and even merchants lack a library.) Most of the rest own just two or three books, one being the Bible. Less than one in ten will have more than five or ten books (Hall; McCraig, Maxted).

Naturally, the down-timers are interested in history. William Wettin has "checked out—usually several times over—every single book relevant to early American history and political theory there is. And British." (1633, Chap. 12) King Charles knows about Cromwell; Richelieu, about Turenne and Mazarini.

Science, too. Doctor Gribbleflotz learned how to construct a wet cell battery from an unidentified up-time science book. (Probably a children's book, since it has "large printing and colorful pictures".)

(Offord, "Dr. Phil Zinkens A Bundle," *Grantville Gazette* , Volume 7) In 1633, John George of Saxony is trying to capitalize on the revelation of the secret of porcelain manufacture in some Grantville text. (Pedersen, "A Question of Faith," *Grantville Gazette* , Volume 8.)

But the down-timers aren't just reading the encyclopedias, the histories and the science books. Clearly, the "Ram" has read "Doc" Smith's *Galactic Patrol* ("Helmut, speaking for Boskone"). Wallenstein likes mysteries.

The down-timers who have money will commission copies of books of interest to them, to the extent their budget allows. By Spring, 1933, Cardinal Richelieu has already acquired books from Grantville, and "had printed copies made and more securely bound. . . ." He explains to Mazarini, "Hand-copying would have engaged every stationer and monk in Paris for weeks and the originals were too fragile to pass around. So I ordered them typeset and the illustrations carefully cut by the best engravers I could find."

Not everyone can send agents to Grantville. But down-time printers are going to be looking for books which might have a large enough audience to be money-makers if published. And up-timers have had works printed for reasons of their own. Canon reveals some of what has been copied and printed . . .

an abbreviated German translation of *Robert's Rules of Order* (1634: *The Ram Rebellion* Chap 32).

three Agatha Christie mysteries (Robison, "Mightier Than the Sword," *Grantville Gazette* , Volume 6)

the *Shorter Catechism in English* (DeMarce, "Pastor Kastenmayer's Revenge," *Grantville Gazette* , Volume 3)

Paine's *Common Sense* (1634: *The Ram Rebellion*)

The Book of Mormon (1634: *The Ram Rebellion*)

Narrow Gauge at War (Lutz and Zeek, "Elizabeth," *Grantville Gazette* , Volume 8)

RND- and MD-level training materials (Ewing, "An Invisible War," *Grantville Gazette* , Volume 2).

Duplicating the Books of Grantville

What would be involved in making one copy of every distinct title in Grantville? We will start by determining the "copying power" of the would-be copyists, which is a function of

- 1) the speed with which the book can be copied (in words or pages an hour)?
- 2) how much time can the copyist devote (in hours/year) and maintain that speed?
- 3) the number of copyists employed.

We will then compare it with the "wordage" of those distinct titles. To estimate that, we need to know:

4) how many books are there in Grantville? (counting the public library, the three school libraries, the books owned by the various businesses and churches, and the personal libraries of the residents)

5) how many of those books are distinct titles?

6) what is the average length of the books (in words)?

Copying Methods

We need to distinguish how quickly a single copyist can make the *first* copy (transcription speed), versus making each of a large number of *additional* copies (publication speed). A computer-cum-laser printer has the same transcription speed as an electric typewriter, but a higher publication speed. Manual typesetting is slow, even compared to handcopying, but once the type is set, you can rapidly print a large number of copies. So conventional printing has a very slow transcription speed, but a high publication speed. For speed comparisons, see table 1 below.

The fundamental equation is

Effective Copying Speed = Individual Copying Speed X Number of Copyists

In other words, brute force (increasing the number of copyists) can compensate for a low individual copying (transcription or publication) speed. Contrariwise, if a copying method has a limited number of copyists or copying equipment (e.g., typing is limited by the number of typists and typewriters), it may not be as effective as an intrinsically slower method.

There are two ways in which machines can improve the duplication process:

–directly, by increasing transcription speed (typing vs. hand copying); and

–indirectly, in that if they are used to make multiple copies (whether that be by mimeograph, letterpress, photo-offset, dot matrix, laser, or inkjet printing), then the cost of copying the original work can be spread over more purchasers, which means that you can afford to hire more copyists and split the work so it goes faster. Indeed, the ability to generate multiple copies cheaply may determine whether the work is copied in the first place.

If a particular book is in high demand, then it is likely that it will be copied by a method with a high publication speed, even if that method is costly or has a slow transcription speed.

Machines can be divided into three categories: the up-time typewriters, computer systems, mimeographs, etc. which made it through the RoF; the down-time, possibly geared down, equivalents; and machines which already existed in the early seventeenth century (printing presses, pantographs).

Particularly for the first category, we have the following issues:

1) Does it make economic sense for the owner to devote his/her equipment to this use? (for example, the owners of the Pentium IIIs might think they can get a higher price/rental for them for use for say, running an airplane simulator, or for engineering design, or for massive database management, than so their printers can be used to make copies of books. This is a comparative advantage argument.)

2) Regardless of economic sense, will the owner allow it? (I am not sure that my son would give up his computer, and thus his ability to play computer games, even if he would be given a lot of money. Since he would want to spend the money on computer games.)

3) How soon will the up-time machines run out of supplies, or break down? Can we duplicate the supplies and spare parts?

4) Will we be rate-limited by the number of trained operators or machines available?

Cost, of course, is important. If you aren't copying the work yourself, then you must hire a copyist, whether that be a scribe or a typist. In theory, it shouldn't cost more to hire ten typists than one, since the work should be completed ten times more quickly, but because there is a limited pool of typists, you could end up paying a premium for speed.

Machines increase transcription or publication speed, but they too have a price. If you have to buy a mimeograph or a typewriter in order to use it, then you have to be able to justify the capital cost. Cost is less of a factor if you can rent the equipment. (Gorg's "Sewing Circle" says that by October 1631, all the sewing machines in Grantville had been rented out. That's a good precedent.) Note that in the early days of typewriting, if you hired a typist, he or she supplied the typewriter. (That is still true, of course, for students hiring freelance typists to type their dissertations.) If a machine is used to duplicate more than one book, its purchase price can be spread over all the books.

Hand-Copying

I am going to start my analysis with hand copying. Some visitors to Grantville will not be able to afford buying or renting a typewriter or computer system, or hiring a typist, and will be interested in books which haven't yet been (and perhaps never will be) reprinted. And even a few years after RoF, there will be far more people in seventeenth-century Germany who can write than who can type at a typewriter. There is also only a limited supply of typewriters, etc., and those who can't wait for the equipment to become available may find it necessary to copy the books with quill and ink.

The good news is that hand-copying doesn't require anything more than pen, ink and paper, and basic reading and writing skills. The bad news, of course, is that hand-copying is slow.

The alleged handwriting speed record, set in 1853, was 30 wpm. (Topik, 212).

Allcock found an average handwriting speed of 16.9 words per minute in high school students, year 11. A 2001 literature review reported these findings: "average writing speed of young workers who left school at 16 was around 20-21 wpm", a Scottish Examination Board considers 16 wpm to be the minimum writing speed for candidates, writing speeds of 10-20 wpm are "normal at age 15"; and "the average speed . . . for a secondary modern pupil is about 10-12 wpm." (Bishop) It also reported new results; an average speed of 13 wpm for ninth graders.

Hilz (p. 379) says the handwriting speed of 1000 professionals (presumably normal or above-normal adults) was, on average, 15 words per minute. Another recent study says text can be copied at 22 wpm (WikiWPM).

If we assume 40 hours of copying per week, 50 weeks a year, that would be 2000 hours a year, per copyist. At 17 wpm, that is 2,040,000 words per year, per copyist. Compare this to an interesting real-world test of sustained handwriting speed. A news article (BBC) said that a Moldovan girl hand-copied *Harry and the Half-Blood Prince* (607 pages, official word count 168,923) in just over a month because she couldn't afford to have a copy shipped from the UK. So one person should be able

to copy about two million words/year .

Shorthand

Shorthand is likely to be used only for personal notes, or as an intermediate copy for those who are reprinting a book outside of Grantville.

Pantograph

The pantograph is a mechanical device used for duplicating the movements of a hand when writing, so as to generate one or more copies. In 1630, Christoph Scheiner (its alleged inventor) used a pantograph to duplicate drawings. This was a two-arm pantograph, with a pointer on one arm and a pen on the other. The pointer is moved to trace over the drawing, and the pen reproduces it on paper. In the 1632 Universe, Scheiner is sent in 1634 to Grantville, to be the resident astronomer, so it is safe to assume that if pantographs are of any value in the copying project, he will say something about it.

Another kind of pantograph has a pen on each arm, so the scribe is making two hand copies of the book simultaneously. Thomas Jefferson used one to produce file copies of the letters he wrote. This could be a good deal for a scholar of limited means; with no additional labor, two copies are produced instead of one, and the extra copy can be sold.

In theory, it is possible to increase the number of arms, and thus the number of copies made simultaneously. (The term "polygraph" originally referred to a pantograph with additional arms.) The catch, of course, is that more effort is required to move the control pen, because of the mechanical resistance of the more complex and more massive mechanism. Still, giant pantographs, armed with ten fountain pens, were used by late nineteenth century paymasters (Schwarz 228).

An interesting strategy is to forgo the pens, and use a pointer on one arm and a stylus on the other. The stylus could inscribe a copperplate, which can then be used as a template for printing. Pantographs were used at the end of the eighteenth century to make portrait prints (Lewis-Clark.org).

