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From the Editor

The Scientific Misadventures of Professor Millsap

In this issue you will find the collected articles that feature my good friend Bert Millsap. As most of you know, Professor Millsap is my distinguished colleague from the Department of Psychology, who likes to dabble in rather unusual happenings in my field, the physical sciences. Professor Millsap has the distinction of being the only psychologist who presented his groundbreaking research on sleep deprivation, in which a tangible proof of his conclusions was a black eye given to him by one of his sleep-deprived subjects.

Bert also has the distinction of having had me ejected from a faculty meeting by a dean who assumed I was responsible for coffee spilled during one of Millsap's attempts to mitigate his inevitable boredom in administrative meetings.

Bert Millsap is actually a very likeable person. He's not particularly handsome, being about five foot eight and 220 pounds, and he still wears a stereotypical tweed jacket and sloppy tie around campus. He is married and has two grown children, both of whom chose academic careers far from their father's. Millsap's wife, Helen, is very devoted to him but actually has an apartment a few miles from where Millsap himself lives. According to her, it is easier to love Bert when you're not constantly "surrounded by him and his sudden enthusiasm." However, Helen and Bert do have dinner together at least twice a week and often spend an evening with my wife, Geri, and me.

Lately, Millsap has been thinking of taking early retirement, with the dean's encouragement. However, in my view, campus just won't be the same without Bert around. What would we do at the Faculty Club without Bert's outrageous opinions and sometimes astute insights to reflect on? Besides, the essence of a university is to have some scholars around who can think outside the box, and Millsap is undoubtedly most skilled at avoiding the constraints of his discipline. What other colleague do you know who had the fire department pour water on his attempts to make a super large superconductor? Who else would insist on an office on the top floor of his building because the lower gravitational potential would allow time to pass more slowly for him? The fact that the difference over a lifetime turns out to be less than one-billionth of a second did embarrass Millsap briefly (he had missed the essential minus sign), but Millsap never remains embarrassed for long.

In any case, we decided it might be instructive to place Millsap's adventures into one handy volume so that the reader would no longer have to search through wastebaskets to look for old issues of the journal. Moreover, it might be fun to have some high school students read these misadventures because Millsap's adventures do focus on issues of scientific interest, even if they are often a bit out of the mainstream of science.

Finally, I would like to acknowledge the excellent editorial and desktopping services provided by the Alberta Teachers' Association.

—Wytze Brouwer

A New Scientific Skill

Professor Bert Millsap and I, on our way to the Faculty Club for lunch, were discussing the teaching of science in high school. Millsap, with his keen mind, was puzzled.

"Suppose I admit for the moment, Brouwer, that the most important goals of teaching science should include, besides scientific knowledge, scientific skills. How do you know what the important scientific skills are?"

"Well, Bert, we've spent a long time observing scientists, and we know pretty clearly what makes them tick. We know they observe, they make hypotheses, they. . ."

"Nonsense, Brouwer." Bert has never been accused of being a good listener. "You don't know the first thing about what scientists do."

"I suppose you do, Bert."

"As a psychologist, I probably know a lot more about scientists than a fugitive from the physics department does."

Usually at such point in our arguments, I like to give Bert a chance to expose his ignorance. "Give me an example then, Bert. What do scientists do that I don't know about?"

"Scientists solve most of their problems in their dreams, Brouwer. Is the scientific skill of dreaming on your list?"

I had to admit it wasn't, but I couldn't for the life of me see how dreaming could be an important scientific skill. "Come on, Millsap, you're trying to make me look ridiculous."

Briefly mentioning that making me look ridiculous did not require his input, Millsap tried to bolster his argument by telling me of some dream research carried out by one of his acquaintances, Merton Schatzman. Professor Schatzman was in the habit of posing problems to his students, with the instruction to work on these in the last hours before going to bed, to make a note of any unusual dreams they had and if they knew the solution of the problem by daybreak.

At this point, we had reached the Faculty Club, and considerable time was spent getting our lunches. When we had found a place to sit, I pressed Millsap for a couple of examples.

"Well, in one case he asked his students to reflect on the letters *H I J K L M N O* and to decipher which chemical compound was represented by the letters."

"So what happened?"

"Come on, Brouwer, try it. I'd like to see what you come up with."

"Look, Bert, you're trying to make a point, and I don't want to wait until tomorrow to get to it."

"Well, okay. Apparently, two students solved the problem before bedtime, and seven had dreams involving storms at sea or water floods. It's rumored that three of the students wet their beds. But they had a solution!"

"They did? What was the solution?"

"Water, you numbskull, water."

Water. Hmm, I tried to look intelligent, but I couldn't see it.

"Don't you see?" Millsap went on, "It's just like Kekule's discovery of the benzene ring after he dreamt about a number of snakes in a circle eating each other's tails. You've got to teach this kind of skill. You've got to involve the subconscious if we're ever going to catch up to the Japanese. Why don't you try some of these puzzles with your students?"

I'm gullible, so I decided to try some of Dr. Schatzman's puzzles. Of course, I had to try one myself first.

"Try this one. Which English word begins and ends with the letters *H E*? And when you've got that, which second word immediately comes to mind as a solution?"

At this point, the reader should do exactly as I did. I did not think of the question again until 10 minutes before bedtime (I thought I might solve it in 20 minutes) and went to sleep. In the middle of the night, I woke up to see my wife getting dressed. I asked her where she was going, and she told me she loved someone else and had left a letter on her pillow, hoping I would sleep through the night. I thanked her for her thoughtfulness and went back to sleep. However, after I had been asleep for a while, I woke up again to find a little man sitting on my chest.

"You are a very callous person," said the little fellow, "to let your wife go off without a tear in your eye. The proper thing at such a point in your life is to suffer a little. After all, suffering makes us better people."

At this point, tears streamed from my eyes because the opportunity to become a better person does not come too often in my life. My heart literally ached in my body.

"Heartache," I shouted, "heartache."

I was sitting up in bed, and my wife who, to my great surprise, had not left me, asked me if I was having a heart attack.

"No, no," I reassured her, "I was doing one of Millsap's problems. . ."

"Oh, Millsap. Go back to sleep." My wife knows Bert and realizes that my association with him often has strange consequences. The next morning, I woke up with a major headache, but at least I had the solution to the puzzle. Of course, Millsap was not surprised. He never wavers in his views and his deep mind had not even required my independent confirmation of his opinion.

There is a postscript. As a member of the Faculty Salary and Promotions Committee, I was able to see Professor Millsap's research report for the past year. The section including his publications for the last year was somewhat sparse, but Professor Millsap promised rapid progress on the following problems:

1. Is the universe infinite? If so, does it exist?
2. What are the main constituents of the smallest particles in nature?
3. Is psychology a science?

The committee was impressed by this list of problems, and by the new Millsap technique by which he proposed to solve these problems, and voted him an extra salary increment. We are all waiting with eager anticipation to see what Millsap will put on next year's report.

With or Without Cream

It's always an experience to sit beside my eccentric colleague Professor Bertram Millsap of our illustrious psychology department at a faculty meeting. While the dean of the faculty reads out the long list of graduating students, Millsap is usually busy with one of the innumerable games he has invented to combat the boredom associated with such meetings.

