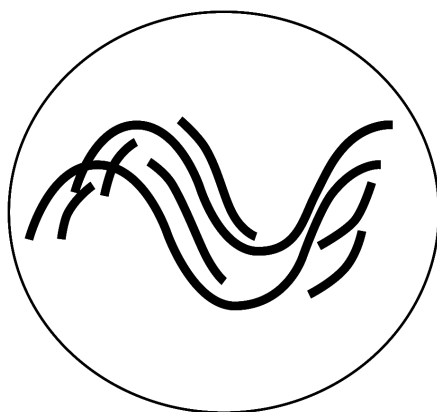


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THE HUM PROJECT



Dev Gualtieri

Tikalon Press

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Author's Forward

Science, technology, engineering, and mathematics (STEM) education has been integrated into school curricula at all grade levels. A fundamental understanding of STEM is an important skill for children in our technological society.

The Hum Project is a novel intended for middle school students. The story evolves around the attempt of a team of students to track down the source of a mysterious humming sound that's been disturbing the sleep of a fellow student.

As their quest becomes more complicated, they enlist the help of their science teacher and a university professor.

Since I'm an advocate of free and open-source software (FOSS), this novel was created using LibreOffice on a Linux desktop. Illustrations were created using Inkscape and the GNU Image Manipulation Program (GIMP). Creation of the eBook version was assisted by Calibre.

This is a work of fiction. All characters appearing in this work are fictitious. Any resemblance to real persons, living or dead, is purely coincidental.

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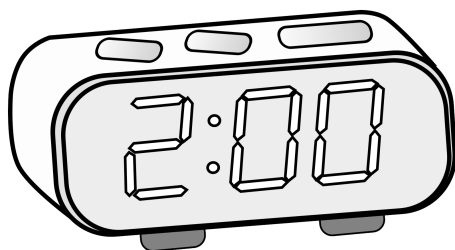
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1 SLEEPLESS

As he rushed down the stairs that morning, Jason was reminded of something he had learned in school. Many grades ago, Jason's teacher told her class that breakfast was the most important meal of the day. Breakfast was important, since it was the fuel that allowed a student to perform well in school before lunch. Without fuel, a machine will stop working. He was starting to believe this saying was true, but for a different reason. Breakfast was important to a student because it was the final hurdle in getting to the school bus on time.

There was another reason why skipping breakfast was not an option for Jason. His mother always prepared him a nice breakfast, and the food she prepared was not the kind you could grab and dash with the idea of having breakfast at the bus stop, or on the bus. Breakfast in his house was eggs with bacon, pancakes, French toast, or some other food that

must be eaten from a plate. Not only that, such breakfasts were designed to be eaten slowly, so every mouthful could be savored. Jason suspected that his mother did all that cooking for him because he was an only child.

Nearly all of Jason's friends had sisters or brothers. From what he heard from his friends, the advantages of having a sibling seemed to outweigh the disadvantages. It seemed to be better to have a brother or sister who was older. An older brother or sister might drive you to school, to shopping, fast food restaurants, and weekend festivals. Jason had no older brother or sister, and he suspected that at his age the possibility of getting a younger brother or sister was close to zero.

Jason never asked his parents why he was an only child. He had read that parents sometimes have difficulty in getting even a first child. It could be that parents might not be able to afford more than one child. Since Jason's father had a good job, they lived in a nice home and had two nice cars, money didn't seem to be a problem. Although Jason's mother had worked before he was born, she didn't work now, and there didn't seem to be any need for her to work. Her present job of being a full-time mother gave Jason a nice breakfast every morning.

There was no rain that morning, so Jason saved a minute in not needing to find the proper rain gear. He was able to walk, not run, to the corner bus stop. There were usually about seven students at the bus stop, but only one of them was Jason's age. Although Kryssa was in Jason's class, she wasn't in his homeroom or any of his classes. Jason's mother said the reason was the

tyranny of the alphabet. His last name was near the top of the alphabet, while Kryssa's was at the bottom. For that simple reason, Jason and Kryssa didn't have much in common. There was the further problem that she was interested in *girl things*, and those things didn't interest Jason.

Once on the bus, Jason walked to the back to take his usual seat next to Zephan. Possibly inspired by something he had read or seen on television, Zephan liked to be called Z-Man. Jason approached Zephan's seat about two-thirds of the way towards the back, but the person sitting there didn't look at all like the usual Zephan. He was bent down in a sleeping pose.

"Hey, Z-Man. You look like crap! Too much homework, last night, or what?"

"Oh, hi Jace." Zephan responded. "I guess I look as bad as I feel. I didn't get much sleep last night, but not because of too much homework."

"So..."

"I couldn't sleep because of some sort of noise. It seemed like a loud hum, sort of like a noisy truck was idling in our driveway. I looked outside, but there was nothing. With the window open, I could tell that the sound was off in the distance, somewhere. It wasn't too loud, but it was super annoying. I asked my father about it in the morning. He didn't hear it, but my parents' bedroom is on the other side of the house. He thought it might have been some nighttime construction out on the interstate. They do that at night so traffic wouldn't be that bad."

"Yeah. I'm sure everyone on this bus would be upset if we were late getting to school because of construction traffic."

Jason got a quiet laugh from Zephan, who seemed more interested in a nap than further conversation. Jason followed the cue and quietly thumbed through a book on the short ride to school. The rush of students through the aisle of the bus signaled their arrival, and that was enough to wake Zephan from his stupor to start the school day.

Fortunately for the Z-man, it was a Friday, so he would have ample opportunity for a rest over the weekend. Unfortunately for Jason, it was also a Friday when the teachers piled-on homework assignments that were due on Monday. Jason was interested in science and math, so homework in those subjects didn't involve much thought. Most of the work for him in science and math was the mechanical process of writing his answers on paper. He fondly recalled the earlier grades when they had worksheets and workbooks that eliminated the drudgery of all that writing - he just needed to scrawl his answer on a line.

Jason and Zephan didn't have the same lunch period, so Jason ate his brown bag lunch, carefully made by his mother, at a table with a few other friends. Unlike other luncheon teams, their table hosted a girl, but for an unusual reason. Filip and Helena were twins; and, Leni, as she was called, was just one of the guys. Possibly influenced by her brother, Leni was interested in the same things as everyone else at the lunch table, and she was even a member with Jason on the after-school STEM team. Jason admitted to himself that Leni was probably smarter than he was. She was actually more

interesting than her twin brother, Filip, who tended more towards sports than STEM.

After the first few sandwich bites, Joe, one of the table regulars, started the conversation.

"They finally found the air leak on the space station. That thing is older than most people's cars. It should be replaced. Jace, I remember that your bus mate, the Z-Man, wants to be one of the first astronauts on Mars. Did he mention the air leak fix this morning?"

"Zephan was more in the mood for sleep than talk this morning. He had a sleepless night because some noise kept him awake. Yeah, he wants to be an astronaut, and he's strong enough and smart enough to pull it off. At our age, the timing might be just about right for a trip to Mars."

"I would never go to Mars," replied Joe. "First, it's a long trip to get there with not much to do. Then, the long trip back - if you can get back! There's too much danger for me. If you want to do some Martian sightseeing, just go to Death Valley. It looks about the same, and it would be a short trip."

Marty, who always seemed to sit next to Leni, joined into the conversation.

"We should use at least some of the vast amounts of money it would take to put people on Mars to solve some problems on Earth, like global warming. Joe talks about Death Valley. Well, more of our planet will become like Death Valley if nothing is done."

"But, there's the adventure of the whole thing," Leni interjected. We would still be living in caves if our ancestors hadn't tried new things. We wouldn't be here in the *New World* if not for

the explorers of a different age. Mars is the *New World* of today. As they say, *nothing ventured, nothing gained.*"

"The Z-Man would have my full support in his *venture...*," replied Joe. "Just not my companionship."

"So, how did they find the leak?"

"They used corn flakes."

Everyone laughed, but Leni persisted.

"How could corn flakes possibly be used to find an air leak, especially on the space station?"

"Here's how it went," said Joe. "One of the astronauts figured that just like dust moves with air currents in a room on Earth, the same could be done up there, in the space station, and the dust would trace a path to the leak. The problem is that without gravity, most of the dust you would throw into the air would just sit there, and the astronauts would breathe it. They do have some air filters, but maybe it would take too long to filter all that dust."

"I can see how that would be a problem," said Leni.

"Well, one of the astronauts had the idea that, since corn flakes are food, a little corn flake dust would be OK to breathe. He ground a few corn flakes into fine powder, which is easy to do since it's so dry, and used that to find the leak. Since the leak was known to have been in one of the space station's many compartments - I think they're called *modules* - he was sure of a result."

"Now, that's thinking outside the box," said Leni. "Cereal box, that is."

Everyone laughed, but one look at the clock reminded everyone that lunch period would soon

come to an end, and the true purpose of lunch period was to eat lunch.

Jason's afternoon dragged-on as expected. Since it was Friday, teachers always seemed to assign too much homework, as if they had checked their notes to find that they had somehow fallen behind during the week. His science teacher last year had an unique approach. Since homework was assigned from problems at the back of each textbook chapter, on the first day of class he passed out a sheet with a schedule of all the homework for the entire term! Jason was delighted, since he enjoyed science, and he now had a way to *bank* homework for a future date; that is, as long as he understood the topic. Fortunately, this wasn't a problem for Jason in science.

Jason also enjoyed math, but he didn't like having math class at the last period of the day. He was tired, and he was sure that his teacher was tired, too. Nonetheless, they were doing something interesting - Using trigonometry to find the length of a side of a right triangle when just the length of another side and an angle is known. This seemed to be pretty useful stuff that could be used in the real world, not just another odd fact of mathematics.

Everything about math was solving things to remove all mystery, but there was one mystery in this process. That was the table of the trigonometric functions, sine, cosine, and tangent, that they used. How was this magic table created? Did someone with a really good ruler make measurements of real triangles, put his measurements into a chart, and say, "Use

this." Jason asked his teacher how the table was created.

"Good question, Jason. They didn't write about this in your textbook. It involves a thing called an infinite series. You can write down divisors that follow a simple pattern, sum these up as far as you're willing to go, and get the sines, cosines, and tangents to better and better accuracy."

Jason's math teacher then wrote an equation for the sine on the blackboard. Jason could see why the equation wasn't in his textbook. It was too complicated, but the pattern was unmistakable. How someone got that equation was another mystery, but Jason's teacher didn't seem willing to go more deeply into an explanation, and Jason didn't ask. It would be a waste of time for most of the other students, and Jason could find the answer on the Internet.