Pantographs increase publication speed, but not transcription speed. If anything, transcription will be a bit slower than normal hand writing, because of the effort needed to move all the hardware. Moreover, despite Jefferson's enthusiasm, pantographs were commercially unsuccessful because of their "constant need for repair and adjustment" (officemuseum.com).

The Lecture Trick

Medieval students obtained copies of their textbooks by having it read aloud by a lecturer, and copying down what was said. The same technique could be used to make multiple copies of any Grantville book. Dictating speed is not likely to be a limiting factor; the lecturer will have to speak slowly so the copyists can keep up.

Unfortunately, all participants must be able to read and write English, which isn't a common skill in the Germanies. And the copies probably won't be identical.

Up-Time Typewriter Inventory

I wasn't able to find any published data on how many people, or households, still owned manual or electric typewriters in 2000 (or any other year). Consequently, I conducted two admittedly unscientific surveys.

Surveying my wife's email correspondents, I got responses from 57 households, mostly in the DC/Baltimore area. There were 30 households with typewriters, owning, collectively, 17 electrics and 25 manuals (total 42). There were a total of 164 people in the 57 households polled. Of those, 88 have access to at least one typewriter within their household. That's 0.1 electrics and 0.15 manuals per person, or 0.3 electrics and 0.44 manuals per household.

On Baen's Bar, I received responses for 24 households, 16 of which have typewriters. They collectively owned 13 electrics and 19 manuals (0.54 electrics and 0.8 manuals per household).

If my email survey results were typical of Grantville, then we could expect 3500 people to own 350 electric and 525 manual typewriters. And of course the Bar survey would paint an even rosier picture.

Canon makes it clear that some manual typewriters passed through the RoF. Musch, "On Ye Saints," says, "Willard returned to hunting and pecking on the old manual typewriter that he had gotten back when he was in high school." (*1634: The Ram Rebellion*). And Clavell, "Magdeburg Marines: The Few and the Proud," includes this passage: "You know, I remember seeing two manual typewriters in my dad's junk. I bet we can use them in Magdeburg." (*Grantville Gazette*, Volume 4). Both manual and electric typewriters are mentioned in *1634: The Galileo Affair*.

Some of the up-time typewriters will be used personally by their owners (possibly to take the load off their computers). Others will be sold to buyers outside Grantville. Only the remaining machines will be available for sale or lease to those seeking to duplicate Grantville's books.

One of the interesting results of my surveys was that many households own surplus typewriters (i.e., more than one). According to my email survey, the 42 households had 12. So, if everyone in the typewriter-owning households didn't mind sharing one typewriter, Grantville should have 256 typewriters which might be sold without too much inconvenience to the owner.

Down-Time Typewriter Production

In *1634: The Galileo Affair*, Chapter 5 contains a passage, set in September 1633, heralding the post-RoF re-invention of the typewriter: "Now there remained only the final edit before any of their dwindling supply of electric typewriter ribbon was committed to the project. And there was another of the many little ironies created by the Ring of Fire. The up-timers considered typewriters "antiques" and made jokes about using them. But down-time artisans would pay a small fortune to get their hands on one—manual typewriters even more than electric—so they could disassemble them and begin designing what would soon become the cutting edge of a new world's literary technology. Indeed, the first seventeenth-century typewriter had just appeared on the market. It was a great, monstrous clumsy thing, which almost needed to be operated by fists instead of fingers. It was also selling like the proverbial hotcakes."

We don't know how many typewriters were produced each month, and the price at which they were sold. These two factors will dictate the impact of down-time typewriters on the duplication of the Grantville Corpus.

The Course in Modern Production Methods (1919), p. 120, says, "Each [typewriter] machine contains about 2500 individual pieces, each of which passes through from 6 to 30 machining and other manufacturing operations. Many trades and handicrafts are required for their production." An antique typewriter expert told me a manual typewriter has 2,000-3,000 parts.

In order to judge the rate at which typewriters might be manufactured, it is helpful to compare them with clocks and sewing machines. However, a typewriter is a lot more complicated than either. A clock is certainly one of the more complex devices which were made by the down-timers on the eve of RoF. Judging from nineteenth-century examples, the down-time clocks had at most a few hundred parts. An 1830s Jerome clock contains "fewer than 100 parts, of which about 10 were moderately complex gear wheels and escapements (stamped) and the rest were mostly bolts, nuts, pins, axles, bushings, washers, and flat stamped casing parts." (Ayres 3). A nineteenth-century tower clock movement has 100 to 500 parts, with the average being 250 (Frank). Frank says that his average time for restoring a movement is 30 minutes per part. Presumably, it would take several hours to make each component from scratch.

In 1680s Geneva, "there were more than one hundred masters and about three hundred workers who produced more than 5,000 timepieces a year." (Cipolla, 65) That implies that each shop (a master and three workers) produced about twelve a year. If their work week was fifty hours, then over eight hundred hours went into making each timepiece, an average of over three hours per part. If a typewriter has ten times the number of parts as a clock, and thus takes ten times as long to manufacture, then that suggests that a similar shop would take almost a year to make a single typewriter. Of course, if enough clockmakers start making typewriters, the total production could be significant.

According to canon, sewing machines were first manufactured in the 1632 Universe in October, 1631 (Gorg Huff, "The Sewing Circle," *Grantville Gazette*, Volume 1). An 1860 sewing machine had 100-150 parts (Ayres 3); one from 1875, about 150. (Groover 36). Trent, in "The Sewing Circle," says that the HSMC machine uses about 100. Karl Schmidt, in the same story, predicts that sewing machines will be manufactured at a rate of more than one a week. Let's say, one every three workdays. Then a typewriter might take 13-30 times as long; that is, one could be made in 40-90 workdays.

With time, some of the parts will be machine-made rather than hand-made. That is, HSMC made what Gorg calls "production machines," by which he means machines which can be used to make some of the parts and thereby speed up production. That technique would probably work better with typewriters than with sewing machines. The reason is that the key lever and type bar mechanisms are essentially identical for each key. The principal difference is that there is likely to be one rod in the key lever mechanism which varies in length depending on the placement of the key. On a Monarch manual typewriter, I counted 42 typing keys. If each key lever-type bar mechanism was 50 parts, and the total parts were 2500, then machine production of the key lever-type bar mechanism would reduce the required handwork by 80%.

Electric typewriters have fewer parts. The original IBM Selectric was a bit over 1,000 parts, the 1990 version under 200 (Utterback 142).

Typing Speed

How much of a difference would typing (whether at a computer keyboard or a typewriter) make? Less than you might expect. Yes, an up-time legal secretary might type 80-100 wpm on an electric. And the manual QWERTY typewriter speed record (Margaret Owen, 1918) was 170 wpm (Schwarz, 464 n. 46). But there are going to be very few expert typists in Grantville and they aren't likely to be persuaded to type books. The normal up-timer is going to be slower.

One study (Ostrach) found that among 4,000 people who claimed they knew how to type (and were seeking a clerical job), the mean raw speed (unadjusted for errors) was 40 wpm (median 38). A clerk/typist might need to type 35-40 wpm, a secretary 50-60, and a word processor or legal secretary 70 or more (Loveday; federaljobs.net).

Finding and Training Typists

Judging from the Grid, there are perhaps thirty up-timers who have worked as secretaries and therefore presumably have high level (50+ wpm) typing skills. There are probably some hundreds more who type their own documents on the computer, at speeds probably in the 20-40 wpm range.

Even if an up-timer knows how to type, recruiting him or her to do so isn't going to be easy. Chances are they have other knowledge which is even more salable—even if they were secretaries prior to the RoF.

So we have to acquire the typewriters and set up a training program. There probably wasn't much training of down-time typists until the Croat Raid established Grantville's "survivability," and the formation of the Confederation of Europe meant we suddenly needed a lot of bureaucrats. At the North Marion Technical Center, the "Keyboarding I" class is one semester, one period. That probably is equivalent to sixteen hours in the classroom, and an equal amount of homework.

With five teachers and a hundred teaching machines, we could probably produce a crop of a hundred new typists every six weeks or so. It wouldn't be too many months before the bottleneck was the number of typewriters, not that of typists.

I am going to assume that the average typing speed of those recruited for book duplication is initially 34 wpm (conveniently twice my assumed hand copying speed). Eventually, I expect this to rise to about 50 wpm, once the pool of down-time typists is large enough so we can pick and choose. The really fast typists will probably be executive secretaries or typing teachers, and not involved directly in the duplication project.

Carbon Paper

Carbon paper can be used with both hand copying and typewriting. The supply of up-time carbon paper is probably quite limited, as it was rendered virtually obsolete by the photocopy machine. However, there are probably some forms with carbons, and these could be used as models for designing down-time equivalents.

In its heyday, specialty carbon paper could be interleaved with copy paper to make as many as 10-25 simultaneous copies (Schwarz 228, 463 n. 43; officemuseum.com). However, the copies are obviously

inferior to the original and therefore will command a lower price in the marketplace.

Spirit Duplicators and Mimeographs

A spirit duplicator (ditto machine) used a two-sheet spirit master. Writing on the master caused a colored wax to be transferred from the second sheet to the back of the first sheet, producing a mirror image. The first sheet was then placed on a drum, waxed side out. A solvent (the "spirit," usually an isopropanol-methanol solution) extracted the pigment (usually aniline purple) from the wax so as to transfer the image to the paper run past the drum. A single spirit master could be used to make a few hundred copies. If you wanted more, then you typed another master. The hand-cranked Ditto D-10 (1954) was advertised as capable of making 120 copies/minute (officemuseum.com).