Last week, Millsap arrived at the meeting with two cups of coffee, two small cartons of cream and two thermometers. As usual, he sat beside me and proceeded to make himself comfortable with more than the minimum amount of disturbance expected from a senior member of the faculty. He then poured some cream into one coffee cup, left the other one black, put a thermometer into each cup and sat back with a satisfied smile.

"What are you up to, Millsap!" I whispered.

"There's a cute little problem in the cooling of coffee. If you want to keep your coffee warm as long as possible, should you add the cream before allowing it to cool, or should you add the cream only when you're ready to drink the coffee?" Several members of the faculty were looking disapprovingly in our direction, but Millsap was, as usual, oblivious to such stares. Moreover, despite my attempts to teach him, Millsap remains to this day one of the few members of the human race who have not learned to whisper. "If Newton was right, one should, of course, add the cream first because the heat loss is less if the difference in temperature between the coffee and the room is less."

"Dr. Millsap, are you requesting the floor?"

"Yes, Mr. Chairperson. I move that the list of graduands be approved."

"Nice try, Dr. Millsap, but we're only halfway through the list. I'll let you know when we'll be ready for your motion."

The next 20 minutes were relatively peaceful, with Millsap reading the temperatures of each cup of coffee at haphazard intervals and noting them down on the agenda for the meeting. He then concluded that Newton had been right after all and drank one of his cups of coffee.

I was somewhat disappointed. True, Millsap had livened up the meeting somewhat for us backbenchers, but we had been led, by previous experiences, to expect a higher standard of performance from him.

The trouble with Millsap's little experiments is that he often takes them too seriously. Every serious academic has noticed that if you take a Styrofoam cup filled with coffee and slide it over a rough surface, you can generate a beautiful wave pattern on the surface of the coffee. But how many of us think of bringing a flash camera to a faculty meeting to take pictures of the wave pattern? At that meeting, the dean had actually requested Professor Millsap to leave the room to carry out his research elsewhere.

My attention had wandered somewhat due to these reminiscences, and I noticed that the topic for the meeting had now progressed to awarding the scholarship medals. I also noticed that Millsap was still busy with that second cup of coffee.

"Wave patterns again, Millsap?"

"No, coffee balls."

Coffee balls? I had never heard of coffee balls, so I leaned toward Millsap to look at the coffee cup, and I got the surprise of my life. I should remark here that my wife feels that it takes precious little to give an academic the surprise of his or her life. But, in this case, I actually saw little balls of coffee forming on the surface of Millsap's coffee cup as he was sliding it carefully along the table. I challenge the sceptical reader to try it!

"Here, you hold the stopwatch." Millsap suddenly recruited me in his research, and what could I do?

"What's this for?"

"I want to know the lifetime of these coffee balls. I want you to focus on one of them and time it to see how long it lives."

"Forget it, Millsap, I want to know if one of our students is getting the Dean's Gold Medal."

"You can listen to the dean, you don't have to look at him. There's a nice one. Time it!"

"Too late, try again."

"There's one . . . how long?"

"Seven seconds."

"Seven? Are you guessing or timing them? There, try that one."

"Three point four three seconds."

"Are you doing this right, Brouwer? Give me that stopwatch."

So with the stopwatch in one hand, and the coffee cup in the other, Millsap continued.

The disaster coincided with the dean announcing that our faculty's budget would be cut by 2 per cent for the following year and that no new positions were to be filled in the foreseeable future. As coffee was suddenly streaming over our laps, Millsap and I jumped up and down trying to save as much of our wardrobe as possible. The dean took our vigorous action as a sign of our dismay over the budget but suggested there might be more productive ways of showing our disapproval over the government's educational funding. With as much dignity as I could muster, I left the meeting. Millsap, not bothering about dignity, was close behind.

"You know, there's a related phenomenon, where little drops of water can skitter across a hot stove for a long time without evaporating. . . ."

I looked at Millsap in amazement. He had already forgotten the stir he had created and the fact that our suits would have to be dry cleaned, at his cost, I decided to insist on, and was pursuing the problem of coffee balls and spit balls on a hot stove to their irrelevant conclusions. That's the kind of friend I'm cursed with.

Serendipity

Five o'clock, Friday afternoon, I was sipping a tall glass at the Faculty Club at the end of a busy but productive week. Various colleagues were spread throughout the Saskatchewan Room, but at the moment, I was peacefully alone.

I was leafing through one of my favourite books, *The Hidden Teacher* by Loren Eisely, and reading about the fellow who was throwing stranded starfish back into the ocean. He reminded me of my friend and colleague Dr. Bertram Millsap, a professor of psychology, whose interests included every topic under the sun. Millsap was just the kind of person who would go out to the beach after the tide went out to throw a few hundred starfish back into the ocean, purely out of the kindness of his heart.

And speaking, or rather thinking, of the devil, there he was.

"Where have you been all week, Millsap? I've hardly had to work to avoid you."

"That's all right, Brouwer, I'm here now. Pour me a glass and move over. I've been at the Annual American Psychology Convention in Milwaukee and just got back this morning."

"Did you have a good time, give a paper or something?"

"Yes, I did, and on a topic you intellectual primitives in the physical sciences should be very interested in but probably couldn't understand."

"Well, don't keep me in suspense. What did you speak on?"

"Serendipity."

Damn! He's got me again. I've heard of the word, but I'll probably have to ask him what it means, and he'll have an opportunity to make more snide remarks about the literacy of the average physicist.

"Oh, serendipity. Hasn't that topic been researched to death by now?" Not a bad try on my part, but I did not expect it to work.

"What do you mean, researched to death, Brouwer. I bet you don't even know what the word means. Come on, confess your ignorance."

"The word *serendipity*, Millsap, derives from the former name of Sri Lanka, which was once called Serendip! Horace Walpole once wrote a number of stories about three princes of Serendip who went around having wonderful adventures and making great discoveries entirely by accident. Is that close enough?"

For the first time in my life, Millsap was dumbfounded. So was I, for that matter, for it was only by accident, or serendipitously, that one of my graduate students had come across the word recently.

"Well, anyway, I talked about the history of serendipitous discoveries in science. Do you remember the story of how Henri Poincare had been trying to solve some difficult mathematical equations but had to give up and take a holiday? Then, one day, while stepping on a train, with one foot in the air, the solution literally hit him. Poincare saw the solutions to the equations in his mind, and with a bit of hard work, showed that the solutions were indeed correct."

"Yes, I remember the story. Chance favors the prepared mind, some people would say. So what did your presentation have to do with that?"

"Just a minute Brouwer. There's the dean. I want to ask him why my research funding has been cut." Millsap was off and was soon in an animated discussion with the dean of science, who had vainly hoped for a few peaceful moments at the end of a week filled with difficult budget cuts.

I got into a discussion with some colleagues about the financial situation of universities in North America, but soon Millsap was back. I've always been astounded that Millsap can carry

on two or three conversations at a time and not lose the thread of his argument, which in itself is quite surprising because the threads of his arguments are always quite unusual, to say the least.

"Well, Brouwer, what I wanted to tell you is that I want to train my students to use their subconscious abilities to make serendipitous discoveries; I want them to use analogies and metaphors to discover different patterns in things."

This was starting to sound a bit familiar. "Weren't you going on at me a few months ago, Millsap, about dreaming, this new scientific skill that was also supposed to help people solve problems in their sleep?"