Zephan seemed in better shape on the bus ride home.

"I had a couple of caffeinated colas from the vending machine during the day, one in the morning, and another with lunch. I can see why adults drink so much coffee. It really works! My mother would not approve, but it was an emergency. I hope I'm not addicted to the stuff!"

"As I hear it, there will be a caffeine withdrawal to remind you why such things are not a good idea," replied Jason. I'll try to hear your noise from my house, tonight. You and I don't live too far apart. If the sound traveled from the interstate, that's a long way. I wonder whether those guys work on Friday nights, too. If they don't, I won't hear anything, but it's your lucky night."

Back at home, Jason decided to delay any thoughts about homework until Saturday. He went to the backyard to tend to his garden, which was actually his father's garden. Many years ago, Jason's father had taken an interest in hot peppers with the idea of making his own hot sauce. He quickly found that there were quite a few popular types of hot peppers you couldn't find at the local supermarket. In fact, hot peppers had a cult-following on the Internet among people with the objective of growing the hottest pepper species on Earth.

Jason's father was more interested in taste than hotness. He found a good blend of peppers he liked, and every year he would make his own bottled hot sauce, complete with a custom label, that he would use and give as gifts. Hobby wine makers did the same thing, but their investment in time, equipment, and starting materials was much greater. With the gardening experience gained for the peppers, Jason's father expanded his garden to grow other vegetables. The area of the pepper portion of the garden remained constant, but that area was now just a small percentage of the entire garden. Since Jason enjoyed eating cucumbers, he was given responsibility for the cucumber patch. This was not an easy job, since cucumbers had vines that grew upwards, and Jason needed to maintain a network of strings to give the vines something to grab onto.

After a half hour's work in the refreshing open air, it was nearly dinner time. Jason went back into the house, washed-up, and waited for his mother's dinner call. That came quickly, and Jason anticipated a really good meal. Thursday

was his mother's shopping day. As a result, suppers on Thursday were usually special. No leftovers then, and Friday was a special case. This was the weekly pizza night, and Jason's mother was a culinary marvel, making pizza dough from scratch and loading the final pie with fresh ingredients she had purchased on her Thursday shopping trip. Although sausage was Jason's favorite topping, anything his mother created on Friday was fine with him. Finally, he heard his mother shout, "Dinner is on the table!"

His mother's shout wasn't just for him, but for his father, too, who was working in his upstairs office. His father did computer programming, a job you could do anywhere, so his father spent as much time at home as in his company office. While working from home made this a great job, working at the company office had its advantages. Jason discovered some of those in his visits there with his father while he conversed with his co-workers and checked on one thing, or another.

First, there was the impressive automatic coffee maker in the break room, much larger and better than any home coffee maker, that produced hot chocolate. Also in the break room was a large display screen computer on which Jason was allowed to play video games. His father's co-workers liked video games, possibly because they had become interested in computers at a young age. They stocked the break room with many of their older games for others to use. Some of these games were quite old, but they were still interesting. The one game that Jason enjoyed the most had a cartoon

character trying to ascend a mountain while trying to dodge falling boulders.

As Jason entered the kitchen, the aroma there was not the expected pizza aroma.

"Mom, this is pizza night, right?"

"Yes, it's pizza night, but we're trying something new, a Greek pizza."

Just then, Jason's father entered the room and said, "A Greek pizza? I'm both curious, and a little afraid. I yearn for that cheesy goodness every Friday."

"We can't work ourselves into a rut," explained Jason's mother. "I found a good recipe online, and I got the required ingredients while shopping. Don't worry. You'll both like it. In the unlikely chance that you don't, then it's off my menu list. I hope it's good. It should be healthier to eat."

The pizza sitting on a cooling rack looked a lot different. Instead of being covered with a gooey mass of cheese with puddles of sausage grease, there were scattered solid chunks of cheese, some olives, and a lot of green leafy stuff.

"Mom, what's the green?"

"It's spinach, but I'm sure it won't taste like spinach. The cheese is feta, and the olives are Greek olives. The crust is my regular crust, so the texture should be about the same. Aside from the nutrition benefits, there's the added health benefit of not getting your mouth burned by molten cheese. There's also a fashion benefit of not getting grease stains on clothing!"

Jason was still skeptical, but his father took a bite and said it was good. "Different, but good," were his exact words. Jason took a bite, and he concurred with his father. After dinner, it was

decided that Greek pizza was OK, but not too often.

After dinner, it took Jason just a few minutes to decide that there was nothing worthwhile to read or view online. He nearly decided to start his homework, but then decided that he wasn't *that* bored. There were two open items on his desk. These were a book about the history of aviation he had recently started to read, and a half-completed crossword puzzle about the Solar System. Since even adults didn't know much about the planets and their moons, they made the puzzle questions really easy - Easy enough for even someone his age.

The trouble with a half-finished crossword puzzle is that there's a point at which all the easy words have already been entered. Jason was pondering the clues to one of the harder questions when his cellphone rang. It was Leni.

"Hi, Leni, what's up?"

"Jace, have you looked at your math homework, yet? I'm having a problem with one question."

"No, I haven't, but the book is right here. Which one?"

"It's the last one on our assignment, number fourteen in the chapter questions."

Jason opened the book to the proper page and scanned the question. "OK, I have it here. So... it's not just a simple plug in the numbers question. It's one that makes you think. Very cruel."

Leni laughed. "So, what we have is half a circle, a semicircle, with a triangle drawn in it - inscribed, they call it. It says that such a triangle always has a right angle, so our trigonometric

functions will all work. That's pretty amazing. I sketched a few different ones, and it looks like that's true. Now for the problem. A mirror image would obviously have the left and right angles swapped, but they want us to prove that using trigonometry. They gave a diagram, and I actually did hold it up to a mirror to sketch the mirror image. After that, I got stuck."

"There's an easier way to get a mirror image," replied Jason. You hold the figure up to a window and look through the back side of the paper. Let me do that with my desk lamp, here. I'll put down the telephone so I can do this."

Leni heard a clunk from the telephone's being placed on the desktop, a few other unidentifiable sounds, then finally Jason's voice again.

"OK. I've got the two figures here, although I'll need to draw them more neatly for my homework. Let's see..."

Since there isn't any noise involved in thinking, there was silence on Leni's phone. She was certain that the silence wouldn't last long, since Jason was a fast thinker.

"OK," said Jason. Even though the triangle is flipped, all the sides keep their same length. What you do is label the sides - you know, a , b , c - making sure that you put the same letters on the flipped image, and the same for the angles, A , B and C . In the case of the circle diameter, which is the hypotenuse - funny name - that's easy. Then, you just look."

It took just a few seconds for Leni to see the light.

"So, in each case, whether you look at the sine, cosine, or tangent, the angles are the same,

since the sides needed to calculate these are the same. Great!"

Leni continued.

"While we're on the phone, I want to ask you about Marty. He seems like a nice guy, and you've probably noticed that he always sits alongside me at lunch."

Sure, Jason noticed, and he was certain that Marty was hoping that Leni would eventually notice.

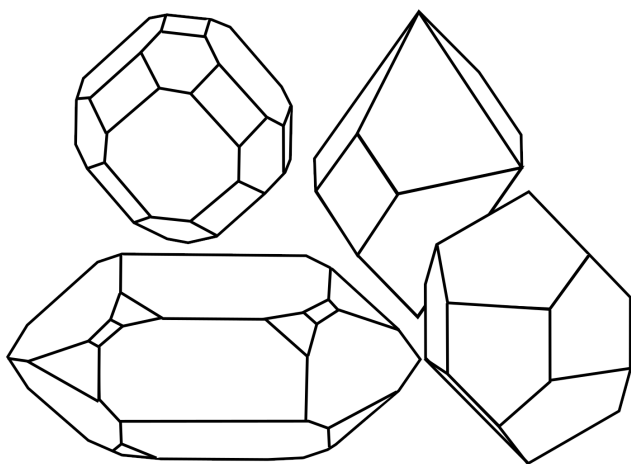
"Yeah. I think he likes you."

"Well, just to make sure I don't embarrass myself, would you ask him about it? I think he and I should go out together, sometime. I'd like to be sure before I ask him about it."

"I'll try to get him into a private conversation at school. I'll get back to you."

Jason wondered to himself how a coupling of Leni and Marty might change the dynamics of the lunch table. He had never thought of Leni in the way that it seemed Marty did. Jason had always just thought of Leni as just one of the guys, since she acted like the other guys at the lunch table.

After the call, Jason noticed his cellphone needed a charge, so he plugged it in immediately. He figured that it was too late that night for further calls, and he didn't want to forget. He thought about the "no free lunch" principle he had heard from his father. Cellphones are nice, but they come with a price. That's the responsibility to keep them charged, dry, and always at hand.



2 ANOTHER MONDAY

As always was the case, Jason's weekend was a blur, punctuated by far too many hours of homework. There was some respite in his family's usual Sunday brunch at a fancy restaurant. Although his family's attendance at church was sporadic, they never missed Sunday brunch. Jason once had the idea that a church that combined brunch and a prayer service, somewhat like a dinner theater, would be a big hit. He was fairly certain that church leaders would reject this idea as blasphemous.

Soon enough, it was back at the bus stop on Monday morning. Kryssa was in her usual state, plugged into ear buds and oblivious to the world around her. Jason suspected that if it wasn't for the movement of other students as a signal to board when the bus arrived, she would happily just stare downwards at her cellphone until her battery was completely discharged. Jason's parents were quite strict with his cellphone use. It could only be used in emergencies during school hours, and that included all the time from leaving the house in the morning to arriving back home in the afternoon.

Once on the bus, Jason took his usual seat next to Zephan, who seemed much better on Monday than Friday.

"Hey, Z-Man. I guess the noise was gone for the weekend. As I suspected, those construction guys have weekends off like most people."

"No," replied Zephan. "The noise was as loud as ever. I called my father into my room, and he heard it, too. It was a continuous low-pitched rumble. He said that it sounded like a motor far in the distance. It didn't seem to him like construction, since those sounds would change, and this noise didn't. It was the same annoying hum minute after minute."

Zephan continued, "Since my younger sister has a room on the other side of the house, where it was quiet, I ended up on some sofa cushions on the floor every night since. My father was going to make some calls to see what might be causing the noise. I can't sleep every night in my sister's room. I might get nightmares about getting attacked by giant stuffed animals!"