A mimeograph uses a single sheet stencil, made of waxed mulberry paper, and a cardboard backing. Writing on the stencil removed the wax. As with a spirit master, the mimeo stencil was placed on a drum. However the mimeograph drum is filled with a true, oil-based ink, which penetrates the paper wherever the wax is missing. With one mimeo stencil, a run of several thousand copies is possible. The A.B. Dick Model 75 Rotary Mimeograph (1904) produced 45-50 copies/minute; later models, 100 (Answers.com; officemuseum.com).

The masters for these processes can be prepared by hand, typewriting or impact printing. If a typewriter is used, the typewriter ribbon is removed or raised, so the type makes an inkless impression. In essence, it means that a single typewriter can be used, with a little additional work, to make hundreds of copies of the same typed page. The copies are not, mind you, of high quality, but they should be readable. Certainly, not significantly worse than a carbon copy.

The down-time adaptation of stencil technology was placed into canon by Virginia DeMarce's story "Mail Stop" (*Grantville Gazette*, Volume 9). In March 1633, Arno Vignelli, an Italian engineer, told a Bavarian official about what he saw at a museum in Grantville. One of its "curiosities" was a mimeograph. Vignelli thought he could make one. "With enough time and money and workmen. It would be difficult and very expensive to make, with much hand-fitting of metal parts, especially teeth, and the need for several springs, but it could be done." Vignelli also saw a hectograph. "Much simpler, but calling for more complicated inks."

Vignelli devised a "duplicating machine" which ran copy paper, a mimeograph stencil and a protective sheet between rollers and across an inked pad. Vignelli thought—but didn't promise—that 100–1,000 copies could be made from a waxed silk stencil, and 25–100 from a waxed paper one. By "several weeks" before his meeting in Bonn, his shop had ten completed machines, and another five almost finished. They aren't complicated devices.

By late April 1633, in Frankfurt am Main, "the gossip (among printers) was all about the new 'duplicating machines'" which Vignelli is selling. At least two local printers had bought them.

Ditto and mimeo copies have two disadvantages. First, they are of obviously inferior quality. Secondly, you don't have the option of simultaneously making a nice typed original and a stencil for mimeo production. Either you have a ribbon in the typewriter or you don't. Now, if you could wire two electric typewriters so typing on one caused the other to "echo," you could have your cake and eat it, too. . . . (This would be more difficult to do with two manual typewriters, since it takes a lot of force to get a good impression.)

Computer Systems: Text Input

In August 2000, 51% of households had at least one computer (Census Bureau P23-207). It's been estimated that there are 750 reasonably up to date computers and 150 "scrap" ones in Grantville (Bartholemy).

The typical computer-based copying system comprises either a keyboard or scanner to input the text, the printer to output it, and the computer to serve as the intermediary. It may be possible to create a homebrew system in which the keyboard sends data directly to a printer, but obviously that requires some electronic skills and parts.

Keyboarding text into a computer is no faster than typing it at a typewriter. The advantage is that the text can be stored electronically, and that it can be sent to a computer printer which can make multiple copies a lot faster than could be done with a typewriter alone (in other words, the transcription speeds are the same, but the computer system has a higher publication speed).

Book scanning is something of a nuisance. The original must be correctly positioned on the scanner window (books have a tendency to shift), and then you do a preview scan. If you are happy with the result, you do the real scan. You can scan 2–3 pages/minute (ppm)(own testing; Cohen; Project Gutenberg). Double that if you scan two pages simultaneously.

It can be tricky to get a book to lie flat enough so that you can scan the entire page of text, especially if it has a narrow "gutter." In fact, you might have to unbind the book (e.g., with a guillotine cutter) in order to make a successful scan.

In theory, unbinding also allows you to use a scanner with an automatic document feeder (if any are available in Grantville), and thereby increase scanning efficiency (to perhaps 25 ppm). The catch is that books often have pages which are too small, large, thick or thin to make the ADF happy, and it jams up. Another problem with thin paper is "bleed through." (Adams)

If the book page is scanned in, then you either need optical character recognition software to convert the image into text, or a graphics quality printer. Printing graphics may be slower than printing text. However, OCR processing will require another 12–60 seconds/page.

Some books, because of their fonts and layout, will be better suited to OCR than others, so it may pay to limit OCR to the works best suited for it. Sometimes, OCR is used just to generate a searchable database to supplement a scanned image (Cohen). OCR works best with unbound sheets, avoiding page curvature, gutter shadow, etc.

A final possibility is to use speech recognition software. Achievable dictation speeds are variously reported as 40–160 wpm (Johnson, Kramer, Devine, Griffith, Patterson)(punctuation and digits count as words). Errors are common and, when correction time is taken into account, typing is faster even for slow typists (Hah).

OCR and Speech recognition software were commercially available as of RoF, but we don't know whether they existed in Grantville. There was almost certainly OCR software bundled with the scanners, but those were most likely "limited" editions. We don't know if anyone upgraded. Speech recognition software might have been owned by someone with a disability hindering typing.

Computer Systems: Text Output

The principal kinds of computer printers which might be found in Grantville are daisy wheel printers, dot matrix printers, inkjet printers, and laser printers. In 1997, 85.5% of home computers were equipped with printers (Statistical Abstracts 2000, Table 912). (Those which nominally lacked a printer were probably sharing one with another computer.) Grantville probably has over 600 printers.

Daisy wheel printers use a spoked wheel; there is a raised letter at the end of each spoke. The printer controller spins the wheel to the appropriate position and then a pawl strikes the back of the selected spoke. Daisy wheel printers were superseded in the late eighties by dot matrix printers.

Daisy wheel printers can only produce character-based graphics (with an appropriate daisy wheel bearing the characters). The other three printer types can produce dot (pixel)-based graphics and hence are far more suitable for reproducing illustrations.

Dot matrix printers produce characters by using tiny electromagnets to drive pins against a ribbon, causing a dot to appear on the paper. Each character is the result of a particular pattern of dots. DMPs have a very long working life and, in addition, it should be possible to build at least draft-quality DMPs within a few years after RoF.

To take maximum advantage of our DMPs, we need tractor-fed paper. The supply in Grantville is probably pretty small, so the ability of down-time papermakers to duplicate it is going to have a significant effect on the long-term utility of DMPs. Tractor-fed paper has regularly spaced holes on both sides to receive the tractor pins, and ideally has seams for separating the pages and removing the holes when the run is complete.

Dot matrix printers were eclipsed by laser printers for general purpose printing, and the DMPs in Grantville are probably nestled away in attics and basements. They are going to come out of storage because, like the even older daisy wheel printers, and unlike laser or inkjet printers, they can be used to make stencils.

The laser printer is, essentially, a modified photocopy machine, with similar paper requirements. The principal advantage of inkjet printers during the Nineties was that they could be used to produce color prints; laser printers were faster and had a lower page cost. There are undoubtedly inkjet printers in Grantville homes, but the businesses are more likely to have laser printers.

Computer Access

Typing at a computer keyboard, of course, is no faster than typing at a typewriter. There are two advantages to typing at a computer; you obtain computer-searchable text, and you can take advantage of fast computer printers (especially dot matrix and laser) to print multiple copies. They aren't necessarily faster than a mimeograph, but the reproduction quality is higher.

Scanning is definitely much faster than typing—especially if you are content to print the scanned image per se. In 1999, 36% of internet households had scanners (InfoTrends). In August 2000, about 81% of computer households had internet access (Census Bureau P3-207). So I would estimate that there are around 200 scanners in Grantville. Scanning is a fairly processor-intensive process, and it is possible that

some computers with scanners will be set up as dedicated scanning stations for time-critical duplication jobs.

Computer printers provide a combination of print quality and speed which is exceeded only by photocopier machines. The problem is that the computers have so many uses, other than for simple text input and output, and the scanner, keyboard and printer can't be used without the computer.

It has been argued that the computers usually have plenty of spare processing power, and hence can be used to print queued jobs in the background (or, for that matter, when the computer would otherwise be idle or turned off). Indeed, those jobs could be sent to them over a Grantville network. Hence, the up-time owner could earn some extra cash by participating in a network-based "printing cooperative."

That's true, but there are a few caveats. First, there may be other jobs which can be run the same way but which can earn more money; e.g., engineering modeling, or calculating reference tables. There are hundreds of possible tables; it isn't just construct a log table and then you're all set. Secondly, there is a hidden price. If the computer is kept on all night to run print jobs, then it is going to fail that much sooner. Finally, there is only a limited supply of suitable paper for the computer printers, and it's uncertain whether it can be duplicated well enough with down-time technology. The same, of course, is true of the toner for the laser printers.

Photocopiers

For the purpose of this article, I am going to assume that photocopies will be made for down-timers only in limited quantities. The most prominent example, of course, is that which appears in Viehl, "A Matter of Consultation" (*Ring of Fire*): William Harvey (the personal physician to King Charles of England) was able to obtain copies of four medical texts and, more ominously, "a few pages" from Trevelyan's *History*. In agreeing to have the copies made, Ed Piazza comments, "We have to conserve its use these days, but doing the books are no problem. Especially after your generous gift of coffee, and telling us where to find the Turkish traders to buy more."

A Kinko's in 2000 might have had a 100-200 ppm copier, but the photocopier machines in Grantville are not likely to be the ones which were state-of-the-art then. The schools and the public library might have 40 ppm machines. The churches, the banks, the accounting firm and the real estate agents probably made do with 20 ppm copiers. Perhaps another fifty businesses have "personal" (8 ppm) copiers (which may in fact be dual-duty laser printers or fax machines).