"Yes, yes, Brouwer, but that was only preliminary thinking. Using serendipity at least involves a lot of hard work and knowledge about a subject. Then, when you're tired of working on the problem, you take a rest and let your subconscious work on the problem. Then your subconscious solves the problem, but of course you still have to prove that your subconscious has the right solution."

"Didn't someone once call this process Preparation, Incubation, Illumination and Verification?"

"Yes, the process is well known but not the conditions under which it works best."

In a curious way, Millsap had almost convinced me that there might be something in what he was proposing. Suppose one could experiment with the conditions that made creativity more likely to happen than normally. Think of what effect it might have on my career.

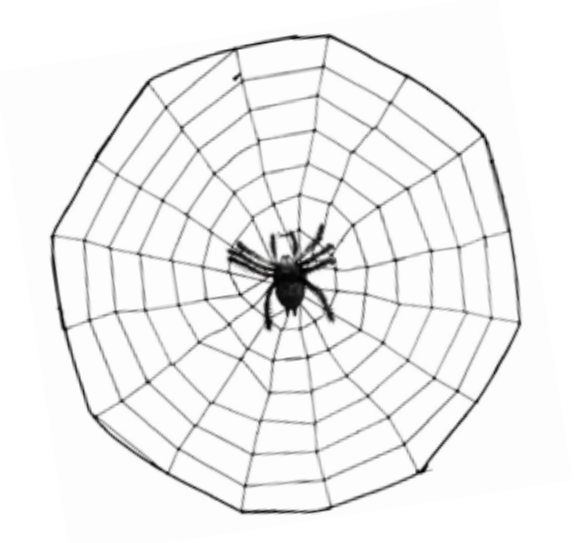
"Exactly, Brouwer, even a moribund career like yours might have some new life blown into it. History is so full of stories of scientific discoveries that could have been made earlier if people had only had the open minds to see them."

Well, an open mind was certainly what Millsap had. So open sometimes that one wondered if there was anything inside his head to which ideas could anchor for longer than 10 minutes. But today?

"Your idea, Millsap, reminds me of a story from Loren Eisely's *The Hidden Teacher* in which he comes across a spider's web with a big yellow spider sitting in the centre. Eisely took out a pencil and vibrated one of the strands of the web to see what the spider would do. The spider moved a bit toward the pencil but then ignored the incident. That reminded Eisely of the plight of being human in our universe. We have our own web of knowledge and our own ways of finding out about things around us. Maybe, just like the spider, we ignore the things happening in our universe that we don't understand or can't measure. I suppose the story is an example of how a prepared mind sees all kinds of analogies in nature."

"You've got it, Brouwer, this must be one of your lucid days!"

Funny, that's exactly what I had been thinking about Millsap.



Irrelevancies

"You know, Brouwer," said Millsap, "you probably think I waste a lot of time solving irrelevant little problems."

"You've noticed that, have you, Bert?"

"Yes, yes, I know that you disapprove of my habit of working on little problems and experiments, especially at faculty meetings, but these experiments sometimes have interesting consequences."

"Aside from ruining one of my suits at the last faculty meeting, for which you haven't yet paid the cleaning bill, what fruitful results did you ever get from one of your little experiments?"

I should back up here for a moment. Some, but not all of you, will remember Millsap's last episode at the faculty meeting at which he had studied, experimentally, the formation of waves on the surface of coffee and upset his coffee. I suspected that the disaster did not count as one of his successes.

At the moment, we were sitting in Quad on a beautiful late fall afternoon, enjoying the last bit of sunshine before the snows of winter finally settled on the plains. Millsap was smoking a rather good quality cigar, being a holdout against the anti-smoking campaign on our campus.

"Don't you remember that Richard Feynman won a Nobel Prize for studying how many ways you could spin a dinner plate on the tip of your index finger?" Millsap always has a way of getting right to the heart of the matter.

"Now just a minute, Millsap, Feynman got his Nobel Prize for his work on nuclear structure."

"But he got the idea of the spinning nucleus from spinning that dinner plate on his fingertip!"

"Well, Feynman mentions it in his book, but scientists have selective memories when they try to reconstruct how they actually did their research. Still, I'll grant you that scientists often do use analogies from everyday experience and apply them to scientific problems. But what does this have to do with your silly little experiments?"

While Millsap was mustering his thoughts and relighting his cigar, which often goes out during fierce discussions, we were joined by Jenny Platt, a professor of biology, who recently won one of our faculty's teaching awards.

"Hi, Jenny, congratulations, by the way. How are you doing on this beautiful day?"

"Not bad at all, Brouwer, how are you? Did you manage to get your suit cleaned after that fiasco?"

"Yes, and I'm still talking to the little beggar."

"What's he doing at the moment? He seems oblivious to my presence. Hey, Millsap, wake up, I don't like to be ignored."

"Ah, Jenny, there you are. Forgive me, but I was just thinking about black holes."

"Black holes? You are a psychologist, not a physicist, in case you've forgotten. Why should you be thinking about black holes?"

"Well, you may remember my little experiment with coffee balls at the faculty meeting last week. Well, these little coffee balls live an average of 2.3 seconds after they've been created, and, poof, they evaporate!"

"Well, golly gee, my day is made! If you gave me a dollar for every time I've wondered how long coffee balls live, I'd be a millionaire by now. Mind you, if you gave me a dime every time I thought you were nuts, Millsap, I'd be still richer."

I liked Jenny's style. Bert never considers my objections seriously enough to interrupt the flow of his argument, but for some reason, Jenny's statement made him blink and ruffle his hair.

"Now just a minute, Jenny. Let me get a word in. According to Stephen Hawking's book, black holes are just these little coffee balls. Once they are created, they should evaporate, the little ones quickly, the big ones more slowly."

"Nice analogy, Millsap," I ventured, "but you're a little late with that hypothesis. Physicists are well aware that black holes evaporate and that any little ones created at the beginning of the universe have already evaporated."

"That's not the point, Brouwer. I don't have to be the first one, but it shows how a little everyday game can lead to insight even if somebody else thought of it first."

Jenny looked surprised: "Do you mean, Millsap, that you're justifying your disgraceful behaviour at the faculty meeting by claiming to be doing something worthwhile? And you're just as bad, Brouwer," she said catching me by surprise, as I was enjoying her destruction of Millsap, "You may pretend to disapprove of Millsap, but I think you're just encouraging him. Why else are you always around him when he's up to his nonsense?"

"You might as well consider me his keeper, Jenny. Somebody has to look after him, or he'd get into even worse mischief."

"As a keeper, consider yourself a failure, Brouwer. You should remember that God looks after fools and little children, and you're certainly not God."

"What does Jenny have against you, Brouwer?" was the only thing Millsap had to offer as we walked back to our respective offices.

Fire at the Millsap Residence

"You know, life is far more pleasant than it has any right to be." Bert Millsap and I were sitting on the deck behind my house sipping sherry and enjoying the summer evening. We had just been talking about the pennant race when Millsap came up with the above remark. "Considering that we live in a world in which chaos rules at the most elementary level, it is remarkable that we can sit here, smoke a cigar, sip a glass of sherry and enjoy such a beautiful day."

Millsap is not always this reflective but, as my wife Geri puts it, Bert if often awed by the fact that nature, with its blind, chaotic forces, has, after millions of years of evolution, produced him, a tubby little psychologist with unruly hair and very bright blue eyes.