"This sounds like a *Scooby-Doo* type mystery," said Jason. "It's too bad that's only in cartoons and movies. They would discover the nefarious reason for the noise in just half an hour! Probably some bank robbers digging a tunnel to a bank vault, or an evil scientist trying to force a volcano to erupt."

"Yeah, real life isn't as simple as a cartoon. I'll see whether my father can discover the source of the noise and how it might be stopped."

Soon, they had arrived at school and went their separate ways. A chance encounter with Marty on the way to homeroom gave Jason the opportunity to ask him about Leni.

"Hey, Marty, we have a few minutes before the homeroom bell. I need to ask you about something."

"Sure." replied Marty, "What?"

Jason looked around. "Not here, let's go there." He pointed to a less trafficked region of the hallway.

"With all the secrecy, this must be good!"

"It could be good. I see that you always sit near Leni at lunch. Do you want to get together with her?"

"What? Are you attracted to her, too?"

"No, no," Jason stumbled, "Nothing like that! You have no competition from me! Leni and I are good friends, and I can get you two together, if you want."

Marty was quick to reply, "Yes," and it was as simple as that.

The homeroom buzz was all about the upcoming class trip. While these trips were intended to be *educational*, it was still fun to be away from school for an entire day. This year's

planned trip was to a large natural history museum about an hour's bus trip away. Natural history museums of the past were generally just marginally interesting bunches of old bones and minerals neatly arranged in glass display cases. Museums of today had a lot of science content; and, most interestingly, a lot of hand-on demonstrations. You could still see the dinosaur bones, if you wanted, but there was a lot more than those to keep you entertained.

As their teacher passed out the information and permission sheets, she said that interested parents could come as chaperones, and the volunteering information was on the sheets. Jason's mother had always volunteered in the past, and he was sure she would volunteer for this trip, also. He was happy that when she did volunteer as a chaperone, she would always travel in a different bus than Jason. He guessed that she understood that children would rather be away from a parent when they're among their friends.

Last year's class trip was an adventure, and more entertainment than educational. The trip was to a Native American reservation to learn about American Indian culture. When the bus left the interstate, the roads were not that well marked. Although the bus driver had a GPS device, he somehow made a wrong turn, and they needed to backtrack. The bus was too huge to just turn around on the narrow roadway, so they needed to drive to a place where the bus driver could turn in, and then back out to the opposite direction. Their bus was a little late, but the students from the other buses were just milling around, waiting for them to arrive.

At the Indian reservation, there was a welcome center and the obligatory gift shop, but all activities were outdoor activities. The Indian chief welcomed the class, who sat on the ground in a semicircle *Indian style*. Jason was smart enough to know that the *Indian* in this expression related to the people of India, and not to the American Indians, who were named Indians in the mistaken idea by the first explorers that America was part of India. The chief thanked the school for its visit, since it would add money to the reservation's school fund. Jason didn't see any nearby school building, but he suspected that a school in such a rural location wouldn't be as nice as his. He was fairly certain that students there his age probably didn't have cellphones. It might even be that cellphone reception didn't exist at the reservation.

Although there were demonstrations of Indian crafting, such as silver working, the highlight of the trip was the native music and dancing. Some of the Indian children Jason's age were part of some of the dances. Later in the day, the wind picked up and started to blow a lot of dust into the air, so the teachers decided to end the excursion somewhat earlier than planned. Still, Jason and his friends had a lot to talk about on the bus ride back to school after that trip.

After this reminiscence of last year's school outing, Jason saw Leni on his walk to the lunch room, so he was able to relay the result of his conversation with Marty. Now it was up to her.

"Thanks for doing that, Jace. I especially liked the way you handled it by not telling Marty that I was the one who was asking."

As everyone unpacked his lunch at the lunch table, Jason noticed an unusual food that Leni and Filip had packed in containers within their brown bags. It looked like meatballs, but the color was all wrong.

"What's that?" asked Jason.

"Falafel," explained Filip.

At that, Marty exclaimed, "Gesundheit!"

"Very funny," replied Filip. "These are like meatless meatballs, made with some sort of beans, and different spices than meatballs. It's a food that's popular in the Middle East."

"Would you like to taste some?" asked Leni.

"Sure." said Jason, as Leni broke one in half and gave half to Jason. Jason chewed and rolled it over in his mouth, deciding whether or not he liked it.

"Well, it's OK. Sort of a different taste. I think I prefer my meatballs the way that they've always been made."

There was some talk about the class trip at the lunch table, but most of the conversation was about the news reports of a possible teacher's strike and how nice it would be not to have school for a few days, or weeks.

"It sounds nice at first," said Joe, "But the problem is that there's a required number of school days. Any time away from class, now, would result in shorter holiday breaks; or, maybe worse, a school year that cuts into our summer."

Leni agreed. "Joe's right. I would hate to lose my springtime break. Fortunately, the news reports say that negotiation are continuing, and most of the problems are just with paying the teachers for extracurricular things, like after-school clubs. I think that advisors to the clubs

deserve fair compensation, especially our STEM club, which takes a lot of work and expertise. That's especially true when we travel weekends to a competition. That was always true for sports and the marching band, and now it should be true for other activities."

"The problem, as I see it..." replied Jason, "is that parents like watching football more than watching robots racing each other on a gym floor."

"I've got the perfect solution," said Filip. "Giant robot football players."

Everyone laughed, and then decided to spend more time eating and less time talking.

Monday afternoon classes were unremarkable. Soon, it was back on the bus for the trip home and conversation with the Z-Man.

"Here's hoping that the noise is gone and I can sleep in my own room," said Zephan. "I guess that city people aren't bothered by all the noises they hear at all times of day and night, but here in the suburbs we expect a little quiet. Something that does annoy my father is aircraft noise, some of which occurs in early morning when he would like to sleep."

"I often think how my life would have been different if my parents lived in a big city," replied Jason. "I like living here, but that might just be because that I've never done anything else. Maybe city kids have more fun; or, maybe they have more stress. It's hard to say. We might be living in a rut and don't realize it until we're off at college and mix with other people."

"Well, my parents were both city people." replied Zephan. "From what I've heard, they were really happy to be able to get a house in the

suburbs. Their only complaint is that they're always in a car going from one place to another. You can get along fine without a car in a big city. In fact, everything about owning a car is too expensive in a city, especially parking."

The bus arrived at Jason's stop, he wished the Z-Man a noise-free night, and he started for home and his usual evening routine.

Jason's cellphone rang shortly after his family dinner. It was Zephan.

"Hey, Z-Man, don't I get enough of you on the bus? What's up?"

"My father asked around about the noise at work. There's one engineer there who knows a lot of things, so everyone's always asking him questions. He didn't know exactly, but he had a few theories."

"Like, what?"

"Wind turbines, for example. While each one produces a noise more like a thump-thump than than a hum, the sound of many of them merged together could sound like my hum."

"There aren't any wind farms near our homes. Could the sound travel that far?"

"Apparently, atmospheric conditions sometimes will direct their sounds towards the ground, and the noise will travel a long way. That might only happen for a few hours, but it would usually happen at night."

"So, what else did he say?"

"He thinks that it could be a motor, probably an electrical generator. Sometimes when they're replacing refrigeration units in places like a food store or fast-food restaurant, all the cold storage is put into a refrigerated trailer in the parking lot. It obviously needs to run day and night.

Tomorrow, my father and I are going to make a list of all the food stores in the area, then drive around to try to pinpoint the source. When we find it, we might be able to file a complaint with someone."

"Well, it makes sense to me," replied Jason. "Keep me informed."

After Zephan's call, Jason went on the Internet to see how many supermarkets, food stores, and eating places were in the area. If you count all the convenience stores, too, there were more than fifty within a mile of his house. If the noise could be heard from two miles away, there were hundreds! Unless Zephan and his father could follow the direction of the noise back to its source, Jason didn't think they would be able to find it in just one night. Maybe a directional sound meter would help. Zephan's father was some sort of engineer, so he might know how to do something like that. Jason was just happy that the noise didn't seem to extend to his house.

The next morning, Jason was eager to get an update from Zephan about his hunt for the source of the noise. In his Internet searches the previous night, Jason had found a device that might help Zephan return to his room. It was a little box that produced quiet sounds, like ocean waves, that worked to hide street noises to help people sleep. This *masking noise* should work for Zephan's noise, too.

When Jason boarded the bus, Zephan wasn't there. Jason was curious about Zephan's absence, but he figured that he had just missed the bus. Perhaps they would be together on the bus trip home. Disappointed, Jason slouched in

his seat and didn't do anything during the short trip to school.

Jason saw Zephan mid-morning in school.

"Hey, Z-Man, what happened this morning?"

"I ended up in my sister's room, again, last night. All that complicated our morning routine, so I was late for the bus. My mother drove me to school."

"So, the noise is still there. Did you and your father discover the source last night?"

"There's a lot to tell," replied Zephan. "I'll give you an update on the bus ride home."

Zephan scurried to his next class while Jason made his way to science class. Science was especially interesting that week, since they were learning about some important crystals. The electronics in their cellphones and tablet computers were built from silicon crystals, and most light bulbs were now made from silicon carbide crystals. He also learned that diamonds were crystals of carbon, the same material as charcoal.

They were even growing their own crystals of a chemical called potassium aluminum sulfate, also known as alum. Alum was a good choice, since they can't use hazardous chemicals in school, and alum is actually used in food preparation in baking and pickling. While Jason's mother often baked, he never saw her pickle anything. His father's garden produced a lot of cucumbers they could turn into pickles, but it's just much easier to get pickles at the supermarket.

As a first step, the students in Jason's science class applied glue to plastic strips and sprinkled on some of the alum powder. As his teacher

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explained, the alum powder was actually tiny alum crystals that would grow into larger crystals when left overnight in solution. He even used the video microscope to show these small crystals on the large screen. The solution that the strips were dipped into was a lot of alum dissolved in very hot water. While not required for the crystal growth, his teacher had added some red food coloring to make the crystals red.

This was a long process, since the glue needed to dry over the course of at least one night and the strips needed to stay in the cooling solution at least one night, as well. They created the alum coated strips on Friday, one for each student, so they were dry enough to insert into the hot alum solution on Monday. Today was the day to pull out the strips. They were all hanging from a single stiff wire, and everyone was excited about the result as their teacher pulled the strips out of the solution. He gave them a careful rinse with water, and hung them in the back of the classroom to dry overnight. The process was so simple that Jason wondered whether he might be able to grow a huge alum crystal at home.