In copying bound volumes, one can waste quite a bit of time positioning the book on the window, especially if the book page is larger than the paper size and you're trying to make sure that all of the text gets copied. You might spend five seconds flipping the page, flattening down the book, and making sure it is where it should be. The copier then has to at least partially warm up again. This rigmarole limits the effective speed to 10–20 copies/minute, even if the rated maximum speed of the machine is higher. On the bright side, with a small book, or a copier which can handle large format copy paper or with reduction capability, you might be able to copy two pages at a time.

Assuming 10–20 copies/minute, 300–600 words/page, and 1–2 pages/copy, the effective transcription speed of the photocopier is 3,000–24,000 wpm, making it, by far, the fastest *transcription* technology in Grantville. If you are willing to unbind the book, so the pages can be fed automatically into the copier, the actual copying will be even faster.

Let's now look more closely at the issue of how long the photocopiers will be operational.

Paper. Photocopiers are extremely finicky about their paper, and it is doubtful that sufficiently high quality paper can be made down-time in the first few years after RoF. A 20–25 ppm photocopier might be used in an office with an average monthly volume of 8–10,000 copies, a 35–45 ppm machine in one making 10–20,000 copies/month (Monash). It is unlikely that the office kept more than a month's stock of paper on hand. The total stock of paper for the ten office-grade(20+ ppm) copiers is probably about 80–100,000 pages. The personal copiers are likely to have low copy volumes, perhaps 500 pages/month. The average user probably has 500–2,500 pages paper on hand. That gives us another 25–125,000 pages which could be run through the office copiers. So our total photocopy paper supply is probably on the order of 100–200,000 pages. Sounds like a lot, but a single encyclopedia is probably 30,000 pages.

Toner. A toner cartridge might be good for 4000–8000 pages. There are probably two or three replacement cartridges on hand for each office copier, and just one for each personal copier. The toner cartridges aren't interchangeable between models. It isn't going to be easy to manufacture replacement toner; particle size and melt point are critical, and modern formulations contain polymers as well as carbon.

Typesetting and Letterpress Printing

There are several publishers in Grantville. The Grid suggests that the Grantville Times was in business pre-RoF. Times Printing Press is a subsidiary of the Grantville Times, founded in 1631, with the aid of Arnold Selfish, down-timer printer from Leipzig. Staff includes six down-timer pressmen and four down-timer translators. There is also the Grantville Free Press, the Grantville Daily News, The Street, and the Grantville University Press, all presumed to have their own presses. It wouldn't surprise me if independent printers set up shop in Grantville.

Publishing was a big business in down-time Europe, and some books will be purchased (or borrowed) in Grantville, and reprinted elsewhere—especially in Germany, the Netherlands, England, France, Venice, and Florence. The work can be typeset in Grantville, and "flongs" (lightweight molds of the set type, made of papier-mache, plastic or rubber) shipped to foreign presses. They in turn can prepare "stereotypes," printing plates made by pouring metal into the flongs. Stereotyping was invented in 1730 and perfected in the nineteenth century.

A typical sixteenth-century print run was 1,250 copies, but runs of 3,000–4,000 were not unusual. The big runs were typically religious (the first edition of Luther's German Bible was 4,000) or legal (the commentaries were good repeat sellers to law students). However, a run of over 3,000 copies of a volume of erotic Latin poetry has been documented. (Jardine, 160–1) What that says for the prospects of Harlequin romances is uncertain. A printing press could use 1,500 sheets a day, and paper was about two-thirds of the cost of production (Jardine, 162).

The bottleneck in seventeenth-century printing is typesetting. Manual typesetting is slow. The winner of a late nineteenth-century hand typesetting championship "produced 2,277 ems of correctly spelled and spaced type per hour." Even production of more than one thousand ems per hour was enough to earn a hand compositor the nickname, "the velocipede." (Sonn, 150). If an average word, including the trailing space, is six ems, 1200 ems/hour equals 3.33 wpm.

I will leave it to someone else to determine how soon the automatic typesetting machine (e.g., Linotype) will be re-invented. I would be very surprised if this happened before 1635. Likewise, I am ignoring

photographic printing methods (other than photocopying).

Proofreading and Correction

Scribes, typists, typesetters and text input software (OCR and speech recognition) have one thing in common: they all make mistakes.

Down-time printers were surprisingly tolerant of typos; Erasmus complained that books were set with thousands of mistakes, rather than hire proofreaders.(Jardine, 228). However, I expect at least part of the Grantville corpus to be treated with more respect.

In estimating the time (and expense) needed to make accurate copies of the books of Grantville, we must include proofreading (checking just for faithfulness to the original) and correction time.

Proofreading by inspecting the typed copy, and looking back at the original when something seems wrong or prone to error, can be done at speeds of 120–200 wpm (WikiWPM; Wald, ViaVoice, Weiler). The safest method of proofreading is to have one person read aloud (probably at 100–160 wpm) the original text while another checks the copy. If the transcribed text is computerized, text-to-speech software can be used. If the text has many errors, proofreading speed is reduced.

The correction time will depend on the number of errors (OCR and speech recognition are error-prone) and on the copying method. It takes time to find as well as fix the error in the document. Correction can be as easy as a global search-and-replace, or as hard as repairing an improperly cut stencil.

OCR character accuracy in 2000 was somewhere in the 90–99% range, depending on the quality of the original (ComputerWorld; Rice). What does 90% accuracy mean? Well, if a page is 300 words, and the average word is 5 characters (ignoring spaces), we have 1500 characters, and 150 mistakes among those characters.

In modern typing tests, the standard penalty per error is 2 wpm. However, that assumes that the typist is working at a speed of 50–60 wpm, and thus that each error takes about two seconds to correct. In my opinion, that's on the low side; in the mid-1900s, the penalty was 10 wpm/error (Wikipedia, "Typewriter").

Still, let's say it takes two seconds to correct each mistake in a 30 second scan-cum-OCR; 300 seconds for 150 mistakes. So, for corrected output, our speed is 300 words/330 seconds (<1 wpm). Increase the OCR accuracy to 99%, and the effective speed is still only 5 wpm. Of course, we could choose to publish uncorrected OCR'd text, or limit checking to numbers.

The total proofreading/correction time on the U. Michigan "Making of America" project (scanned nineteenth-century documents) was 8–9 minutes/page (vs. 2 seconds/page for the OCR processing)(Shaw).

Speech recognition software, in 1998–9, had a word error rate of 5–15% for dictation at 40–160 wpm (Devine, Kramer). Word errors, unlike character errors, destroy the meaning of the sentence so proofreading is critical. (typewell.com)

For computerized text, some improvement in proofreading speed can be achieved by use of spell-checking software. If it is set to replace without user approval, you can increase effective speed, but

the software will introduce some errors of its own. If net OCR accuracy were nonetheless raised to 99.9%, effective speed would be 200 wpm.

A big advantage of the photocopier (and other photographic transfer processes) is that you don't have to worry about proofreading, just check that the page wasn't cut off and the text is legible. The same is true if you are just printing a scanned image.

Table 1: Speed Comparison

| | Estimated Full Day Transcription Speed or Processing Speed (italics) | Publication Speed (additional copies from master) |
|---|---|--|
| Hand Copying* | 17 wpm | Can be used to simultaneously make stencils or carbon copies |
| Typewriting* | 35 wpm initially, eventually 50 wpm | |
| Computer Keyboarding | Same | "master" is in computer memory |
| Scanning without OCR (bound) | 600–3,600 wpm | |
| Scanning without OCR (loose) | up to 15,000 wpm? | |
| OCR | 50–500 pages per hour | |
| Scan Bound +OCR, uncorrected | 200–1200 wpm | |
| Scan+OCR+correct, if OCR 90-99% accurate | 1–20 wpm? | |
| Daisy Wheel Printer* | computer input | 0.5–1 ppm |
| Dot Matrix Printer, high speed draft* | | 8–16 |
| Dot Matrix Printer, NLQ* | | 1–4 |
| Inkjet Printer | | 8 |
| Laser Printer | | 8–24 |
| Spirit Duplicator | | use * to make stencil master |
| Mimeograph | | |
| Photocopier | 3,000–24,000 wpm (bound) 12,000–48,000 (loose) | 40+ |
| Typesetting and Printing | 3 wpm for setting type manually | 1,500 sheets/day (16C) 250/hr (1911 hand press) 200,000/hr (1911 double octuple)(8 pages/sheet) |

(Page assumed to be 300–600 words; average word, five letters plus space. Italicized technologies don't produce printed copy by themselves.)

Choice of Copying Method

I assume that the copying of the corpus is going to be sought mostly by down-timers. The down-timers don't have routine access to photocopiers and computer systems. I suspect that sale of such equipment

by the up-timers will be rare, and rentals will be quite expensive. The up-timers are well aware that both supplies and spare parts for that equipment are limited and will tend to reserve them (especially photocopiers) for their own use. There will be exceptions made for people like Gustavus Adolphus and the Abrabanel-Nasi contingent, but most interested down-timers will have to copy material by other means.

Those other means, of course, are hand copying and typewriting. Until September, 1633, the only typewriters available will be those of up-time provenance. It is debatable how willing the up-timers will be to sell or rent these. On the one hand, they will undoubtedly command a great deal of money (at least the manual typewriters, since those can be used outside of Grantville), and some of the up-timers are going to be in straitened circumstances (e.g., they were living on Social Security, or their jobs are irrelevant in the new economy). On the other hand, the up-timer, if able to type, can use the typewriter to make a living. There will also be a tendency to use typewriters, when possible, instead of computers, in order to conserve the latter.

A typewriter, of course, produces more legible copy than what can be done by hand. And a trained typist is at least two or three times faster than a scribe. But if those were the only advantages of the typewriter, they probably wouldn't be enough to justify buying one for use in duplicating books. The early seventeenth century was an era in which complex mechanisms were much more expensive (when available) than labor, even literate labor.