Dr. and Mrs. Millsap were our dinner guests, and part of Millsap's feeling of goodwill was undoubtedly due to seeing his wife again. Helen Millsap also lives in town but lives apart from Bert.

"Bert and I are madly in love with each other, but I can't live in the same house with him. The best thing for us is to meet at neutral locations in which Bert can do little harm and have lunch or dinner together before going back to our own places. I don't even ride in the same car as Bert. He usually forgets where he's going, and, in the confusion, creates havoc in traffic."

My wife and I were, of course, familiar with most of the catastrophes Bert had perpetrated on his family. We became aware of the latest episode just last Sunday when a fire truck delivered Millsap, with one suitcase, at our front door.

"Bert, come on in. What happened?"

"The fire department was kind enough to bring me here. Can I sleep here a few nights?"

"Well, of course," I replied with some trepidation because Geri has told me repeatedly that she could take Bert only in small doses. "But what did you do? Burn down the house?"

"No, no, nothing of the sort. If an interfering neighbor hadn't phoned the fire department, nothing would have happened."

I realized that it would take some time before Millsap would actually get to the point of telling me what had happened, so I poured him a drink, and plunked him down on the sofa, while my family stood around wide-eyed to hear what had happened.

After a few deep draughts Millsap started to relax and began his tale.

"Actually, you're partly responsible for this experience, Brouwer. Remember about six weeks ago, you showed me the new superconductor, which you cooled in liquid nitrogen and balanced a little magnet on it?"

In the interests of clarity and out of fear of offending my family who wanted to hear what Millsap was about to reveal, I did not correct his grammar. He was referring, as the perceptive reader knows, to the new discoveries in superconductivity in which it's possible to pass electric currents through newly developed substances at higher temperatures.

"Yes, I remember. My students had baked quite a few of these little pellets, and they worked so well I'd been showing them around."

"Well, just keep quiet and let Bert get on with his story, will you?"

"Yes, Bert, I can't for the life of me see what my superconductors have to do with the fire department."

"Well, all I was trying to do was to make a superconductor for myself."

Frankly, I was puzzled. How could even a social scientist like Bert Millsap get the

fire department involved by making a tiny superconductor?

"So what did you do wrong? Did you have your oven too hot and start a fire?"

"No, no, nothing went wrong at all. I wonder if I can sue my neighbor for wrongful interference or something."

"I doubt it, Bert. Most of your neighbors are pretty reasonable people, and my money would be on them in any court case involving one of your stunts."

"Dad, will you shut up? We're dying to hear what Dr. Millsap is trying to tell and you keep sticking your oar in." That was my daughter, Lisa, who doesn't lose her temper with me too often, so I decided to shut up.

"And they completely destroyed my superconductor. Attacked it with axes. At least they did apologize, but they still claimed it was my own fault."

I hit Bert on the knuckles. "Concentrate, Bert, tell us all the details. Otherwise, no dinner."

Bert took a deep breath and started again, more coherently this time.

"OK! Here goes. As you recommended, I bought some barium carbonate, some copper oxide and some yttrium oxide. I mixed the ingredients and took them down to the petrol station at the corner and they pressed it into a pellet. They helped me carry it back to the car and put it in the trunk. . . ."

"What do you mean, they helped you carry it to the trunk? A pellet only weighs about two grams!"

"Not this one. I bought a hundred kilos of the ingredients, which cost me a lot of money, by the way, so the pellet was 200 kg."

"Wow, it must have been as big as a wheel of your car!"

"Yeah, that's about it! I got it home, rolled it down the stairs with my son's help, and went back to university to pick up one of the heavy magnets you guys use in your physics labs."

"Well, so far I follow you. It's mind-boggling but still in the realm of reason. But how could you possibly cool that big pellet down to low temperatures?"

"I guess that's where the trouble started. I hadn't realized how much liquid nitrogen I would need to cool the pellet. I tried with a 100-litre container of liquid nitrogen, but it wasn't enough. So I brought home five big containers, each with 100 litres, and poured them over the pellet. I practically froze my feet, the basement floor got so cold. But it worked, Brouwer, it worked! The big lab magnet hovered several centimetres above the superconductor. But then I heard the basement windows break and water started to pour into the basement. And if you thought it was foggy before, when the water and liquid nitrogen mixed, the vapor was pouring out of every window. Then a couple of firefighters jumped into the basement and carried me out while one of them hacked at the superconductor with his axe. Why would the fool do that?"

I suppose it wasn't too hard to reconstruct the story. As usual, Millsap had decided to do things in such a big way that it went out of control. When 500 litres of liquid nitrogen are poured into a warm room, a lot of vapor is formed. When one of Millsap's neighbors saw the vapour pouring out the basement windows, the neighbour jumped to the obvious conclusion. And when the firefighters poured water on the liquid nitrogen, 10 times as much vapor poured out. The obvious thing to them was to get at the source, so they destroyed Millsap's successful, and expensive, superconductor.

"What you want to do, Millsap, is wait a few days and then go back and gather up the pieces of your superconductor. You could probably sell chunks of it to local high school science teachers for about 10 bucks apiece and recoup some of your losses."

"Ten bucks apiece? Let me see. If I sell 10-gram superconductors at $10 apiece, then 200 kilograms would make . . . 20,000 chunks worth $200,000. Say they destroyed some of it, but if we save even 50 per cent, I'll have about $100,000. That should pay for the damages and quite a bit besides."

The Millsap Meteorite

After the incident was over, I admit I felt a bit foolish. We had played a practical joke on Bert Millsap, but, after things had settled down, I still wasn't sure who had really been fooled.

My colleague, Evan Adams, is an astronomer. Astronomers are generally easy to get along with, except at the beginning of August or October, when the more spectacular meteorite showers occur. Since early July, I had been steeling myself to refuse his annual invitation to head out into the mosquito-infested countryside just to see more meteorites. As usual, my efforts were in vain. It was Millsap, in fact, who urged me to come along to the observatory to join Adams in the meteorite watch this year. Millsap, of course, is my colleague from the psychology department, although you would never know that because he is always meddling in the physical sciences.

Of course, we shouldn't have had to go all the way to the observatory to watch meteorites. We weren't even going to use the telescopes. But neither Evan nor Bert was impressed by my offer to watch for meteorites from the comfort of my balcony.

So, on the evening of August 10, the three of us got into Evan's car and headed 48 km out of town to the observatory. Once there, we settled ourselves with a thermos of coffee, well-hooded and jacketed—not against the cold but against the scourge of the western plains, the aforementioned mosquito.

A mosquito watch I could understand. We could probably count a couple thousand of them per hour, but we'd be lucky to spot even six or seven meteorites per hour.

"Now the best thing would be to sit down against one of these posts and look toward the northeast," Evan suggested. I, of course, followed orders, but Millsap faced southwest.

"Northeast is better because the rotation of the earth will cause us to intercept the stream of meteorites so that they are first visible in the northeast, Bert." I could have told Evan that, in such cases, it's simply better to let Millsap do whatever he wants. He never follows *my* advice either.

"Yes, yes, I know, Evan," explained Millsap, "but my eyes aren't very good. This way, if you see one in the northeast, let out a shout, and by the time it gets to me, I'll be ready to see it."

"But, Bert, by that time most of them will have disintegrated in the earth's atmosphere." Evan still doesn't know Bert very well. Bert had decided to face southwest, so southwest it was. And so the long watch began.