It was finally day's end, and Jason was back at his usual seat with Zephan.

"OK, Z-Man, let's have the full story."

Zephan stowed his book bag under his seat before his lecture.

"So, right after dinner, my father and I got into the car and drove towards the busier part of our neighborhood. We had the windows open, listening, and we immediately realized one problem. There was so much traffic noise that the hum couldn't be heard, no matter how hard we tried."

"Then, you gave up?" asked Jason.

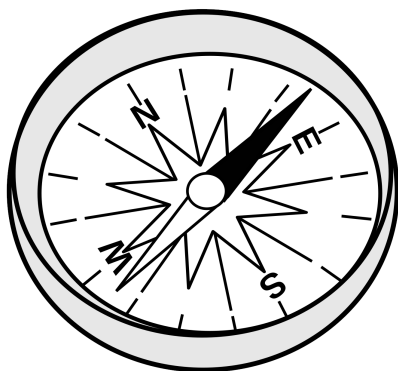
"No. Since we were already on the road, we did a visual search of restaurant and supermarket parking lots for about half an hour. We didn't see or hear anything out of the ordinary. It was definitely not a thorough search, and the whole thing was just boring. Aside from making an attempt to drive around at a quieter time, like, 3:00 AM, this isn't the right approach."

"So, as you said, you're still sleeping in your sister's room. What's next?"

"My father thinks that I can't be the only one who hears this hum. There must be others, some of whom may have registered complaints with the town's public works department or the police. He's going to make some calls to see."

Jason remembered the noise-masking device he found on the Internet, and he described it to Zephan.

"That might be a good solution, for now," replied Zephan. Of course, it would be a shame to waste money that might have been better spent on a video game if the noise disappears before it arrives! Email me the link when you get home."



3 NAME OF THE GAME

Since Zephan's noise problem hadn't stopped, Jason wondered whether he could hear the noise from his house, also. So, late at night, with his parent's permission, he ventured outside to listen. He had even fashioned a makeshift *ear horn* from a rolled-up comic book. It was a cone with the small end designed to cover his ear, and the wide end to gather sounds. Jason's father, who was good at math since he was a computer programmer, explained that sound would be amplified by such a horn in the ratio of the area of the wide circle to the small circle, which would be about a factor of ten.

He had no luck in his backyard, but the front of his house was a different story. He definitely heard Zephan's humming noise through his ear

horn, and he could just barely hear it with his unaided ear. Then he remembered reading about a horn device for detecting the direction of sounds, and he returned to his room to see whether he could find information on that device.

Jason couldn't remember exactly what he had read, so it took a few tries with different keyword searches. And there it was! About a hundred years ago, soldiers wanted to detect the location of the noisy propeller aircraft of their time on cloudy days. A device to do that was two large horns, each connected by a hose to a soldier's ears. By rotating the horns, it was easy to find the direction, much like a person rotates his head to find a sound.

Jason started to think. Leni and he were skilled enough in making things in their STEM club. Maybe they could make a modern version of this direction-finder. If they used microphones, they could get great sensitivity. They would need some help with the electronics, but Zephan's father was an engineer, wasn't he? They could go to Zephan's house, and each house of the lunch table crowd, and maybe accurately pinpoint the noise source. He would discuss his idea with Zephan and Leni. For the present, he just did more reading about how these horn direction-finders worked.

Jason was excited to board the bus the next day to tell Zephan about his idea for building a horn direction-finder to pinpoint the origin of Zephan's hum, but Zephan had his own news.

"I showed my father the sound-masking device, and he ordered one immediately. I think maybe my sister had been complaining too much about my sleeping in her room! He understood

how those things work and said it was so inexpensive that it was worth a try. It should arrive in about two days."

"That's great, but I've got an idea of how we can pinpoint the source of the hum."

Jason then described his idea for a horn direction-finder, how Leni and he would build it, with advice from Zephan's father, and how they would find the direction from several houses and draw lines back to the source.

"Yeah, my father would help," replied Zephan. "He knows about microphones and electronics stuff like that. He even builds some simple circuits in his cellar workshop. They're mostly just kits, but you can buy kits for just about any purpose, sometimes making small modifications to have them do things they weren't originally intended to do."

Jason was starting to realize that it would be possible to build a modern version of the horn direction-finder. The idea kept building in his head during morning classes, and then it was time for lunch. Jason approached the lunch table crowd and asked, "Has anyone here heard about the Z-Man's hum?"

"The Z-Man's parents bought a Hummer?" asked Marty. "Those cars are way cool, and so expensive!"

"No, no!" Jason replied. "Zephan has been hearing a strange humming noise at his house every night. It's so annoying that it keep him awake. He's been sleeping in another bedroom where the noise isn't as loud."

"So, where is the hum coming from?" asked Filip.

"That's the mystery," replied Jason. "No one knows, but I think I have a way to find out, if I can get some STEM help from Leni and some cooperation from the rest of you."

Jason then outlined his idea for a horn direction-finder, his plan to have Leni and Zephan's father help to build it, and their going to everyone's house for direction measurements.

"Sounds interesting," replied Leni. "Sure, I'll help. We'll need to make plans sometime after school."

"Not just yet," said Jason. "Zephan's father is seeing whether anyone knows about the source of the noise, first. If the source is known, then we don't need to do this project." Jason paused for a second. "It sounds illogical, but I'm sort of hoping that no one knows. I'm really interested in doing this."

"Spoken like a true mad scientist," joked Filip. "When will we know if *Project Hummer* is a go?"

"We're definitely not giving it a silly name like that," replied Jason. "We'll decide on a better name, later."

"I can think of a better reason for not calling it *Project Hummer*," said Marty, as he moved towards Jason to whisper in his ear.

"Gee, Marty!" Jason exclaimed. "Your mind's been contaminated by your older brothers!"

The rest of the table seemed confused, and neither Marty nor Jason was inclined to explain.

At the end of the day, on the bus trip home, Zephan affirmed that he would call Jason that evening with an update on his father's inquiries into the hum.

Zephan called very early, about 6:00 PM.

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"Hey, Jason, Zephan here. My father made some telephone calls during the day, first to the public works department, then to the building codes department, which approves all construction in the city, and then the police department. The public works people said there was nothing they were doing that would cause the noise. Since they were always informed about all road construction in the area, they said that there was nothing road-related being done by other agencies, like repaving or pipeline digging, that would cause the sound. They suggested calling the building codes department for information about any private construction projects."

"When he called the building codes department, my father was connected to one of the engineers, so the two were able to talk at a professional level. My father explained the hum, and the codes engineer said that there was no private construction that would cause it. He did say that my father's call wasn't the first. Someone else had asked the same question the other day."

"His call to the police was the most fruitful. The police captain he spoke with said that there had been several noise complaints about a sound like the one that my father described. The captain said that the police patrol cars travel through the entire city many times during the day. None of the policemen had heard the hum, and they haven't seen anything out of the ordinary that might cause it."

"So, it's real, and it is a mystery," said Jason. "I guess our hum project is a go. Have you told

your father about our plans and asked about his helping us with the electronics?"

"Yeah. He said he would help, and it would be easy for him. Once he had the components that he needed, it would take just a single night of his work. Should I have him place the order for the components? It usually takes about three days for delivery."

"If possible, have him order things tonight," replied Jason. "We don't want to waste any time. I don't think it will take Leni and me too long to create the cones and mount them together. Everything will come together at the same time."

Immediately after his call with Zephan, Jason called Leni. There was no answer, so it was likely that she was still eating dinner with her family. Instead of a voice mail, Jason sent her a text message to call him.

At that point, Jason decided that he should start on his homework. An early start was important, since the class assignment for history was to write a one page summary of the important information in the chapter the class had just completed. He didn't mind the work, since he realized that this was excellent preparation for the soon to be announced chapter test. His history teacher had cautioned Jason's class not to just copy sentences from the textbook. Even with that constraint, he had made fairly good progress by the time that Leni returned his call.

"Hi, Jason. What's up."

"I got a call from Zephan that all his father's inquiries into the noise led nowhere; so, our noise detection project should proceed. He said that his father would do the electronics for us.

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The electronic components he needs should arrive in a few days, and Zephan says that the microphone circuit would then take just an additional day to build."

"That's good," replied Leni. "I've been thinking about an easy way to do it. You know how cheerleaders use megaphones to shout to the fans? Those should be easy to buy, locally. They're lightweight, and we can use those for the horns."

"Great idea! Those need to be mounted at an angle for direction-finding. I'll send you a link to an article about that. Our part of the project can be finished by the time Zephan's electronics portion is done."

After a few pleasantries, the call was over, and it was homework time once again.

Back on the bus the next morning, Jason gave Zephan an update.

"I called Leni right after your call, and we've already started our part of the project. Did your father order the electronic components?"

"Not yet," said Zephan. "He said that he needed to decide on the best parts to use, but he promised to order the stuff this morning."

"Great! Any noise updates at your house?"

"The noise-masking device hasn't arrived, yet, so I'm still in my sister's room. I did spend some time in my room to see whether the noise was still there. I hoped that it was finally gone, but I could still hear it."

Jason felt bad for Zephan, but somewhere in his mind he was happy that he still had this mystery to solve.

When noon approached, Jason was more excited about lunch than usual, but not for the

food. They were about to start planning for their noise-detection project, which still needed a name. He laughed to himself about Marty's comment about Project Hummer, but it seemed that hum still needed to be part of the name. He racked his brain during the morning classes thinking of a name. He figured that he had better come to the lunch table with a few names, or the conversation would degenerate into some Project Hummer nonsense.

Two names that seemed to fit were *Hum Detector Project* and *Hum Detection Project*, although he wouldn't object to the simpler *Hum Project*. He had watched a television show about some weird guys who searched for hidden treasure with metal detectors. They called themselves *detectorists*. Although Jason and his friends were searching for a noise, and not buried treasure, they could still call themselves *detectorists*. There would be a lot to talk about at the lunch table, enough to detract time from any technical discussion.

Filip greeted Jason as he approached the lunch table.

"It's nice that Leni and you are bringing us all into your effort to track down Zephan's hum. I've got no complaints, since it sounds interesting, and my role would be just as an interested bystander."

"Don't think you can get out of work that easily," replied Jason. "We can use your computer skills. Once we measure the direction to the hum from all of our houses, we need someone to put the lines on a map to see where they cross. You can do that, right?"

"Yeah, I can get the local map online. I learned online how to use this graphics program called Inkscape that will make it easy to add lines to an image. How close will you measure the direction?"