The key point (credit to Gorg Huff) is that the typewriter can be used, in conjunction with a mimeograph machine (or equivalent), as a "micro-press." If you can identify a sufficient number of books for which there is significant demand (say, a hundred copies), and the customers are willing to put up with the limitations of a ditto or mimeo copy, then the capital cost of the typewriter and mimeograph are spread out over all of those titles and customers. Naturally, it would be smart to collect subscriptions before you even started the reprint process.

If there are only a few people interested in a book, they will probably need to make, or commission, a hand or typed copy. It isn't much extra trouble to simultaneously prepare a speculative "sales" copy or two with the aid of a pantograph or carbon paper.

When the level of interest justifies a print run of hundreds, we are talking about typing a stencil and then duplicating by means of a spirit duplicator, mimeograph, or "Vignelligraph."

The picture changes somewhat if substantial computer resources can be invested in the duplication process. If you just need one copy, the combined speed achieved by scanning, followed by dot matrix printing in graphics mode, is about 0.5-3 ppm, more than ten times faster than typewriting.

On the other hand, for making large numbers of copies of textual material, it is still faster to print from a typed stencil than to use a dot matrix printer.

When the demand is for thousands of copies, the book will probably be reprinted by a conventional printing press. The copy quality is far higher, and the cost is spread over a large number of purchasers.

Work HoursPer Copyist-Year

We also need to decide how much time is spent by each copyist, per year. I realize that ten hour days, with only Sunday off (a 60 hour work week), were not unusual in this time period. But copying is not

something that can be done accurately and efficiently if work is prolonged. Even if you are a Dickensian scrivener.

Consequently, I am going to assume 2000 copy hours per copyist year. But 3000 certainly isn't impossible.

The Encyclopedias

A reasonable initial target for copying and printing (and, eventually, translation) would be the encyclopedias, especially the 1911 encyclopedia (only two copies known). Chances are that Grantville itself would want to increase the number of copies available, to minimize the risk of loss as a result of fire (not to mention Croat raids!).

The 1911 EB is over 44 million words. Call it 45. So, by itself, it is a 22–23 copyist-year project with the liberal copying allowances made above. Half that, if you are using typists instead of scribes.

The modern Encyclopedia Britannica claims ([Error! Hyperlink reference not valid.](#)) to have over 44 million words, and thus is comparable in size to the 1911 EB.

According to Wikipedia, the 2004 edition of the Encyclopedia Americana contains 25 million words, and Collier's Encyclopedia (1997 edition?), 21 million.

The World Book Encyclopedia is about 10,000 pages, but I don't have a word count. Likewise, I know Father Mazza has a copy of the Catholic Encyclopedia, but not its statistics.

Since the encyclopedias are in heavy demand, there is likely to be a special protocol for getting them duplicated. It would be wise to set up typesetters inside the high school building so the encyclopedia doesn't have to travel far. I figure one volume at a time would be withdrawn from circulation. Options include

1) bring the volume to the onsite typesetters and set directly. (The printing can be done offsite.) This is faster and more accurate than if they work from an intermediate copy, but other users will be screaming.

2) Hand copy (or type) first. Then typeset from the intermediate copy. This will delay printing but keep the book in circulation.

3) Photocopy the volume first, then typeset from the photocopy. That's the fastest method, but it will require devotion of our limited photocopy resources.

4) scan the volume, OCR, correct the text, and print to a computer printer. That has the advantage of creating electronically searchable full text useful for data mining. We could decide to speed things up by doing an uncorrected preprint.

5) scan the volume and print each page, as a graphic image, to a computer printer. That is faster than #4 and, if we can burn CDs to store the graphics, we can do the OCR at our leisure.

In an ideal world, we would probably pick option 3. Unfortunately, even the 1911 EB is close to thirty thousand pages. While paper is available in early seventeenth-century Europe, it doesn't meet the specifications for modern copiers. It is very doubtful that we have that much proper copy paper in

Grantville. And even if we do, we might not have a matching supply of toner.

It has been suggested that the library might have the encyclopedias being rebound so each of the standard volumes is split into several smaller sections. That would allow for more people to use the encyclopedias simultaneously, and it would also mean that only a smaller section is held out of circulation for typesetting purposes.

Number of Books in Grantville

Catch-22. If I explain exactly how I came up with my estimates, some readers will be bored. And if I don't, some readers will complain that my estimates aren't justified. So, I am providing a telegraphic, bare-bones explanation here, and if you want all the details, look in the "Books of Grantville Appendix" I have posted to www.1632.org.

In a bottom-up estimate, we look at each kind of library, estimate its holdings, and add up. We need to look at the three school libraries, the public library, books at places of business, and home book collections.

| Table 2: Books in Grantville Estimate | |
|--|---------------------------------|
| Category/Basis | Estimate |
| School Libraries: (1) 2001–2 enrollment in <u>Blackshere</u> Elementary, Mannington Middle or North Marion High (WV DoEd) X 1999–2000 average number of books/pupil nationwide, all grades [17] (NCES) (2) 2001 modal library size as function of school size (ELS:2002) (3) avg elementary or middle school (4) avg high school (5) avg 200–499 students (6) avg 750–999 students | see below |
| Elementary School Library (437 students) (1) 7400 (2) borderline between 60.1% at <8000 for 1–399, and 46.1% at 8–16,000 for 400–799 (3) 9375 (5) 8583 | 8000 |
| Middle School Library (390 students) (1) 6600; rest as above | 8000 |
| High School Library (943 students) (1) 16000 (2) 53.7% at 8–16,000 for 800-1199 (4) 13164 (6) 12886 | 13000 |
| Public Library (WVLC 2005 data for Mannington Public Library) | 24000 |
| Place of Business ~100 businesses (from Grid) X 10 books/business (my guess!) | 1000 |
| Home Libraries (1) 162, books per family household with children, nationwide (Kelley) / 2.62, avg size of family household (Statistical Abstracts), = 62 books/person, X 3500 (population Grantville) =217,000. But only 28.9% of residents are in family households with children. (2) Given Grantville education demographics, and 2003 adult reading habit data (NCES 2006), 85.6% predicted to have 25+ books in home; if acquiring books is a Poisson process (worst case assumption), avg is 30.5 books. X 3500=106,750. 28.9% of 62 + 71.1% of 30.5=39.6 books/person. X 3500=138,600. (3) reduce size per ratio of total library circulation per capita in Marion County WV (2.9) to nationwide value (6.4); =62,500. (4) if only non-family households are so reduced, 28.9% of 62 + 71.1% of 45% of 30.5=27 books/person =95,000 books. | 62,500–217,000 |
| Total Bottom-Up Estimate | 116,500–271,000 33-77/person |

I have also made a top-down estimate of the number of books sold to Grantville residents, based on per

capita book sales (adjusted for the lower interest in books in Marion County) and a simple "discard then buy" model of book purchasing and discarding. Public library annual discard rates seem to be in the 0.2–7% range. For a discard rate of 5%, the model person had 64 books at age 40. For a rate of 1%, the person was left with 122 books. For details, see the Appendix.

Taking this into account, I decided to use, as my final estimate, 50 books/person (15 books/person from public and school libraries, 35 personal), or **175,000** total.

Distinct Titles

What we want to know is not how many distinct titles are in each of the libraries mentioned above, but how many there would be if all of those libraries were merged. I have looked at the distinct titles/holdings figures for a variety of individual public/academic libraries and library consortiums. I found a linear relationship between log titles and log holdings (R²); a holding of 175,000 is predicted to have **74,000** distinct titles.

However, a large library consortium might include 100 libraries, each with tens of thousands of books, and might make some effort to avoid duplication. Whereas we are looking at 3500 personal libraries, each with just tens of books, plus a few larger libraries, with minimal effort to avoid duplication. Consequently, I believe that the number of distinct titles in Grantville could be as low as **35,000** (20% holdings).

Distinct Corpus Size

So, it's time to multiply.

35,000-74,000 distinct titles

*70-100,000 words/book (see Appendix)

=2.45-7.4 billion words!

Of course, it is uncertain whether every book in Grantville will in fact be completely copied. Some researchers will read the books, take notes, and only copy key passages.

My First Copy Time Estimate

So, to hand-copy 2.45–7.4 billion words, at a rate of 17 wpm, working 2000 hours a year, we would need 1200–3600 copyist-years!

That's not counting time for negotiating with people to let you borrow books from them, picking up and returning the books, cataloging what you have copied so you ignore duplicates, etc. It also ignores that you are competing with other would-be readers and copiers for access to the works.

If typewriters, with "average" typists, are twice as fast, we would need only 600–1800 typist-years to accomplish the same goal. Thus, it could be done with 300–900 typewriters, and typists, working for two years. I think it probable that no more than 200–300 typewriters/typists would be devoted to the duplication project, and that would mean it could take two to nine years to be completed. The typing produces one typed copy or possibly a few hundred "ditto" copies or a thousand or so "mimeo" copies.

Obviously, it isn't necessary to assume that all of the work is done by typists. But each typist (equipped with a typewriter) is worth at least two scribes. And typesetting is about one-sixth the speed of hand copying, so to truly reprint all the books with a letter press could take several decades.

In any event, it is important to recognize that all that hand-copying or typing accomplishes is to disseminate modern English texts. Which brings us to the translation problem.

Translation

Most down-timers are going to have trouble reading twentieth-century American English. So for the corpus to be useful, it will have to be translated. Most likely, into Latin, although there will probably be German and French translations, too. And there will be demand for down-time annotations, as well.