"There's one!"

We turned around quickly to see the meteorite Bert had spotted, but it had disintegrated already.

"There's another one!"

Again we turned around, and again we were too late. Bert was either very lucky, or he was pulling our legs. By the end of the first hour, Bert had spotted an improbable 32 meteorites, whereas Evan and I had spotted only four. Evan and I were getting a bit tired of this, so we moved a bit further away, but not far enough obviously. We could still hear Bert: "There's another one…37—" and so on.

"Let's try something," said Evan, "Let's poke a couple of holes in this pop can, fill it with some wood chips and light it. Then we'll heave it over Bert's head, and see how he reacts. It should look reasonably like a meteorite trail."

Of course, I agreed. Anything that would stop Millsap counting imaginary meteorites sounded good to me. So, while Millsap went on counting—he was up to 46—we gathered some twigs and dry grass, stuffed them into the pop can,

and lit it. It smouldered nicely and, when we swung it over our heads, really looked a lot like a meteorite trail. Then, with one mighty heave…

"Fifty-one, hey!" Millsap actually jumped up. "Did you guys see that one? The biggest meteorite of the night. It just landed in the next field!"

We regretfully admitted that we hadn't seen it, and Evan tried to explain patiently that perspective often plays tricks on inexperienced observers, but the more we argued, the surer Millsap became that he had seen a very large meteorite.

"No, no, I even heard it land. I'm sure it came down less than a mile away."

"Maybe you should look for it, Bert. Who knows, if it really was a big meteorite, it might become known as the Millsap Meteorite." Or as Millsap's folly, I was thinking. And that's when all our trouble started.

"First, I'm going to make a phone call," said Millsap and disappeared into the observatory, while Evan and I continued the meteorite watch in peace. When Millsap reappeared, he went into the adjacent farmer's field to try to spot the fallen meteorite. After all, it might still be glowing and easy to spot in the dark.

So the peaceful night continued until, toward dawn, a number of trucks drove up the observatory gates. That was quite unusual because the observatory was in a pretty lonely section of the prairie.

"Television crews," whispered Evan. "The ass has phoned the television studios."

Evan and I looked for a place to hide but could only see open prairie around us. We stood by while Millsap condescended to be interviewed by two local television studios on his impending discovery of the Millsap Meteorite. After dawn had fully arrived, a number of camera technicians and interviewers helped comb the fields for traces of the meteorite. Evan and I, of course, helped search. After an hour and a half, the search was abandoned.

"All I could find was this thing." A cameraman came to where Evan and I were still trying to look as if we were carefully studying the soil for tiny traces. "There's some wood chips in it, and they look as if they've been smouldering." He showed it to Evan, who passed it to me.

We shrugged, but we must have looked a bit guilty as the cameraman continued to look at us. He finally broke the long silence and made a suggestion:

"Is it possible that the meteorite burnt up in the atmosphere just before it hit the ground?"

What an excellent cameraman! I don't know if there is a fund for the widows of cameramen killed in the line of duty, but at that moment Evan and I would gladly have made a large contribution. He winked at us while we agreed that his explanation was undoubtedly correct.

On the way back to town, Evan and I were unusually quiet, while Millsap slumped quietly in the back seat. The funny thing was that he didn't look at all disappointed that his meteorite wasn't found. In fact, he was quietly smiling.

Can *You* Hear the Northern Lights?

"Come and see the northern lights, honey."

I was watching the evening news and following the most recent troubles in the Balkans when my wife called me from upstairs. Geri came down, grabbed her coat and mine, and we went out into the front yard to look at the curtains of light waving across the sky.

At our latitude, the northern lights are often visible early in the evening, but the urban growth of recent years has made the displays far more difficult to see, unless, like that night, they are very spectacular. After our eyes had adjusted to the darkness, we could even detect a lovely green among the predominately white color.

"How come it waves back and forth like that?" asked Geri. "Are the lights blown around by the wind?"

"It sure looks like it, but it's probably changes in the earth's magnetic field or changes in the number of charged particles that hit the upper atmosphere near the North Pole."

"Oh," Geri replied.

I realized my inadequacy as a teacher then. It is so deceptively easy to give a mundane answer to what appears such a beautiful mystery. There must be a real talent required to explain in everyday terms what causes the northern lights, without destroying the wonder with which we observe the changing patterns of light across the sky.

"Do you remember the night we actually saw some red colors in the northern lights?"

Geri was referring to an evening on Lake Athabasca in the Canadian north, where we spent a holiday with our young children. On one particular night, we had been privileged to see the northern lights in all their glory, with red, green and white curtains alternating across the sky.

"Should we give Bert Millsap a call?" I suggested.

"Have you forgotten? Bert's up north doing some research on cabin fever."

Ah, yes, of course. Bert was engaged in some research into the kinds of behavior northerners, and some of us southerners, get up to toward the end of our long winters. In the old days, the fur traders or trappers would occasionally go berserk and shoot some neighbors, but modern-day symptoms are mostly restricted to severe depressions and suicide attempts.

"So Bert's actually doing some legitimate research now, is he?"

Geri scolded me for being a sceptic: "He's up there with a whole team of psychologists, each looking into some different aspect of northern living."

Well, with a whole team of colleagues around him, I imagined that even Bert Millsap could not get into any serious trouble.

And I was right! A few weeks later, Bert Millsap returned with his colleagues from beyond the Arctic Circle, and we scheduled a lunch. But I might have known. Bert was not at all interested in cabin fever or any of the work his colleagues had been doing. Bert had gotten into minor difficulties with his colleagues because by far the largest amount of luggage and equipment carried north had been Bert's. He had brought a lot of high-resolution video and audio equipment that the rest of his group had thought rather excessive. A bit unjust, I felt, because it would be valuable to keep good records of their interviews with the northerners.

"It wasn't for interviews," explained Bert, while chewing on his Caesar salad, "I wanted to listen to the northern lights."

"The northern lights? You must be crazy, Bert. You can't hear the northern lights. That's been known for years to be a product of the

intoxicated imaginations of the Yukon gold miners of the 19th century. There's no way you can hear the northern lights."

"Well, I heard them. I had read that many Indian and Inuit legends mentioned the sound of the northern lights, and I interviewed 1,100 northerners, and 612 of them had heard the northern lights."

"But geologists have tried to measure the sounds and couldn't get anything at all. And there's no theoretical explanation for why there should be any sound with the northern lights."

"Well, I've heard them myself," claimed Millsap again, "crackling and humming noises similar to what you would hear with static electricity. The problem with all the old measurements was that the audiorecording technology was no more sensitive than the human ear. The new equipment I brought up should prove that the sounds are real."

I had absolutely no faith in Millsap's technology, but I went with him the following morning to hear the tapes. One of the technicians at the acoustics lab loaded the tapes and went for coffee.

"Now close your eyes, and pretend you're sitting outside, in the snow, watching the northern lights. Ready? Now listen."