"It should be really close, if we can do it. Just North-South-East-West won't be enough. Adding things like Southeast will bring us to eight different directions, and that might be enough. I would actually like to go to the next level, things like South-Southeast. That would give us sixteen."

"Actually, a compass angle would be better," Marty interjected. "And why do you need to measure from all our houses. You just need two lines to get your point."

"Well, one thing about measurements, the more, the better. In this case, how the lines cross will tell us how good the measurements are. They should give us an area for search."

"Now for the important part," laughed Jason. "We need a name for our project."

Jason presented his names for the project, and Joe was the first to respond.

"The longer ones sound too fancy. I vote for the simple one, the *Hum Project*. If we're going to be saying it a lot, a shorter name makes the most sense."

Surprisingly, everyone at the table agreed, so the discussion was a lot shorter than Jason expected. He guessed right that selecting from a bunch of names would be a lot easier than having people try to think of something on the spot. Now that the name was selected, Jason invited Leni to describe the direction finder.

"It's really simple, she said. There are two megaphones slightly angled to each other. I think Jason and I will mount them so they can be handheld. We'll need a compass, too, and we can mount that to show the exact direction."

Leni took a table napkin and made a sketch of how it would look. Jason was always impressed by how well Leni could draw.

"So, what about the electronics part?" asked Marty.

"Zephan's father is buying two microphones, one for each megaphone at the small hole," explained Jason. "There's an amplifier for headphones, and everything is battery-powered. From what I've read, you just move around until the sound is the same in each ear, and that gives you the direction."

"Sounds simple enough," said Joe. "When do we start."

"The weekend is almost here," replied Jason. "If Leni can get the megaphones, she and I can build everything except the electronics. From what I've heard from Zephan, once his father gets the electronic components, it will take just an hour or two for him to finish the electronic circuitry. The microphones will be stuffed onto the ends of the megaphones with the aid of a little packing foam after we get them from Zephan."

With the details of the *Hum Project* settled, everyone tried to finish their lunches before the lunch period ended and they needed to run to their classes.

On the bus trip home, Jason gave Zephan an update on the lunch table talk, including the name of the project.

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"I like the name," said Zephan. "It's simple to say."

"You aren't disappointed that it isn't *Zephan's Hum Project*?"

"Ha! I never thought of that! No, just *Hum Project* is OK."

Jason said that he hoped that he and Leni could build the horn structure that weekend, and Zephan said he would call when the electronics were done.

"It should be easy to test, since you can hear the hum at your own house at night, when things are quiet, using an ear horn, said Zephan. "That would be the first measurement."

At lunch the next day, Leni announced that she had found a local sporting goods store that carried megaphones. They actually had a service in which they would imprint your school logo and school colors on the megaphones while you waited at no extra charge. She would ask whether they could just print *Hum Project* on them. She and her mother would buy them that evening. Jason was sure that his father had a few small pieces of wood and some screws in the garage to mount the megaphones.

Leni asked, "What about the compass?"

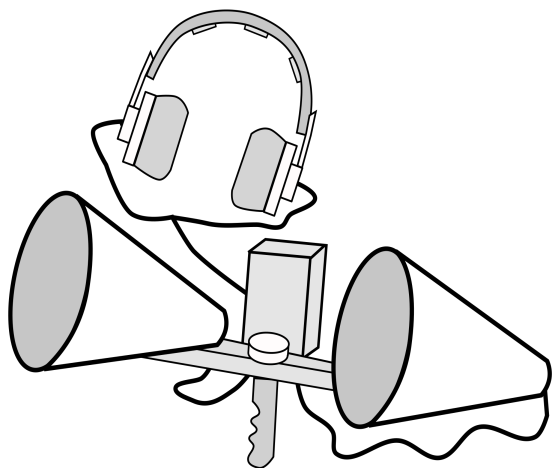
"Since you're buying the megaphones," replied Jason, "I'll get my father to go shopping to find a good compass. I'm sure that almost every novelty store would have toy compasses, but we want something better than that."

That night, Jason talked to his father about buying a compass. His father said he knew the right store to buy one, so they made their way to what was called an *Outdoors* store near their house. Jason had never been in a store like that,

and he was amazed at everything you could find there. There were fishing poles, hunting jackets, and tents, along with climbing ropes and survival kits. The compasses were near the tents.

There were quite a few choices, and the prices ranged from under twenty dollars to over a hundred dollars! He was sure that one of the cheaper compasses was all he needed. He was attracted to one that looked like a ball floating in water that seemed easiest to read. The compasses with pointers had a ring around the outside you needed to turn to align with the North pointer to find your direction. This seemed like too much work.

Jason's father found a salesman to answer some questions about compasses. The salesman's advice was that the pointer compasses were always the most accurate. He had heard enough complaints from customers about the ball compasses to decide that the pointer compasses were the best. Jason's father found a smaller one of those in their price range that seemed like it would be easiest to mount. One thing that the salesman said was to keep the compass away from magnets and metal. That would be OK for their hum detector, since the mounting would be wood, and they'll glue the compass onto the frame.



4 HUM DETECTOR

Jason had the compass, and Leni had the megaphones, so it was time to build the hum detector. Leni had agreed to have one of her parents drive her to Jason's house Saturday afternoon. Jason's father had all the tools, like a hammer and saw, and supplies, like glue and nails, they would need. Jason didn't think they would want to paint it, since paint takes too long to dry, and making the hum detector pretty wasn't that important.

Jason's father had found an old game controller with a handle, and he was able to disassemble the handle from the controller so

they could use it for their hum detector. He was hoping it wouldn't be too heavy for that. Leni arrived promptly at one o'clock, and she said she could stay as long as she wanted, calling home when she wanted a ride back.

The first order of business was to examine Leni's plans for the device. Since Leni hadn't known about the handle that Jason's father found, they added that to the plans. The design was simple - The megaphones were attached to the ends of a board about 18 inches wide and angled outwards about 20 degrees. Leni got the angles from an old photograph, but she didn't think that the exact value was too important.

The game controller handle had a shaft that would fit through a hole drilled into the center of the board, where it would be glued. The compass would be glued right over the center hole. Jason was happy that the megaphones were light enough that the device could easily be held by the handle.

The device came together easily. All that remained was to wait for the glue to dry and the mounting of the microphones at Zephan's house. Jason said he would go to Zephan's house for that final step when he got the word that the electronics were finished. He had some packing foam fitted to the megaphone ends for that final step. Leni called her mother, and there was some time remaining for them to talk.

As usual, common ground for conversation was school. Leni and Jason shared no classes together, although they did share many of the same teachers. They both had the same science teacher, Mr. Munro, whom they agreed was an excellent teacher, and also the same teacher,

Mrs. Bertrand, for math. Mr. Munro was a young teacher who seemed to be well versed on the latest science news. Mrs. Bertrand seemed to be about the same age, but the advantage she had was that most mathematics, at least the kind they had in school, was old news.

"Leni, did you do the crystal growth in your science class, too?"

"Yeah," replied Leni. "I'd like to grow some larger crystals, maybe using different food colors. They would look really nice, side-by-side on my shelf."

"I had the same idea," said Jason. "We should do some Internet searches to see how hard that would be. My mother said she grew some sugar crystals on a string when she was in school. She used a hot water solution with a lot of sugar, just like what we did with the alum."

Leni's mother arrived, and the first essential step in the *Hum Project* was completed. The next step was waiting for Zephan's electronics. Zephan telephoned on Sunday afternoon to say that his father had completed the electronics, and he asked whether Jason could visit that evening for the final assembly and test. Jason said he would complete all his homework assignments by dinner time, and that would ensure the permission of both his parents and their willingness to drive him there.

Since the hum was heard late at night, possibly because all other noise sources had quieted down, they decided to make Jason's visit late, at nine o'clock. Jason was certain that the latest his parents would allow him to stay was 10:30, so he hoped that an hour and a half would be sufficient time. One thing that worked in their

favor was the idea that Sunday night, of all the nights of the week, should be especially quiet.

Jason, carrying the megaphone device in his hands, arrived at Zephan's house promptly at 9:00. Zephan's mother greeted him at the door and directed him to the cellar, where the workshop was located. The workshop turned out to be a well lighted desk in one corner of an otherwise typical cellar that was overloaded with boxes and furniture. There was even a fully assembled artificial Christmas tree. Jason figured that if you had enough room for storage, it made more sense to keep the tree whole, rather than breaking it apart year after year.

Zephan and his father were sitting and talking, apparently just waiting for Jason. Zephan's father was the first to notice Jason's arrival.

"Hey, Jason, I see you're carrying the hum detector frame. It looks like a nice job. Put it here on the bench."

Jason complied, and both Zephan and his father carefully examined the device.

"Nice job!" said Zephan. "I especially like the handle, but I guess the trigger doesn't do anything."

"I was lucky that my father had an old game controller that he was willing to donate to the project, and that's where we got the handle. The work that Leni and I did is probably much less than what your father did."

"Not really," Zephan's father replied. "All I needed was a preassembled module, and the only work involved was connecting everything with wires. Of course," he laughed, "you need to know where the wires go. Some of my

engineering courses have finally been useful! Let me show you how it works."

While there were various tools arrayed around the periphery of the table, sitting at the center was a small plastic box with its cover removed. There was a battery holder screwed to the bottom of the box, and two long wires threaded through a hole in one side. The wires terminated in small cylindrical objects that must be the microphones. On the opposite side of the box to the wire hole was a jack into which a small headphone set was plugged, a switch, and what looked like a volume control knob. The box contained two small circuit boards stacked on top of each other.

Zephan's father continued.

"I'm sure you've already identified all the important parts. Here are the two microphones, the headphones, the on-off switch, and the volume control. Put on the headphones, and we'll give it a try."

Jason noticed that the microphones were labeled with permanent marker as L and R. Zephan's father picked up the L microphone, flipped the switch, and spoke a few words. Jason noticed that his voice was heard in his left ear. He then spoke into the R microphone, and his voice was heard in Jason's right ear. He then motioned to Jason to remove the headphones.

"The important part is to put the L microphone in the left horn, and the R microphone in the right horn. Also I found," as he continued, "it's important to have the volume set low at the start, so you don't blast your ears. Now, let's see how we'll mount the microphones."

Zephan's father took the megaphone device that Jason and Leni had built from where Jason had set it on a chair, and he put it on the table alongside the electronics.

"We've put some packing foam at the small ends of the megaphones." said Jason. "Can we just put holes in it to insert that microphones?"