A common modern standard for translation is 2500 words a day (proz.com). With translators working five days a week that would be about 650,000 words per translator year. And translating a 100,000 page book would nominally a 40 day job.

The trouble with use of this standard is it makes a lot of assumptions: a professional translator (probably a native speaker of the target language and fluent in the source language) who is familiar with the subject matter of the book. But for down-timers, a lot of the social and technical referents will be very confusing. This subject was explored in some detail in Turner, "Non-Fiction: Exegesis and Interpretation of Up-Timer Printed Matter," *Grantville Gazette*, Volume 6.

My guess is that the translators will be lucky to achieve 500 words a day if they want the translation to be a sensible one. But even at 2500 words a day, five days a week, translating two billion words would take over 3000 translator-years. Translating just 1911EB would require 69 translator years.

Conclusion

One of the great tragedies of history was the destruction of the Royal Library of Alexandria. The library contained perhaps 500,000 scrolls (the number of individual works is even less certain), and drew scholars from all over the Hellenistic World. There are many ancient manuscripts which we know once existed, and probably were held by that library, but which we know of nowadays only by reputation.

The Grantville Corpus rivals the Royal Library of Alexandria in size, but its loss would be far more devastating. The only way to ensure that it is not lost through some mischance of war or nature is to reprint it.

Bibliography

The Bibliography for this article is in the Books of Grantville Appendix, posted at www.1632.org.

Aircraft in the 1632 Universe

by Gorg Huff

The essence of the Ring of Fire was the knowledge, ideas and information that it provided to the Early Modern period. Perhaps the least predictable aspect of the Ring of Fire was the order of inventing. In our own history the railroad (1804) came a century before the airplane (1903). Now, I know someone is going to correct me here. They will point out, quite accurately, that the Englishman George Cayley made a glider flight in 1856. That the Montgolfier brothers flew in a hot air balloon in 1783. That several other people are credited with the first powered-flight in various parts of the world any time from the late 1880s to 1905. All true, all true. So what? If you go back and look for information on the railroad, you will find the first rut roads (an ancestor of the railroad) were in existence around 430 B.C. Yes, again, I know they weren't "real" railroads and they didn't have steam-driven locomotives. But the *when* of their invention depends on where you draw the line. For the railroad, we draw it in 1804 with the first steam locomotive. For aircraft, we draw it in 1903 with the first powered heavier-than-air flight.

The important questions are: when did the world wake up and realize that there would be choo-choo trains? And when did the world wake up and realize there would be airplanes? And the answer is: about a century apart. By the time the first consistent, documented, repeatable powered-flight occurred, the Iron Horse had already conquered most of the United States, Western Europe, also large chunks of India, parts of Africa, China. . . Well, you get the idea. According to family history, a great-grandfather of mine who was, by all accounts, not a very nice person, once ordered a young woman from his home for having the effrontery to claim that man would someday fly in a powered heavier-than-air aircraft. This was in 1904. Apparently, the stiff-necked old coot was an honest man, because when an airplane flew over the house only a couple of years later, he went and looked up the young woman to apologize. There's actually a reason for me telling that story. Even after something can be done, whether it's railroads, airplanes or submarines, you still have to convince people that the attempt is worth the effort. From 1804 for the steam-powered railroad, and from 1903 for the airplane, that process really began and proceeded apace.

In the 1632 universe those processes were separated by two years. It is a safe bet that when the first airplane flew over Magdeburg, there were still people in town that did not believe railroads worked. People like my great-grandpa. For all practical purposes the first functional railroad engine and the first functional airplane might as well have taken place at the same moment. So why does that matter? Because this article is not about how to build an airplane. There are lots of articles that go into much more detail than I ever could; there are even kits. If you have the time and money you can build your own. I know several people who have. This is not even an article about how to build an airplane in the 1632 universe, though of necessity it will touch on that using two examples: The *Jupiter*, built by TransEuropean Airlines by S&M Aircraft and the *Gustav* built for the USE Air Force. (For the *Jupiter*, see "The Monster" in *Grantville Gazette*, Volume 12.)

This is an article about why to build an airplane or whether to build an airplane. Why invest the resources in such an expensive undertaking? Both for the government and for private enterprise, the resources necessary to make something fly in a controlled way will buy a lot of guns and, for that matter, quite a bit of butter.

Militarily, aircraft have proven both their worth and their limitations in the twentieth century, as scout platforms and weapons platforms that can observe and hit the enemy from the highest of high ground.

They are an important, perhaps even vital, part of a combined arms approach to warfare and offer those who have them rapid reconnaissance and communications. Those advantages are quite clear to the generals of the USE. What isn't clear at all is how much are they going to cost to produce and how long it will take. Those questions get answered in 1633 when the *Las Vegas Belle* takes its first flight. And the only reasonable reason that it takes that long is because the New US government was unwilling to make a significant investment in aircraft production until they knew for sure, not just that it could be done, but that they could do it in a reasonable amount of time. While the *Las Vegas Belle* is answering that military question, it is also answering the parallel civilian question.

In our timeline, the first attempt at a for-real passenger plane happened in Russia . Not in the United States or England or France , but in backward, barbaric Russia . I don't mean to insult Russia or Russians when I say that, but that is pretty much the way most of Europe and America thought of Russia at the time. And they weren't totally wrong. In 1913, when the 16-passenger, four-engine *Ilya Muromets* was first flown, Russia was a nation of contrasts. There was both great wealth and knowledge and grinding poverty and ignorance. So why there? Why not the good old USA or England , France or some other "civilized" country? Well, part of the reason was that Igor Sikorsky was an honest-to-goodness genius, but I submit that that wasn't the whole reason. Curtis was a genius too; so were lots of other people working in the newly-born field of aircraft design. And Sikorsky didn't build the Ilya in his basement nor from his own funds. He was a wealthy man from a wealthy family which supported his efforts, but that would not have been enough by itself. It was enough to get him started and enough to let him win some prizes and come to the attention of the elite of Russia . But his wealth alone was not enough to build the Ilya. He was able to raise significant money for the project. I submit that the reason he was able to raise that money was because Russia was backward.

Imagine the conversation when some bright-eyed enthusiast in the good old USA started to wax poetic about his plans to build a multiengine passenger plane:

"It will never work!"

"It will, sir. I'm convinced we can build this plane."

"Don't interrupt. Even if you did manage to get it to fly, what advantage would it have over the already existent network of railroads and roads. Will it be faster than the trains?"

"Well, yes, probably. Most of them anyway. It should go about fifty to eighty miles per hour, depending on a number of factors. (Remembered this is the early teens to the early twenties. Airplanes just weren't that fast then.) There are some express trains that go faster than that. But most are slower and the plane will travel as the crow flies. That will help some."

"Will it be safer than trains?"

"Well, no. Not at first. Trains are a proven technology."

"Will it be cheaper than the trains?"

"No. It will be much more expensive."

"So I should invest a medium-sized fortune in a device that won't work and, even if it did, would be more expensive, less safe. And not much faster or even quite as fast as the fastest trains?"

This not the sort of conversation likely to produce large investments in the development of commercial

aircraft.

Sikorsky, on the other hand, was in Russia. Russia did have railroads, however the rail network was much less extensive with larger gaps. He was not asked how a working passenger plane would compete with railroads because his potential investors already knew the answer. "What railroads?"

That lack of existing solutions also had a secondary effect: The potential investor was not as likely to focus on reasons why his designs wouldn't work. They were looking for a solution, not for a reason not to invest. When the *Ilya Muromets* first flew, the reports were met in the west with skepticism. The experts in Europe and America had, for the most part, convinced themselves that a plane that large would never get off the ground. Even after WWI when the Russian Revolution caused Sikorsky to leave Russia and come to the USA, he was not able to build planes as big as the *Ilya Muromets*. This was after more than forty *Ilya Muromets* had been built by Russia and used as heavy bombers during WWI.

With a proven track record and improved technology, and even with a prototype to show, Sikorsky's first effort in the USA, the Sikorsky S-29-A, failed to find service as a passenger plane. It—only one was ever made—was eventually sold and had a varied career, ending its life in the movie *Hell's Angels*. Because of the lack of interest, Sikorsky then had to switch to smaller aircraft and wait for the market to catch up. His first American passenger plane that was actually put into service in that capacity, the S-38, first flew in 1928, nine years after Sikorsky arrived in the USA. Sikorsky first learned of the Wright Brothers flight in 1906 and didn't switch to fixed-wing aircraft till 1910 and the *Ilya Muromets* carried its first passengers in December of 1913.

What does all this have to do with the 1632 world? In 1632 there is a tremendous concentration of technology but very little in the way of infrastructure outside the Ring of Fire. Yes, they are building railroads. But by 1634 the main rail line out of Grantville has not yet reached Magdeburg. "What railroads?" is an even more valid answer to the question of how a plane will compete with railroads than it was in Russia in our time line. And it will continue to be—in the USE for years, and the rest of the world for decades. This gives aircraft of all sorts a tremendous advantage, because they don't need infrastructure.

Yes, I know someone has to build the planes. Someone has to drill the oil and refine the fuel. But the difference in investment in infrastructure is so great that the cost of airports gets lost in the noise of the cost of a rail line. The oil will need to be drilled and refined anyway. There are too many other products that need it. Aircraft don't need rails, tons of iron per mile. They don't need roads or canals. They need approximately what ocean-going ships need: places to build them and places to dock. Well, a bit less than the ships. The ships, after all, need open water, an ocean—or at least a river—between their ports.