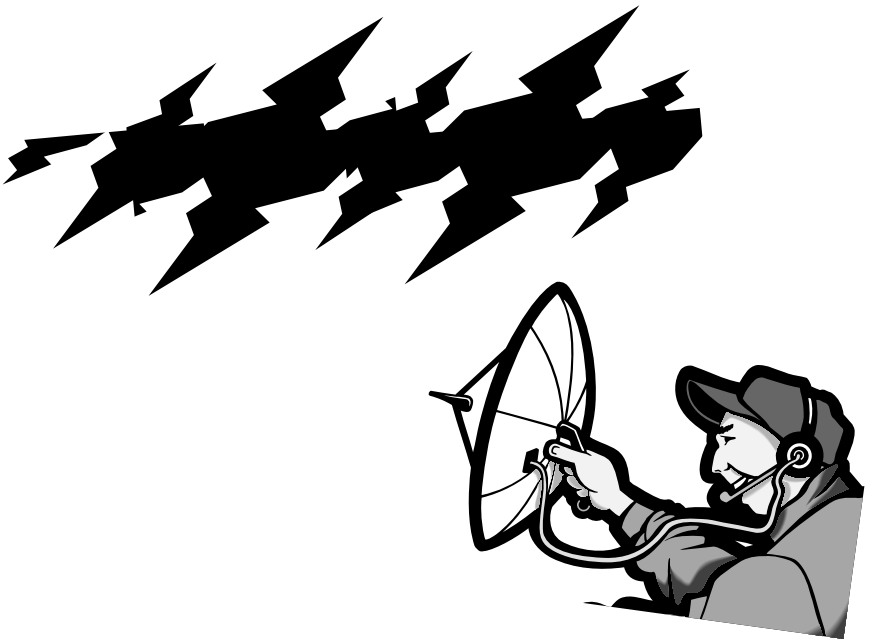
Silence, and then slowly I began to hear a faint crackling and hissing sound that did remind me of the crackle of static electricity or of the sounds you sometimes hear around power transmission lines, especially in the wintertime.

Millsap saw the astonished look on my face and cackled: "What do you think now, Brouwer?"

I didn't answer, I couldn't answer, but just waved for Bert to be quiet. The sounds were exactly the sounds described for many years by northern Natives, and I was dumbfounded. Had Bert finally solved what had puzzled northerners and southern scientists for many years? And what about the theories? I had always believed the theory that the intense stimulation of the optic nerves had caused the sense of hearing to be stimulated but that the sound itself had no actual physical basis. And now Bert, of all people, had turned that explanation upside down.

The technician wandered up, sensing something, and listened also. "Just a minute," he said, pushing a button. "Now you can hear better, and all that static will be gone."

And Bert and I sat there, listening to the complete silence of an Arctic night.



Rainbows

One Sunday evening, just after we had come home from a nature walk, the phone rang. It was Helen Millsap.

"Will, could you do us a favor and come by and pick Bert up tomorrow morning on your way to work?"

"Of course, Helen. I'll walk by, and we'll go the rest of the way together." My mental processes were a bit slower than usual that Sunday. "So you're back home, are you? Did you have a good time?"

"You're not getting the point, Will. Just listen a moment. Bert has a broken leg, so you'll need your car in the morning. I'll take care of Bert at home for a few days until he can manage on his own again." Helen normally lived in her own apartment, as she and Bert have been living amiably apart for several years now.

"A broken leg? How did that happen? Did he forget where he was going and step in front of a truck?" It seemed a reasonable hypothesis to me, but I got the impression from Helen that I was still talking too much.

"No, no, he fell off a mountain! Luckily enough, there were a couple of German climbers in the same general location. They called the rescue service and got Bert off in a helicopter."

Bert Millsap falling off a mountain! I couldn't in any way imagine Millsap as a mountain climber. He was far too tubby and unathletic to have taken up that hobby.

"But what was Bert doing on top of a mountain?" Geri, my wife, was standing beside me, trying to listen in and shaking her head. She doesn't have high expectations of Bert, but a broken leg was a bit beyond his usual standard in mishaps. Although you could expect almost anything from someone who gets accidently hosed down by the fire department while doing a simple science experiment.

"I don't know what he was doing up there," cried Helen. "He was babbling about taking pictures of rainbows. Does it make sense to you that someone would climb a mountain to take a picture of a rainbow?"

Well, rainbows are beautiful natural phenomena, of course, but I was pretty sure that Bert would have a strange but plausible reason of his own for taking pictures of rainbows from a rather inaccessible mountain top.

"We'll probably get to the bottom of this eventually, Helen. Don't worry about tomorrow. I'll pick Bert up, deliver him to the psychology department and bring him home again in the evening."

Just in case, I remind readers that Bert is a professor in the psychology department and that I was not volunteering to take him there for counselling, although the thought has often crossed my mind. I was still a bit puzzled as to why Bert was in such a hurry to get back to work. A couple of days at home to recover would be sensible at this point.

"I don't know either why he wants to go back tomorrow. He wanted me to drive him to his lab tonight, but I refused. You know how unreasonable Bert can be at such times. I've put him to bed and threatened to hit him with a frying pan if he so much as blinks. Why did I ever marry such a crazy man?"

That, of course, was one of life's great mysteries. Helen rang off, and we spent the evening speculating about why Bert had been after rainbows in the mountains. I rejected Geri's suggestion that it had something to do with pots of gold. Bert may do some foolish and dangerous things, but there is always some element of logic behind his reasoning.

When my son Allan came home, he speculated that Bert might somehow have found out that from above you can sometimes see a

complete circular rainbow, not just the arc that we prairie dwellers are used to seeing. Bert would, of course, want to verify that for himself and might well venture up a mountain, complete with photographic equipment but completely omitting to take into account the knowledge and skill he would need to do all this safely. Allan's suggestion sounded so reasonable that we accepted it and went off to Sunday dinner, followed by some classical music and a favorite book—in my case, Dante's *Inferno*.

I've often dreamt of ending up, after death of course, in the first circle of Hell, where, for some reason, I would find Plato, Aristotle, Averroes, Maimonides and all my other favorite philosophers and scientists of the past and present. Just imagine the fabulous discussions you could have with the best minds of all time, and compare this with the eternal joys of heaven, which, at least in Dante's description, would become unbearably dull after a few millennia.

The next morning at 8:30, as I stopped in front of the Millsap residence, Bert emerged wearing a shirt and tie, Bermuda shorts, and a cast on his right leg. Although it was only October, Bert would suffer a bit from the nippy early morning air if he persisted in wearing Bermuda shorts for long.

It took both Helen and me to get Bert into the back seat while I speculated on who would be available at the other end to help me get him out again.

"Why don't you stay home for a few weeks or so, Millsap?" I asked. "I'm sure one of your colleagues would take your lectures for a while, and you'd feel a lot better in a week's time."

"I feel okay now. I want you to take me to the photography lab. I think I got some good pictures of double rainbows before I fell down the mountain, and I want to see them."

"Double rainbows, eh? If I leave you there, will you be able to get around for the rest of the day? I've got a lecture to give, but I'll pick you up at your office at 5:30."

I managed to lever Millsap out of the car and went on to the faculty parking lot and then off to my lecture. I love teaching modern physics because you get to talk about all the most important experiments that changed our views of reality. That particular morning, I was reviewing the beautiful experiments that gave the first hints of the existence of antiparticles, when Mrs. Howard, our department secretary, came into the lecture room with the message that there was an emergency at the photography lab and would I please come down quickly?

What now? How had Millsap managed to get himself into another calamity so soon? I gave my students a reading assignment and a couple of problems to solve before next class, picked up my car from the parking lot and headed for the lab.