"That was a really good idea," replied Zephan's father. "Since the foam is too soft for an ordinary drill, we'll use this."

He reached back to retrieve a pointed piece of metal with a handle. It had grooves going lengthwise from the handle, where it was thick, to the point.

Zephan, who had been watching quietly off to one side, broke his silence to explain, "It's a reamer. It's used to make small holes larger. I guess it can make a conical hole in soft foam, too."

"That's right," said Zephan's father as he removed one of the foam pieces and proceeded to twist the reamer into it. The foam came away in small crumbs, and after a while, when the hole looked about the right size, he stopped twisting and withdrew the reamer. He then stuffed one of the microphones in the hole and exclaimed, "Perfect fit." He then invited Jason to do the same with the other piece of foam.

Jason was hesitant at first, but he repeated the same motions done by Zephan's father. In less than a minute, the second hole was done. Jason then stuffed the other microphone into the foam, and he and Zephan stuffed the foam pieces back into the megaphones, making certain to match them to the left and right sides. Zephan's father then attached electrical staples to the

wooden frame to keep the microphones from being pulled out by stray tugs on the wires. He also attached the plastic box with two small screws and screwed on the box cover. Then it was time for the first test of the hum detector.

Zephan's father led them back up the cellar stairs and out the back door of the house. It was a clear and somewhat cool night, and Jason was thankful that it seemed to be mostly quiet, as expected for a Sunday night. Jason put on the headphones, and Zephan's father reminded everyone to be quiet. Jason flipped the power switch, and adjusted the volume control.

"I can hear the hum!" exclaimed Jason, who was then sorry he had, since his voice was really loud in the headphones. He switched off the power, pulled off the headphones, and offered them to Zephan to give it a try.

"I can hear it, too," said Zephan, who was smart enough to talk in a whisper. Zephan's father flipped off the power switch and said they should try to find the direction.

"Wait." said Jason. "We need to set the compass dial to North."

Zephan, still wearing the headphones, passed the hum detector to Jason. Jason held it level and adjusted the compass dial to match its needle. Then he remembered what his father had taught him.

"No. I was wrong. We do that step when we stop to get a reading."

Zephan stood away from the two, flipped the power switch, and slowly rotated all the way around. He then rotated again and zeroed-in on the direction of the hum. He stopped there and motioned Jason over to read the compass. At

that point, Jason rotated the outer dial to match North to the compass needle, and he looked at the mark his father had made on the wooden frame that showed the forward direction of the hum detector. It was at WNW, close to 290 degrees. Jason had a scrap of paper in his pocket, and he wrote down the reading. He knew he would need to transfer the number to a project notebook when he got home.

"Let me try," whispered Jason.

Zephan flipped the power switch and gave the headphones and hum detector to Jason, who went through the same routine as Zephan. When they adjusted the compass dial, it was the same WNW reading that Zephan obtained. Confident that they had their first reading, he turned off the detector, and they returned to the house.

Since they had finished earlier than Jason's ride home, Zephan's father brought them to his computer, where he accessed a map of the area.

"Since we now have a direction, let's see where it points."

He located Zephan's house on the map that had the usual orientation of North at the top. He retrieved a transparent ruler from the desk.

"This isn't completely accurate, but it will give us something to think about," he said as he placed the ruler on the screen at an angle of about WNW. Unexpectedly, the direction wasn't towards a busy area, like the city center, but outside the city. The map marked nothing notable along the line.

"Well, I guess you really do need to get directions from other houses," said Zephan's father. At that point, Jason's mother arrived, so they put the hum detector and headphones in a

THE HUM PROJECT

large bag for him to carry home. Jason was eager to tell Leni about their success, but it was too late for a telephone call. He would need to wait for the lunch table on Monday.

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5 DETECTORISTS

Since they had done the first direction measurement the previous night, Zephan and Jason had a lot to talk about on Monday morning's bus. Zephan's father had printed the area map, and he drew a more accurate direction line on it. He also cautioned Zephan that the best way to zero-in on the source of the hum was to make measurements from widely spaced locations. Jason lived quite close to Zephan, so measurements at just their houses wouldn't be that good. It had been too late in the night on Sunday for Jason to make a measurement at his house, but he would try to do it that night to see what he got.

"Can I take the map with me to lunch," asked Jason. "That way I can mark everyone's house on it to see how far apart we can get measurements.

I don't think that anyone at the lunch table lives too close to anyone else."

When his morning classes were finally finished, Jason was excited to be able to report to the lunch table crowd the first successful direction measurement with the hum detector. He started talking when he was close enough to Leni to be heard over the cafeteria buzz.

"Leni, the hum detector works! Zephan, Zephan's father and I mounted the electronics and tested it in his back yard. We've got one direction line already."

Jason fished the map from his front shirt pocket and handed it to Leni.

"So, the tiny circle is Zephan's house, and the line is the direction to the hum?" asked Leni, as their other lunch mates moved to view the map.

"That's right. I thought that the line would point to the city, where you would expect the hum to be generated. Instead, it points away from the city to no special place."

"That is curious," replied Leni.

"I'd like everyone to mark their houses on the map, so we can plan our next step. Of course, just one mark for Leni and Filip, since they live in the same house. Then we can plan a schedule to get a direction from everyone's house. Oh... and remember that the hum detection needs to be done late at night; probably, the later, the better."

Joe asked, "When did you do the direction measurement at the Z-Man's house?"

"It was around 10:00 PM, but it was a Sunday when things are expected to be quiet at an earlier time. Any noise, like automobile traffic, would make the hum hard to hear.

"Or, in my case, my older brothers playing their video games or loud music," said Marty. "I guess I could convince them to take a half-hour break for the measurement."

Marty studied the map and put a circle at the location of his house, then everyone else did likewise. Jason pocketed the map.

"Would everyone email me, with a copy to Leni, which nights this week your house would be available for a measurement. The whole process is so quick that I could have my father, or mother, just wait in the car while it's being done. That way, I'll be in and out with no fuss."

"I'd like to tag along," said Leni. "Would it be possible to get me at my house first, before traveling to the other houses? Of course, when the measurement is at your house, I'll just have my mother or father bring me there. When the measurement is at my house, I'll already be there!"

There was no question that Leni should be included, since she did just as much work on the hum detector as Jason.

"Absolutely," replied Jason. "Maybe this will drag on into next week, since we need to coordinate your schedule, my schedule, and the availability of the hosting house."

With the *Hum Project* planning out of the way, everyone concentrated on eating before the lunch period ended.

Jason monitored his email at home that evening, and when everyone's timetable had been posted, he proceeded to make a schedule for hum detector trips. He made a chart of the days of the week as rows, and members of the

Hum Project as columns. He shaded the boxes when each member was available.

Since He and Leni had a big science paper due on Monday, she mentioned in her email that at least one of her weekend nights should be kept free. She didn't prefer any one of the three nights. Since Sunday was expected to be a quieter night, and Friday night was likely quieter than Saturday night, Jason decided that he would reserve Saturday night as science paper night.

Jason had nearly forgotten two important team members, his parents, who needed to drive Leni and him to each house. He found his parents both in the living room at the same time and explained the situation. After a little discussion, they decided that Saturday was the only night that neither of them could drive, since they were *binge watching* a television series together on that night. That worked out well, since Saturday was already excluded on his chart.

Back in his room, Jason crossed-off the rows in which he and Leni weren't available to see which houses were available on what nights. The schedule would be his own house on Wednesday, Marty on Thursday, then Joe on Friday, and finally Leni and Filip on Sunday. He emailed the schedule to the team and then continued with the *real* work of the night, his homework, part of which was preparation for writing his science paper.

The assignment was to write a three page biography of a famous scientist. Jason's science teacher, Mr. Munro, had given the class a list of possibilities, but he said they could write about any famous scientist from any field of science,

and that included computer science. Jason's decided to show the initiative of choosing a scientist who wasn't on the list. Since his father would know about all the famous computer scientists, he would ask him for some names. His father might even have a book about one of them, and that would save a trip to the library.

His father suggested one of the first computer scientists, John von Neumann, who was also a famous mathematician. As his father explained, all the early computer scientists were mathematicians, and computer programming was considered to be a form of applied mathematics. As a bonus, Jason's father had a book about the history of computer science that had an entire chapter about von Neumann!

The chapter about von Neumann was long, and it contained everything he would need to write his paper. There was, however, one problem. A lot of the chapter was too technical for Jason to understand! As he scanned the text, he did find that he could understand the details about his life that were sprinkled throughout. What he needed was another book at his grade level that made von Neumann's computer work understandable. He was happy that he discovered this problem early, since he would still need to make a trip to the school library and do some Internet searching.

It was Tuesday, a day that wasn't on the hum detector schedule, but Jason had a lot to report to Zephan on the morning bus. He pulled the map out of his book bag as soon as he had seated himself next to Zephan and described the schedule.

"So, you and Leni will do a measurement at your house tomorrow night?" asked Zephan.

"Yeah. I would have done it tonight, but it was only fair for Leni to be involved. Besides, two people doing the hum detection is a way to make sure there aren't any errors."

"Right. You and I got the same compass reading at my house, so we're confident that it's right. It's interesting that we didn't need any special instructions on how to do the direction measurement. Once the headphones were on, it was obvious how it worked. You just moved around in a circle to get an equal hum in each ear."

When Zephan was talking about moving around, Jason got an idea about the hum.

"We've been thinking that the hum is coming from one place. What if the source of the hum is moving around?"

Zephan thought for a second, and then replied, "That would make finding it really hard, even with the hum detector. Of course, it would be nice if it moved so far away that it didn't disturb my sleep!"

At that point, the bus arrived at school, but this new idea gave Jason something to think about and tell the *Hum Project* team at the lunch table.

History class proved to be somewhat interesting, but not for anything that his teacher expected. A pipe had burst in a room above the classroom, and water had started to run down an exposed pipe at the ceiling onto the floor. The flow of water was stopped quickly, but the white board had been hastily moved to the back of the room so that its electronics wouldn't be damaged

by the water. As a result, the classroom was flipped, with the teacher at the rear of the room and the desks hastily rotated in place into a jumbled mess. As a consequence, Jason got to view the back of the student who had always viewed the back of his head.

Lunch period arrived, and Jason made his way to the lunch table. He was the first to arrive, but Joe lagged by just a half minute.

"So, I heard your history class was flooded, but the teacher still kept you there. Did everyone do a doggy paddle for forty-five minutes?"