That means that aircraft aren't going to compete with railroads or, for the most part, even the improved roads of the USE. They really won't be competing with barge traffic on rivers or canals, either. If someone builds a railroad or a canal along your route, you smile, thank them for making it easier and cheaper to get your fuel. Then move your route, or one end of your route, to somewhere where the competition doesn't go. Ships can compete with you between ports. They are slower but cost a great deal less per ton mile. But you will still get much of the luxury trade and virtually all of the trade in perishables. For most of the things that an aircraft will carry, the primary competing transport is going to be mule trains. That is, horses or mules traveling over roads that are not much better than paths through the woods.

So, let's take a look at mule trains. According to "Hither and Yon," *Grantville Gazette*, Volume 11, a mule train can do "15-30mpd easy terrain, 5-15 mpd in mountains.(See note 2)." Split the difference between terrain types and call it 15 miles per day. To carry a ton of goods, you need about ten mules

and two packers leading them. So, ten animals and two men. The cost is figured in ton miles and comes to 10d or around \$17.50 in New US or USE dollars. That's for every mile traveled. For three hundred miles, that comes to \$5,250. Why is it so expensive? Because you have to pay the packers, you have to pay to feed and care for the mules and the packers for days or weeks.

For an airplane to break even charging the same rate per ton mile, you need one or more aircraft that can carry one ton of cargo for three hundred miles at the same rate. The aircraft must be built, but the cost of building it is amortized over the projected life of the aircraft. Be conservative and call it five years of flights. Assume two flights a week and fifty weeks a year (everyone needs a vacation and even though they are only spending a couple of days a week flying and the rest of the time being maintained, it's still wise to do a full takedown twice a year.) Three hundred miles a flight makes six hundred miles a week. Fifty weeks a year gives thirty thousand flight miles a year, times five years gives an amortized aircraft cost of $X/150,000$ with X equaling the cost of building the airplane. So, if your aircraft cost \$150,000, your aircraft cost per mile is \$1.00. If the plane cost \$450,000.00, then the ton mile cost is \$3.00.

Of course, money costs money, and half a million dollars (more or less), costs quite a bit. The cost of money in the mid 1630s is a tricky issue. A safe portfolio or a mutual fund might reasonably be expected to have a return of as much as fifteen percent a year or as little as five percent. However, much of that return is not reflected, or expected to be reflected, in immediate productivity. The money is being spent on industrial infrastructure and the investors know it. As that infrastructure gets nearer completion, the values of the stock that represents it increases. In other words, the market is anticipating, as markets tend to do. Investment in automobile manufacturing plants probably started in late 1631 with no expectation that the first car would roll off the assembly line before 1636. What the investors do expect is that when the cars start rolling off the line in 1636 or 1638 or perhaps even 1640, they are going to make whole heaps of money. So the value of the stock is expected to increase, but it's not expected to pay dividends for a while.

What does this mean in terms of financing aircraft production? In terms of military aircraft like the *Gustav*, not much. They will be built on military contracts, with government cash on the barrelhead. In terms of private investors, it makes it harder in some ways and easier in others. It's harder because there are a lot of places where they can invest their money and expect a significant return. So the cost of money is going to be on the high end, somewhere around ten to fifteen percent per year. On the high side, by our standards. The availability of loans from the First National Bank of Grantville and the credit union are going to push the cost of secured loans down by seventeenth-century standards. Again, not everyone agrees on this subject. How much a loan will cost will depend a lot on who is borrowing the money and on who they are borrowing it from. Whether you invest money in an aircraft is a related question. If your other option is to loan money, you will want a higher return because you're not getting ownership. It stops paying. Ownership has more risk, but at least the potential to pay you back and leave you with stock that will continue paying you for much longer.

There are two ways of calculating the cost of money—how much will you have to pay back over a given period of time and how much would the money make you over a given period of time. Generally, how much it would make you is a bit less than how much it would cost you. My best guess about the cost of money over a five year period is that \$450,000.00 will represent a cost of \$600,000.00 to \$650,000.00 over the course of five years. Which brings us to the plus side. The car factory won't even start paying off for years, neither will a lot of other investments. But the aircraft will start paying for itself as soon as it's delivered. Thus, hope makes it a more attractive investment. Assuming \$650,000.00 paid over five years that's \$4.33 per ton mile. If the plane is still in good shape after that time, your profits go up. And the plane probably will be in good shape.

The planes are only one part of the cost. There is also fuel, maintenance, flight crew, and interest. Also

airport or station fees. Still, flight mile gives us one major component of the cost.

So, how much is fuel going to cost on a per ton mile basis? The best I can do is make a WAG (Wild Ass Guess) It's probably going to be a methanol-gasoline mixture, perhaps 90% alcohol and 10% gasoline because alcohol improves octane. The engines will, of course, have to be modified to run on this mixture. How much per ton mile is impossible to say across a range of aircraft. You can work it out partly for a single airplane, but even there it's a constantly changing number. As the plane flies, it uses up fuel and gets lighter, reducing induced drag. So every mile it travels, it needs a little bit less fuel for the next. Obviously, the degree to which it is loaded affects the amount of fuel used. The airspeed and so on also affect fuel use. Still, it can be worked out with reasonable accuracy for a single plane.

The plane I'm going to use is the *Jupiter* from and my and Paula Goodlett's story, "The Monster," which is based on the *Ilya Muromets* built in 1913 by Sikorsky. We did make some reasonable improvements focused on reducing drag and improving laminar flow. And we added air cushion landing gear that was developed in the late 1960s.

Even if you knew to the inch how far a gallon of fuel would take you, there is still the question of how much a gallon of fuel costs. The best we can possibly come up with is a WAG. My WAG is about 10 dollars a gallon for standard 1634 aviation fuel. That's not the aviation fuel used in 2007, because, at least at first, people in the 1632 universe won't be using the sort of aviation engines used in 2007. What they will be using is converted automobile engines, most of which will be heavier than a modern aviation engine, and less robust. Don't misunderstand, these engines will be better than anything the Wright brothers or Sikorsky had, even if they have steel rather than aluminum blocks. They just won't be up to modern aviation standards.

A pretty good gas mileage for a year 2000 automobile engine is around twenty-five miles to the gallon at a highway speed of fifty-five miles an hour or a bit over two gallons an hour. I assume you will lose about half that in a rigged-out aviation engine that uses about four gallons an hour. Four such engines on the *Monster* gives a fuel consumption of sixteen gallons per hour. Absent headwinds or tailwinds, the *Monster* can reasonably be expected to travel about sixty-eight miles per hour. (Bill Wathen, the aviation engineer and aircraft designer that I checked this stuff with says sixty-eight miles an hour is too slow. It will probably go faster than that.) That figure gives us four and a quarter miles per gallon for the *Jupiter*. On the *Jupiter*, that means not quite a quarter of a gallon, .23529gal, of fuel per ton mile. Or \$2.35 in fuel cost per ton mile. So \$4.33 aircraft cost plus \$2.35 gives us \$6.68 per ton mile. Please note that the *Gustav* single engine plane has only one engine but has a cargo capacity that is probably less than five hundred pounds. It carries an ordnance load of three hundred pounds, so while it's cheaper to build and operate, it's more expensive when measured in ton miles.

Maintenance and Crew cost:

It is likely that most of the pilots in the early days will also be aircraft mechanics just as they were in our time line. They will be able to fabricate some of the aircraft parts that may break just about anywhere they are. Other parts will have to be fabricated in Grantville, at least at first. Well, that's not entirely true. The cost of fabricating some of the more precision parts outside Grantville will be much greater. I'm tempted to say prohibitive, but the truth is, it probably won't be prohibitive for what you get. It will just take what seems like forever. In any case, it is probable that the planes will take their primary maintenance staff with them, in the form of pilots. They will also take a small stock of critical spare parts. So, maintenance costs and crew costs flow together, much as they do in a mule train. There are, however, two important differences: how long you have to pay to get the same number of ton miles, and

how much you have to pay. The first works for the airplane owner, the second works against him. The *Monster* will cover 340 miles in five hours of flight time. So call at 300 miles a day. If it really needs to, it can be 600 miles a day. But that means you're skipping on your maintenance, and the chance of engine failure, or some other midair disaster is increased. It's not something you want to do very often. 600 miles a day also means that you're either carrying extra fuel or have some place on route where you can stop and refuel.

So, assume that you're paying the pilot and copilot \$100,000.00 a year each. That's \$200,000.00 divided by 30,000 miles a year. And the *Jupiter* carries at least a ton of cargo or passengers that comes out to \$6.67 per ton mile. Plus \$6.68 gives us a total so far of \$13.35 per ton mile. Remember our pilots/maintenance guys are spending about ten hours a week in the air and another ten to twenty hours a week on aircraft maintenance. When they aren't at home (about half the time), they are eating and sleeping in nice inns in mostly major cities. And to top it all off, their job is pretty glamorous. This is a cool job.

Just for reference lets look at the mule packers cost per ton mile for a year's transport. The mule train travels thirty miles a day but not 365 days a year. At a minimum they're getting at least Sundays off, giving us 313 days or 9390 miles per year. It takes two mule packers to handle ten mules carrying a ton of cargo. To get the same personnel cost per ton mile, you can only afford to pay the mule packers about \$31,000 a year each. They spend about five hours a day traveling, generally on foot and another five or so hours a day taking care of the mules. For a total of about fifty hours a week. When they are away from home, most of the time, they are generally eating camp food and sleeping on the ground. All for about a third of what the fly boys are getting. Ain't that just the way it goes?