As I entered the reception area, there sat Millsap, covered from his head to the bottom of his cast with some sort of black fluid. The secretary was still busy cleaning some of the fluid from his face.

"What happened?" I whispered.

The secretary answered, "Well, our development lab is usually closed on Monday mornings, but Dr. Millsap said his pictures were too important to wait, and he insisted on developing them himself. I'm not supposed to let anyone into the lab…I'll probably lose my job over this."

She sounded quite distraught, but I assured her that Dr. Millsap was not likely to tell her supervisor what had happened.

"I suppose I don't even have to ask what happened. I assume Dr. Millsap went into the lab, poured the various emulsifiers and developing fluids into a tray and, then, broken leg and all, tried to carry it all into the darkroom."

"I think so. I don't think he hurt himself very much, but how will he ever get clean? Will he need a new cast?"

"I don't think so. I'll take Dr. Millsap home. Will you be able to clean this place before your supervisor arrives?"

On the way out, Bert didn't even thank the receptionist. "Interfering female," he muttered. "If she hadn't rushed in, I might have saved the pictures."

"Now, don't be unreasonable, Bert. She was very concerned about you and certainly cleaned you up as much as possible. And if you want some slides of circular rainbows, double rainbows and what have you, we have lots of them in our atmospheric studies lab. There's no need to break another leg over them."

Twenty Minutes of My Time

As I was driving Millsap to his weekly appointment with his psychiatrist, Dr. Vinod Mukkerjee, I wondered how many sessions with Millsap it would take before Dr. Mukkerjee would be seeing his own psychiatrist. Professor Millsap is a bit of a strange character. I've known him for about 12 years, and I suppose what attracts me to him is as much his unpredictability as anything else. Not that he isn't an intelligent person, but he jumps from one intellectual enthusiasm to another with astonishing speed. I suppose it must wear on his mind, and thus his need to see a psychiatrist.

While we waited for a left-turn signal, Millsap babbled on about the fact that the universe was going in only one direction in time and that one of the simplest ways of understanding that tendency was to consider the boiling of an ordinary egg.

"Listen, Millsap, I know all about the irreversibility of natural processes and the tendency of natural events to increase the amount of disorder, or entropy, in the universe. What does that have to do with eggs?"

"Well, consider the egg. Boiling it is one of the commonest processes in nature—three minutes for soft and five for hard. And no matter how hard you try, how many millions of dollars you want to spend, you cannot reverse the process, you cannot unboil an egg."

"Be quiet a minute, Millsap. If I turn here and then right at the third light, I'll be in front of your shrink's office, right?" I wasn't Bert's usual driver, but his wife was visiting some friends.

Millsap showed no interest in my mundane concerns and ignored my question.

"Do you know, Brouwer, that the earth is currently as old as 1,300 trillion soft-boiled eggs or 870 trillion hard-boiled ones?"

"What on earth are you babbling about now? I'm not surprised your psychiatrist is wondering where to put you." I finally managed to turn into the right lane and for a few moments gave Millsap 75 percent of my full attention.

"Well, consider that a soft-boiled egg takes exactly three minutes and a hard-boiled egg takes exactly five minutes. Then you can calculate the age of the universe in your head as 3.68 quadrillion soft-boiled eggs or 2.45 quadrillion hard-boiled eggs."

I cursed Millsap for three reasons: one, for wasting my time; two, for making it hard for me to find the building that housed his psychiatrist; and , three, because he probably knew that, for some perverse reason, I would spend part of my evening calculating whether the universe was really 2.45 quadrillion soft-boiled (or was that hard-boiled?) eggs old.

"So what's the point, Millsap? Why would anyone want to know the age of the universe in boiled eggs?"

"You have no appreciation of the beauty of nature, Brouwer. Don't you know that not a single law of nature would be broken if an egg would suddenly unboil itself or if an old man like you would suddenly start getting younger and younger?"

"What do you mean 'old man'?! I'm at least five years younger than you. And, besides, physicists know all this, and they have enough trouble understanding how nature runs forward in time without worrying about what would happen if it suddenly ran backward."

The tall office tower in which Dr. Mukkerjee worked came into sight, and in a few minutes I would be rid of Millsap for a few hours.

"Did you know that St. Augustine claimed that time had no real existence but was all in the mind? He thought that only the present

had a real existence, with the past being a memory and the future only an anticipation."

"Sounds reasonable to me. Look, where do I drop you off? Is that traffic light a good place?"

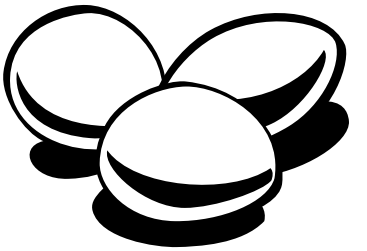
"Did you know that according to Zeno, you can never get to that light? First, you would have to travel half the distance, then half the remaining distance, then half again of what's left and so on. We'd never get there."

"Look, we *are* there. Now get out before the light changes. I don't want to hold up traffic."

"My college professor used to say that Zeno's paradox might not have a theoretical solution but certainly had a practical one. Just line up the boys in your class on one side of the room and the girls on the other. Now tell the boys to walk half the distance toward the girls, then half again and so on. Before you know it, for all practical purposes, they'll be there."

"Millsap, for goodness sake, get out! That cabbie behind us is honking away and looks like he wants to push us through the intersection."

"Stephen Hawking has the totally wrong idea about time and only. . . ." I had to lean over to shut the door and drove away. Millsap was undoubtedly continuing our conversation, but he never really needed an audience anyway. Dr. Mukkerjee would have his hands full today.



Skipping Stones and Space Shuttles

We were standing on the shores of Lake Minnewanka in the Canadian Rockies, Bert Millsap and I, in one of our infrequent moments of relaxation in the midst of a hectic research life. Well, fairly hectic at least, because I would have to admit that many moments throughout the year spent in Bert's presence could not actually be counted as research. Bert and I have developed what could best be determined as a friendship of opposites. Bert was nominally a psychologist but was interested in every other topic under the sun, whereas I was a science educator-physicist, a rather conservative type of person, most comfortable with the tried-and-true. But I must admit that my fascination with Millsap's lunacies probably does hint at some hidden depths of folly within me.

We were skipping stones. Lake Minnewanka is probably the best place on earth to practise skipping rocks because the proportion of small flat stones is higher there than anywhere else we are aware of. I was having a good time just trying to skip the rocks the maximum number of times, but Bert was trying to determine the angle at which the rocks would make the longest hops.

"This is a very serious problem, Brouwer, because the space shuttles all enter the atmosphere like these flat stones and use the skipping action to slow down so they can descend slowly enough that they don't burn up."

"Yes, I can well imagine approaching NASA for a research grant to fund an experimental study into stone skipping, leading to applications to space shuttle flights. How much do you think we'd need for a month in the mountains, Millsap?"

While Millsap, who always took such suggestions seriously, was trying to calculate the amount, our wives, Geri and Helen, came along the path. Having no interest in skipping stones and frivolous scientific discussions, they had wandered on ahead for a while.

"So there you two are. What's holding you up?"

"We're discussing the re-entry problems of the United States space shuttles, and we slowed down because our brains needed their full blood supply." I ventured, pointing at Millsap.

"Why is Bert standing there like a stuffed frog?"

"$15,000," Bert exclaimed, re-entering our presence.