"It wasn't that bad," replied Jason. "The janitor tried to make as little noise as possible when he was mopping, but that was still a distraction. It helped that the teacher was at the back of the room, so we were turned away from the mopping. Why do pipes burst like that? The building isn't that old."

"As my father once explained it, the pipes are rigid, and they're attached to the building. New buildings take years to settle into place, and the movement of the building will sometimes be so much that a junction between pipes will break."

At that point, the rest of the lunch crew arrived. After they were settled, Jason told him about the idea that the source of the hum might move.

"Well, there was the idea that it was a refrigerated truck, or some mobile generator," said Leni. "So, that might be true. Does this mean that our direction-finding is doomed to failure?"

"All we know is that it *might* be mobile," replied Jason. "Even if it were mobile, it might

stay at one place for quite a while. The hum travels so far that I'm starting to think that whatever is making it must be huge, like something on the floor of a building, or on a concrete pad outside. Something like a huge piece of factory equipment, maybe an assembly line for something big like tractors, or a printing press."

Joe interjected.

"A printing press! Maybe we're on the trail of a gang of counterfeiters!"

"Not likely," said Marty, who paused between sandwich bites to say to Jason, "From the schedule, the second reading is at your house, tomorrow. With two lines, one from Zephan's house and one from yours, you'll be able to see where they intersect. That will give you the supposed source of the hum. If Thursday's reading from my house gives you a line that doesn't come close to where the other two lines intersect, then it's mobile."

"Then what?" asked Filip.

Jason responded, "Without at least another hum detector to give two measurements at the same time, we could never track the source. Let's hope it isn't mobile; or, as Zephan told me this morning, mobile enough that it leaves the city forever and leaves him alone."

During a free period in the afternoon, Jason went to the school library, hoping to get another book about the subject of his science paper, John von Neumann. From what he observed about the other students, not many of them had ventured into the computer section of the library; so, if the library had any books that mentioned von Neumann, he was sure they would still be on the

shelves. He confessed to himself that he, too, was one of the students who had never checked-out a computer book. That was especially bad in his case, since his father worked with computers.

The computer section of the library contained many books, but most of them were about computer programming. Jason finally discovered a promising patch of books about the history of computers. Thumbing through the index, he found one with many pages that referenced von Neumann. Since Jason didn't have much time left in his free period, he didn't bother to check any of the referenced pages. Instead, he just checked-out the book, hoping for the best.

There was nothing new to discuss about the hum on the bus ride home, so Jason and Zephaniah discussed the forthcoming school trip to the natural history museum.

"Did you return the permission slip, yet," asked Jason.

Zephaniah responded, "I gave it to my mother, who signed it, but it isn't due for another week, so I keep forgetting to bring it back to school. I'm sure as the deadline closes in, my homeroom teacher will give us persistent reminders, and I'll remember."

"I wonder what happens to anyone who doesn't return the slip. Would there be some parents who won't sign, for one reason or another. Maybe it costs too much."

"I heard that behind the scenes, the school would waive payment for a disadvantaged student. I think our parents pay a little more to help like that."

"There's another thing," said Jason. "This is a natural history museum. Some religions don't

believe in evolution and stuff like that, so parents might disapprove on religious grounds."

"I don't think that would stop anyone. The students would just get a lecture from the parents that some things in the museum aren't quite true, and that would be that. It isn't like we're really there to learn anything."

Jason laughed. "Yeah. The school idea that these trips are *educational*" - He made *air quotes* around the word - "is a joke, at least to students."

"I'm sure that we're affected subconsciously," replied Zephan.

"Just like some classes in regular school render us unconscious," joked Jason.

Back at home, after dinner, it was time for Jason to examine his von Neumann book to see whether it would be helpful. As he dug into the chapters he saw that the author had written things to be understandable to someone his age, mostly by analogy to everyday things. He read that von Neumann was interested in random numbers, so there was something in the book about flipping coins and throwing dice. Jason became more interested in the book than just as a way of completing an assignment.

Von Neumann was a boy genius who divided eight-digit numbers in his head and spoke many languages. Although his parents had him attend school at the grade level appropriate for his age, his real learning was from private tutors at home, especially in math. Jason felt sorry for von Neumann's classmates in math!

Jason could see from the photos of von Neumann in the book that he liked to eat. His wife said that her math genius husband could count everything except calories, and he loved

parties. He memorized the telephone book, which was shorter in those days, and entertained his friends at parties by matching names they called out with telephone numbers, and *vice versa*. He was a bad automobile driver who sometimes got into minor accidents by trying to read a book while driving!

As for computer science, he wrote some of the first computer programs, including those for a huge computer called EDVAC, the type of computer you might see in very old science fiction movies. EDVAC weighed about eight tons, and it took two dozen people to operate. Jason started to have a higher regard for his half pound tablet computer.

Jason didn't know much about computer programming, except for some simple examples he had learned in school. He was always amazed at the programs he had seen on his father's desktop computer. Jason had learned about binary numbers, so he was interested to read an example in the book about something called stochastic computing invented by von Neumann.

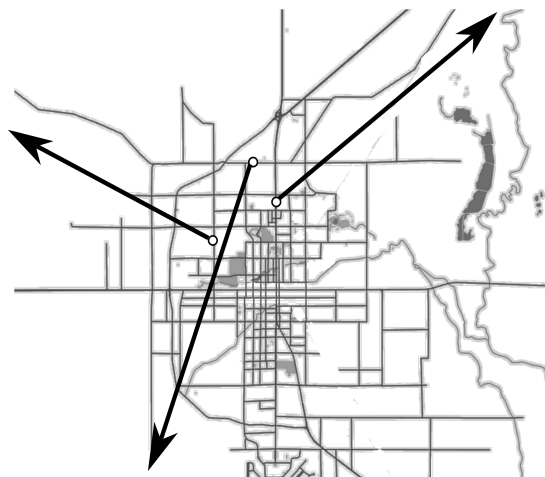
Stochastic computing was one way to solve the problem of how to have a computer understand decimal numbers, and not just whole numbers. If you wanted a number like 7.3, how could you make your computer understand this if it only talked in binary numbers?

Von Neumann reasoned that 7.3 is just the average of the numbers, 7, 7, 7, 7, 7, 7, 7, 8, 8, and 8. If you wrote these numbers together in binary, they would be

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and this averages out to 7.3, at least as far as the computer is concerned. Stochastic, as Jason found, is a word that means random. The stochastic part is that you can jumble these ones and zeros and still get something that averages to 7.3. Now, that's clever!

On the Wednesday bus, Jason learned that Zephan's noise masking device had arrived the previous day. Zephan said that it was somewhat hard getting accustomed to its sound. He needed to adjust the volume to make it loud enough to mask the hum, and not so loud as to become another nuisance; but, he was finally able to sleep in his own bedroom. At lunch, Jason and Leni planned a time for the hum detection at Jason's house that evening. They were finally starting to zero-in on the source of the hum.



6 MYSTERY

When morning arrived, Jason was excited that he and Leni would finally make a measurement with the hum detector at his house. Since they needed all other noise sources to be quiet, the measurement had to be late at night. Leni said she would try to convince her parents to bring her to Jason's house at 10:00, with a promise that everything would be over by 10:30. For his part, Jason would convince his mother to buy pastry, or something like that, to host Leni's parent while they waited.

No floods that day in his history classroom, although Jason noticed a stain on the ceiling at

the place from which the water fell. His history teacher was back at her desk at the front, along with the white board. Overnight, they had cleaned and waxed the classroom floor, and the residual odor of the wax was a mild distraction.

At lunch, Jason greeted his lunch table crowd with the news that Zephan was back in his bedroom.

Leni asked, "Did the hum stop? Is the *Hum Project* canceled?"

"No," Jason replied, "The noise masking device works. The Z-Man just needed to make some adjustments to effectively mask the hum."

Joe interjected.

"Maybe I was chewing too hard when you told us, and I didn't hear, but what's a noise masking device? Is it some sort of mask that covers his ears?"

"Oh, I guess I didn't tell you about the noise masking device ordered for Zephan. It's a little electronics box that makes a quiet ocean wave type of sound. The idea is that it's not that loud, but it's loud enough to mask noises like the hum. It's a soothing sound, so you can sleep with it, like if your bed was at a nice beach resort. Zephan told me on our morning bus that once he had the volume set, it worked great."

"Do you think one of those would block the noise from my unruly brothers?," asked Marty.

"From what you've told me about them, I don't think so," replied Jason. "This is more for a low-level annoyance, not the noise of energetic high school students."

"Back to my first question," said Leni. "Is he OK with that, so we don't need to still track down the hum."

"As I look at it, that masking device is just a band-aid. The best solution would be to find the source of the hum and somehow stop it. Remember, it's probably not just Zephon who can't sleep. There might be a hundred people out there annoyed by the hum."

"Plus," said Filip, "You've already built the hum detector. What do they say about the guy with a hammer - He's always looking for a nail."

Everyone laughed. Jason and Leni confirmed their hum detection meeting at his house that night, and everyone dug into their lunch bags.

At home that evening after dinner, Jason was somewhat distracted by the idea that Leni would be visiting that night. However, she wouldn't be there until ten, and there were quite a few hours before that time. After quickly finishing his more routine homework assignments, he decided to work a little on his science report about John von Neumann.

Jason had learned the trick that the best way to write any report was to first prepare an outline, so he started an outline about von Neumann. At the first level, he had the main topics, his childhood, his mathematical work, and his computer work. The first and last topics would be easy to write about, since his reference books had a lot of information. The middle topic, mathematics, would be harder, since the math that von Neumann did was quite advanced. Jason would probably write that section last. After this first level of the outline, he scratched in some paragraph level topics, like the "boy genius" aspect, his schooling, and the stochastic programming idea. He was sure that just using

the word, "stochastic," would get him a high grade.

After that, he did some things online until the doorbell rang to announce Leni's arrival. Leni arrived with her mother, whom Jason had never met, and he was amazed at the close resemblance between mother and daughter. In fact, they were dressed almost identically, in jeans and a brightly colored top. Jason's mother tended to Leni's mother in the living room while Jason and Leni went right to work in the back yard. It was the first time that Leni had seen the completed hum detector.

"So, this is how it looks," she said. "Cool! Explain how we operate it."

Jason gave Leni a quick summary and handed her the headphones.

"The headphones are labeled *left* and *right*, to match the megaphones."