Station-keeping or airports:

For regularly scheduled flights, depending on the type of plane, you need an air field: a lake or other body of water that is long and wide enough to land on, or packed snow or ice that is long enough to land on. And at all such places you need some place you can taxi to, where you can store fuel, oil, and some spare parts. You also need it to be a place where you can pick up or drop off passengers and cargo. If it's a place where you can ship fuel cheaply so you don't have to make extra trips carrying fuel, that's all to the good. Now, in most places, you're going to be able to have the alcohol component of your fuel produced locally. That's going to save you quite a bit. Especially with a ninety/ten mix. For every one hundred gallons of aviation fuel, you only need to load ten gallons of actual gasoline. And since wood alcohol works just fine as a fuel component, the quality of the hooch that your suppliers start with is not an issue. Which, again, should save you a bit.

How much the airfield is going to cost depends primarily on the type of landing gear you have. If you have wheels, you need an airport. A flat piece of ground that has had the stones and rocks removed, any potholes filled in, and so on. Most of the time, that's not going to matter all that much. It's that one time in ten, or one time in twenty, when the wheel does catch a rock or a pothole and the plane flips over on its back, that it becomes an issue. Still, better safe than sorry, so you have to pay people to get the field ready and then to maintain it. If there are several airplanes coming into and out of the field on a regular basis, that's not that much of a chore. The cost of maintaining the field can be divided among ten or twenty or thirty aircraft that land on the field in a given month. But, at least in the early days, that's mostly not going to be the case. It's going to be one, two or five airplanes. So you're talking about as much \$1,000. per plane in ground fees, besides the other fees associated with an airport.

You're a bit better off if your plane has pontoons. Water is naturally flat. There is still a danger of the

occasional log floating in the pond or lake you're landing in, but it is a much lower probability danger. So you don't really have the maintenance cost, if you're using an amphibious aircraft. What you do have is drag. Whether pontoons or a hull, you have to push a weight of water equal to the weight of the aircraft out of the way for your entire taxi run and for most of your takeoff run. That requires a more powerful engine than you need to maintain flight once you're in the air. That more powerful engine will use more gas and weigh more, decreasing the amount of useful lift the aircraft has available.

Skis for use on snow or ice have a bit of the disadvantages of both wheels and pontoons. The runway still has to be maintained as with wheels. While drag is less than with pontoons, it's still more than with wheels.

Now we come to two types of landing gear that never really caught on in our time line: air cushion and hydrofoil. The first experimentation with hydrofoil landing gear was done by Alexander Graham Bell near the beginning of the twentieth century. The problem is, he never actually got it to work. I cannot say this with absolute certainty, but from what I have read and seen of his designs, the problem he failed to overcome—and, to the best of my knowledge, has never been overcome—was the boundary layer. The boundary layer is that point when much of the lift is being provided by the wings of the aircraft, and the hydrofoils are still partially in the water. At that point, a little distortion on the surface of the water can throw the drag thoroughly out of balance. It wasn't that Bell's planes couldn't fly, or that they couldn't run along the water on their hydrofoil. It was switching from one to the other that was never accomplished.

On the other hand, air cushion landing gear has been built successfully in our time line. Its troubles were economics and timing. By the time the first air cushion vehicle that worked came about, airports were spotted all over the United States and much of the rest of the world. And for those places where there weren't airports or where it was impractical to put an airport, pontoons were an already proven technology, with regulations and insurance premiums already firmly established. Air cushion landing gear would have had to start from scratch in a regulatory environment that was stacked against it. However, in the 1632 universe, the regulatory environment is fairly close to nonexistent.

Pontoons would still be simpler and almost certainly cheaper to build and install. But pontoons have the disadvantage that they do not work on land. And there is the issue of drag. Air cushion landing gear has very little drag, which means smaller, lighter engines are needed for take off. All of which would seem to be the case beside the point except for one thing: it affects the fixed cost of running an airline. Both directly in terms of how many places you can land and how much preparation is needed, and indirectly in terms of bargaining position. In general, the more options you have, the better your bargaining position with any of those options.

So it turns out that the fixed costs are just as variable as all the others. All the way from landings costing several hundred or thousand dollars per landing, when you're running two or three planes a month through only a couple of airfields, to the airfield paying you to make a stop at their location. Which starts to look like a reasonable deal for them, if you can land a hundred other places and totally bypass them.

So it's time for another WAG, but this one doesn't fit into your calculations very well in terms of ton miles. Costs per ton mile go up or down as a percentage of cost almost in the reverse. The more miles you cover, the less they cost per ton mile. For the *Jupiter*, I'm guessing an average cost of around \$500.00 USE for landing with an average of one landing every 300 miles. Some places it's going to cost more, some places it's going to cost less, some places they're going to pay the airline to make a stop. For the *Gustav*, which needs a prepared landing field, figure around \$1,000.00 per landing. And it needs to make five trips to deliver the same amount of cargo or passengers.

Back to the *Jupiter*. \$500.00 every 300 miles adds in another \$1.67 per ton mile plus \$13.35, for a

grand total of \$15.02 per ton mile. That's \$2.48 less per ton mile than a mule train times 30,000 miles a year. If the airline charges the same amount as the mule train, it's only going to make about seventy-five grand a year. Less than the pilots are being paid.

The Garden Path:

Which is what I have been leading you down. In our time line, several of the air shippers of cargo and passengers went broke in the early years of commercial aviation and most of the rest were only saved by mail contracts that were, in effect, government subsidies. Not that they didn't carry the mail and carry it fast, but without the mail contracts, the fledging commercial air transport industry probably wouldn't have made it.

The situation in the 1632 universe is not analogous to that of our history, not even close. What people in 1920sUSA were willing to pay for transportation was defined by how much they would have to pay to get their stuff transported another way. The same is true in 1634, but their other options are a great deal more expensive, a lot slower and much more dangerous. So price, acceptable speed, and acceptable danger are all much looser constraints in 1634 than they were in 1920. No one in their right mind is going to expect to get themselves or their cargo three hundred miles in a single day for the same price that they would pay for a ten-day trip. There are real differences in what the market will bear.

So, while in a pinch the airlines of the 1632 universe could compete with mule trains in terms of cost, they don't have to. The actual price for customers seeking to transport goods on an aircraft or for a passenger seeking to travel on an aircraft is going to be five to ten times that of travel by ground transport. And the airlines still won't have enough aircraft to carry all their customers.

Also, aircraft are expensive pieces of equipment. They are going to be worked as hard as they safely can be. Four trips a week is still only twenty hours a week in the air, with forty man hours for maintenance. Which effectively cuts the amortized cost of the aircraft in half. And the crew cost as well, since the pilots are still getting the same hundred grand a year apiece but are now transporting passengers and cargo 60,000 miles a year. If necessary, the airline can hire a couple of ground-based mechanics to add another 80 man hours a week of maintenance for less than two more pilots would cost.

In general, I have taken the worst possible scenarios from the point of view of the owners of an airline and still ended up with a marginally profitable business. If, for instance, I were to use \$50.00 per ton mile—less than three times the cost of a mule train—the net profit on one *Jupiter* comes to over a million dollars a year. See the chart below.

| Miles flown per year. | 30000 | 40000 | 50000 | 60000 | 70000 |
|--|----------------|----------------|----------------|----------------|----------------|
| Crew cost | 200,000.00 | 200,000.00 | 250,000.00 | 250,000.00 | 250,000.00 |
| Per ton Mile | 6.67 | 5.00 | 5.00 | 4.17 | 3.57 |
| Air craft cost with interest 650,000.00 per ton mile | 4.33 | 3.25 | 2.60 | 2.17 | 1.86 |
| Fuel Cost Per ton mile | 2.35 | 2.35 | 2.35 | 2.35 | 2.35 |
| Airport costs | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 |
| Operating costs per ton mile | 15.02 | 12.27 | 11.62 | 10.35 | 9.45 |
| Annual Net at a given | | | | | |
| Price per ton mile \$17.50 | \$74,400.00 | \$209,200.00 | \$294,000.00 | \$428,800.00 | \$563,600.00 |
| Price per ton mile \$20.00 | \$149,400.00 | \$309,200.00 | \$419,000.00 | \$578,800.00 | \$738,600.00 |
| Price per ton mile \$30.00 | \$449,400.00 | \$709,200.00 | \$919,000.00 | \$1,178,800.00 | \$1,438,600.00 |
| Price per ton mile \$40.00 | \$749,400.00 | \$1,109,200.00 | \$1,419,000.00 | \$1,778,800.00 | \$2,138,600.00 |
| Price per ton mile \$50.00 | \$1,049,400.00 | \$1,509,200.00 | \$1,919,000.00 | \$2,378,800.00 | \$2,838,600.00 |
| Price per ton mile \$60.00 | \$1,349,400.00 | \$1,909,200.00 | \$2,419,000.00 | \$2,978,800.00 | \$3,538,600.00 |

I stopped at a little over three times the cost of a mule train, and seventy thousand miles a year because the profits were getting obscene. At \$60.00 a ton mile the cost of a two hundred-pound item or, say, a passenger is \$1,800.00 for a one-way ticket which naturally seems exorbitant to us. But when you start comparing it to the cost of a carriage ride of like distance, plus the fact that the carriage is going to take you six days or so, during which time you're going to be beset by toll keepers and possibly other bandits—not to mention the weather and the level of comfort—plus the fact that the carriage is going to have to take a roundabout route avoiding things like mountains, and it's going to cost you over \$500.00 anyway, that \$1,800.00 starts looking pretty attractive.

So in the 1632 universe there are millions of good reasons to build commercial aircraft. They come right after the dollar sign.

Editor's Note:

Statistics being statistics, numbers being numbers and people being people, there are, of course, dissenting opinions regarding the potential costs and profits for an airline in the 1632 universe. And, deadlines being deadlines, another article covering the dissenting opinions wasn't available for this issue. It's entirely possible, though, that one will appear in a future issue. Staytuned . . .

THE END

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