Leni put on the headphones and flipped the power switch while Jason remained quiet. She rotated slowly around and whispered, "I hear it." She then rotated back and forth, zeroing-in on the direction of the hum. She stopped and motioned Jason towards her. That was Jason's signal to adjust the compass ring to get the direction. It was directly North.

At that point, Leni switched off the power and passed the headphones and hum detector to Jason, who went through the same routine to get North again. Satisfied that the direction reading was correct, Leni and Jason returned to the house. Leni's mother and Jason's mother were laughing in the living room, so Leni's mother must have had a pleasant wait.

Leni's mother asked Leni, "Done so soon?"

"I told you it wouldn't take that long. Remember that Jason will meet me at our home tomorrow night for a direction reading at Marty's house," said Leni.

"Then Joe on Friday," added Jason. "Finally, I'll be at Leni's house on Sunday."

"Well, you two seem to have this well organized," replied Leni's mother. None of those days will be any problem."

Jason's mother offered the two visitors a few pastries to take with them, and these were graciously accepted. He was glad there was at least one reserved for him, but it was close to bed time, and it would need to remain for the next day. It was also too late to put the new direction line on the map. That would need to wait until the next day, also.

In a flash, it was the next morning, and Jason was seated next to Zephan on the bus.

"So, how was last night's measurement," asked Zephan.

"It was just as easy as at your house. Leni and I got the same direction, North, in no time at all. I didn't have time to add the line to the map last night. We still have a lot of time before we reach school. Would you like to do it now?"

"Yeah. Two lines will meet at the location of the hum. Of course, your house and my house aren't too far apart, so it will just be approximate, depending on the direction."

Jason pulled the map from his backpack and located his house.

"The direction was easy to remember," explained Jason. "It was just North."

Jason used the edge of a book to mark a line straight up from his house. Immediately, both of them saw a problem.

"The lines don't intersect on the map," said Zephan. "Are you sure it was North?"

"It was North. We're also sure of the direction reading at your house, too. Something is wrong!"

Zephan attempted an explanation.

"Maybe an indication that the hum is moving? We talked about that before."

"Leni and I are still scheduled for Marty's house this evening. We'll see where his line points. The only way we can be sure that it is moving is to recheck your house and my house, too."

"Yeah. You're right. I hate to think that after all this work we're back at square one. Worse yet, I might be stuck with the ocean wave machine in my bedroom forever."

At that point, the bus arrived at school, and both of them had something to think about during the day.

When the time came, Jason displayed the map at the lunch table.

"Something strange is going on," he said, as everyone looked at the map.

Leni exclaimed, "Our direction line from your house doesn't cross the one from Zephan's house!"

"So, it's mobile," said Marty.

"Well, it looks like that," Jason replied. "We're still going to get a direction measurement at your house, tonight. That should tell us something. Maybe your line intersects the one from my house, so it moved just between the

reading at Zephan's house and mine. Remember, Zephan's reading was on a Sunday. The source of the noise might move from week to week."

"Interesting theory," replied Leni. "Now I'm especially curious about tonight's reading, and the one after it."

"If it does move week-to-week, we still have a good chance of finding it," said Jason. "If two, or three, measurements early in the week intersect at a point, and we rush to that place, we should find it."

"Here's hoping," said Filip, "for the Z-Man's sake. Oh, since you'll be getting Leni at our house, tonight, can I tag along? I'd like to see how the hum detector works. I'd also like to meet those two older brothers that Marty always talks about."

Jason agreed, and he and Leni decided that to get to Marty's house by 10:00 PM, Jason and his parent would need to get Leni and Filip at their house at about 9:45 PM.

Later that day, on the bus ride home, Jason told Zephan that they would do the measurement at Marty's house that night. He was hopeful that the direction line of the hum from Marty's house would at least intersect the direction line from Jason's house. That would somewhat confirm the idea that the source of the hum moved from place to place each week. However, they wouldn't really be confident in that idea until the direction line from Joe's house on Friday came close to the same intersection. Of course, Friday night was part of the weekend, so the source of the hum might already be on the move by then.

When Jason arrived home, he was greeted with the welcome fragrance of his mother's

cooking. It was apparent that this would be a night of Indian food, one of his mother's specialties, and also one of his favorite cuisines. His mother had learned about cooking Indian food from a classmate in college, but she dials back on the spicy hotness for her own family. Jason wondered at what age Indian children, and even Mexican children, ate the same spicy food as their parents. He still didn't like foods that were too spicy.

There was always conversation at the dinner table, but most of it was about Jason and school. After a few mundane facts about his school day, Jason was able to update his parents on the *Hum Project*, including the mystery of the random directions that they had found.

"The only real check to see whether the hum source is moving," said his father, "is to recheck at least a few of the houses. I hate to say it, but there might be more than one source of the hum, whatever that could be. Maybe something with the electrical wires or those transformers hanging on the utility poles. Maybe these hum sources were always there, but the one closest to Zephon got louder. If it is close to his house, you should do some direction finding at many places around his neighborhood."

Suddenly, the *Hum Project* was getting much more complicated. Jason's father's idea seemed really logical. Something more to think about and tell the lunch table team. Also at dinner, Jason's mother mentioned that since his father had some emergency work task to tend to that evening, she would be the driver that night, and she needed both Leni's address and Marty's address for her GPS app.

At the scheduled time, Jason stowed the hum detector in the trunk of his mother's car, and they headed to their first stop, to get Leni and Filip at their house. Then it was off to Marty's. On the short trip to Marty's, Jason told Leni and Filip about his father's idea that the source of the hum might be everywhere, and the one near Zephan had just gotten louder.

"Yeah," replied Filip. "One night, when I was walking around our neighborhood, I head a buzz from one of the street lights. It was loud enough to hear for at least the distance between houses. A couple of nights later, the street light was out, so the buzz must have been because of some problem. I wonder whether there's a street light like that near Zephan's house. It might be as simple as that."

"But we've heard the hum at all the houses we've been at," said Leni. "How do you explain that?"

Filip replied, "The hum detector has an amplifier, right? It allows you to hear the slightest sound, like the nearest streetlight. They might all make some sound."

"I'll ask Zephan about streetlights on the morning bus," said Jason as they arrived at Marty's house. As soon as they exited the car, Jason looked around for some street lights. Jason pointed them out to Leni and Filip. "Maybe we can get a direction reading from here after one at the back yard. That would be a sure test."

Marty had heard them talking after they exited the car, so he was waiting for them at the front door of his house. While Marty's mother took charge of Jason's mother, the four *Hum Project* members walked through the house to

the back yard. Marty's brothers were nowhere to be seen.

Filip asked, "Marty, where are those brothers that you're always talking about? I expected a garage band recital, or something like that, when we arrived."

"One of them is old enough to drive, so the two of them are out, somewhere, with some girls," Marty responded. "It's nice that the two of them get along. It gives me some time to myself. So, this is the hum detector." This was the first time that Marty had seen the hum-detection device.

"Leni can make the first measurement," said Jason, "then all of us can repeat it as a check. You really don't need any training to operate it. It just comes naturally. One caution, as you'll see as Leni operates the detector, is that you need to hold still at the end so we can turn the compass ring to get the direction."

With that, Leni put on the headphones, flipped the power switch, and did a slow twirl. She finally stopped and motioned for Jason to get the compass reading."

"Looks like SSW," said Jason. Then the other three went through the same motions and got the same direction. Jason pulled the map and a short ruler from the same bag he had used to carry the hum detector, he walked over to a picnic table that was there in the back yard, and he carefully drew the direction line as the other team members watched.

"OK. The crazy continues," said Jason. "The line points almost exactly at my house! We have these three lines that don't intersect on anything!"

"Let's try the front yard," said Leni.

"Why the front yard?" asked Marty. "We got four readings exactly the same here."

Jason then explained about his father's street light idea, and continued, "We'll see whether the hum is coming from the direction of one of the lights."

So, the four hum team members walked to the front of the house. Since Jason was holding the hum detector, he tried a reading. He knew immediately that the direction wasn't from any light. However, the direction was different from what they found in the back yard. Just slightly different, but still different.

"I'm getting a different direction here," said Jason. "We should all take a reading, just as a check."

They all got the same direction, SW. They walked back to the back yard, and Jason stowed the hum detector into its carrying bag.

"So, the mystery deepens," said Jason. "Leni and Filip, maybe I can convince my mother to let us make one quick measurement at your house when we take you back home. Your house was scheduled for tomorrow, but I'm really curious."

"Me, too," said Leni.

With that, they retreated to the house. Jason's mother agreed to have him spend a little time at Leni and Filip's house. She also said that she would wait in the car. She didn't want to burden their mother with an unexpected visitor that late at night, and with no proper notice. During the trip, Filip had an idea.

"Marty mentioned that one of his brothers is old enough to drive. We should keep that in mind. There might come a time when we'll need

to take direction measurements from many different places, all on the same night. He might volunteer to help us."

"Let's talk it over with Marty at tomorrow's lunch table," replied Jason, as they pulled into the driveway of Leni and Filip's house.

"Don't rush on my account," said Jason's mother. "Just don't go much over fifteen or twenty minutes."

"Thanks, Mom," replied Jason, as he hauled the bag containing the hum detector off the floor of the front seat where he had been sitting.

"Backyard, first, then here in the front?" asked Leni.

They all agreed and headed around the garage to the backyard. Going through the motions, Jason got a reading.

"Almost exactly NE," he said. "Here, Leni," he said as he handed the hum detector to Leni, "confirm the measurement."

Leni's direction was the same.

"OK, front yard it is," said Jason.

When they arrived at the front yard, Jason noticed that his mother was playing some music in the car. The car windows were closed, and the volume was really low. However, the hum detector amplified sounds quite a bit, so he asked his mother to turn off the music while they did the measurement. Since Leni was still holding the hum detector, she did the first measurement. The direction was directly East!

"That's quite a change," said Jason. "Let me try." Jason got East, also.

Filip summarized the measurements.

"So, NE in the backyard, but E in the front. A real difference, just like at Marty's house. Now what?"

Jason replied, "Well, we've done the measurement at your house, so Sunday is open. Joe is scheduled for Friday, but I think we should try something else instead. Let's repeat things at my house on Friday, plot everything carefully on the map, and see whether anything makes sense."

"And, if it doesn't make sense, then what?" asked Leni.

"Then we'll need some expert advice, maybe from that engineer or scientist guy who works with Zephan's father."

With that, Filip retrieved the carrying bag from the backyard, Jason stuffed the hum detector into it, and he and his mother left for home.

About the Author



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

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

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