The thought struck me that Bert Millsap's passage through life also resembled the skipping of a rock, with his mental processes making contact with reality only occasionally and, even then, very obliquely. I translated for the ladies.

"Bert has just calculated that a modest research grant of $15,000 would be enough to allow us to live at this resort for a month and spend our time studying stone skipping."

Our wives knew enough not to ask further questions and walked on again. And after a silent glance at each other, we followed.

Relativity Disproved

"You know, Bert, if I could only bring my science class out here to study the way water waves spread out when a rock hits the water, they would understand their physics much better."

We were back at Lake Minnewanka, one of our favorite places to relax. For some reason, our wives had elected to spend the day exploring the mountains on their own, and I was saddled with Bert Millsap, my colleague at a western university. Bert had already spent considerable time dropping different sized pebbles into the water trying to find ways of getting the water waves to spread out at different speeds. I had settled on the bank with my eyes closed, listening to the frequent plunks as the pebbles hit the water.

"Give it up, Bert. Water waves all travel at the same speed. Take my word for it."

"Never mind, Brouwer, I've given up on that. I've come to a more important conclusion. Relativity just has to be wrong."

That someone claims that relativity is wrong is not enough to wake any physicist out of his slumber. The world is full of crackpots, including politicians and theologians, who have proven relativity to be wrong, and physics departments the world over have a voluminous file where such proofs are deposited. Even the fact that Millsap had apparently joined that group was not enough to get to sit up. However, a handful of cold water succeeded where logic had failed.

"OK, Millsap, I'm awake. Tell me, by what process of logic have you arrived at the conclusion that Einstein was wrong?"

"Notice how these waves travel, Brouwer, in nice concentric circles spreading out on all

sides. Now look at the waves near that motor boat. They're not circles but seem to spread out like a vee. Do you know why that is?"

"Yes, every school child knows that."

"Well, tell me then."

"I'd much rather you told me, Bert."

"OK, I'll tell you. It's because the boat is going faster than the waves."

Not bad for old Millsap. Once in a while, in the chaos of his mental processes, one catches a glimpse of a good mind. He was right. Apparently, when the boat travels faster than the waves can travel, the waves sort of pile up against each other and spread out behind the boat, as Millsap put it, like a vee.

"But how does that prove Einstein wrong?"

"Well, the thought hit me that the same thing happens when an airplane creates a sonic boom. The plane travels faster than the speed of sound so the sound waves all pile up and create a lot of noise all of a sudden. That's just like the vee-shaped waves behind the motor boat."

Millsap was practically jumping up and down with excitement, and I was impressed. At moments like this, I feel there is still hope for my old friend. I had an inkling by this time where he was heading, but I wanted to hear it before dampening his enthusiasm.

"So far, so good, Bert. Now what's next?"

"Well, light is just waves traveling through space, right? If the object that makes waves in water can travel faster than the waves and if the object that makes sound in air can travel faster than the sound, it follows that an object that makes light should be able to travel faster than light, right?"

Excellent logic. Millsap didn't realize how close to a major scientific insight he was. It is in fact true that an object like an electron that creates light as it travels through matter can travel faster than that light does inside matter. So, inside matter, you can get "light booms" very similar to sonic booms in the atmosphere. The Soviet scientist who predicted this won the 1949 Nobel prize for physics. But, as I told Millsap, it doesn't happen in empty space, so that Einstein is still safe: **Nothing travels faster than light in free space**. At least, I'm pretty sure nothing does.

"Come on, Millsap, I'll buy you lunch. You've earned it."

Physicists Are Arrogant?

"You know, Brouwer, you physicists are a pretty arrogant lot." Bert Millsap had been unusually pensive during our lunch, but I had attributed that to the particularly frigid weather we had been enjoying for the past few weeks. Near the end of the long western winters, most of us suffer from a kind of cabin sickness, which makes us long for green grass and milder temperatures.

"Physicists, Millsap, are known to be among the humblest people on the planet. You can't be serious?"

"If you took a survey, Brouwer, among students at this university or any other institution of higher learning anywhere in the world, you would find that students considered you physicists very arrogant people."

Millsap wasn't far from the mark, actually. I had seen some survey results that indicated precisely that, but I could hardly change the habits of a lifetime and agree with Bert, so I feigned ignorance.

"What precisely got your dander up about the public image of physicists today, Bert? Haven't psychologists enough problems of their own to worry about that you have time to worry about us?"

"I'm not worried about you. I'm just trying to understand some physics, but your colleagues tell me not to bother since psychologists cannot possibly understand the intricacies of physics anyway."

The time had come to have dessert, and then we were joined by a couple of administrators and had to postpone further intellectual discussion until later. Administrators at our institution could only talk about increasing enrolments and decreasing finances, thereby further ruining what had already been a pretty awful March day.

The following Thursday evening, Bert and Helen Millsap joined Geri and me for a drink after sitting through a student performance of *Six Characters in Search of an Author,* but even that was not enough to take Bert's mind away from an obviously wounding experience with physics.

"How do you manage to live with a physicist, Geri? Don't you find a physicist almost impossible to live with?"

I sensed a sort of encircling movement that might well leave me defenceless against three possible opponents unless I met Bert's problem head on. Something must have rankled Millsap deeply for him to have become so bitter about what I have always considered a pretty noble profession.

"Tell me, Bert, what's been bothering you the last couple of days?"

"Well, two things: I was reading Heisenberg's conversations with Einstein, and Heisenberg had the nerve to tell Einstein he wasn't allowed to ask a certain question. Where does Heisenberg get the right to tell Einstein not to ask certain questions?"

"What kind of questions was Einstein asking?"

"He wanted to know what an electron was doing while it was sending out light, and Heisenberg said that Einstein wasn't allowed to ask that. Can you imagine the nerve of the guy? And what are you laughing at, Brouwer?"

"Well, I think it's pretty funny, Bert. I don't think Heisenberg meant any disrespect to Einstein, but it's just that quantum physics has ruled out that kind of question."

"That's absurd! Neither you nor any other physicists has the right to say that certain questions don't belong in physics anymore. All you're confirming is that you're just as arrogant toward

outsiders as that fatheaded colleague of yours who I was consulting."

"Which fatheaded colleague was this?" Normally such a question which would incriminate a colleague of mine would have been beneath my dignity to pursue, but this was too good an opportunity to miss.

"Paul Rutter, one of your theoretical colleagues. I went to him to see if physicists were actually trying to find out today, 70 years later, what the answer to Einstein's question might be, but he said physicists didn't bother with nonsense like that. When I tried to reason with him, he told me that's a way for physicists to win friends around campus."

"I agree with you, Bert, that Paul's not the person you would go to for lessons on humility and tact. I suppose he does get a lot of letters from people trying to prove Einstein or Newton wrong so that he's lost patience trying to explain his views over and over again to people who don't know enough physics to understand what they're saying."

I had the feeling my audience was not overly impressed with that response, and going over it again in my mind, I could see why. I decided to try again, but Helen Millsap got the floor before me.

"Much as I respect your views normally, Will, aren't you being a little condescending yourself in suggesting that Bert shouldn't have approached a high-and-mighty physicist on a problem that might be beneath His Majesty's dignity?"

I looked at Geri fro some sympathy but sensed that I would have to dig myself out of this hole by myself.

"I apologize, Bert. Helen is completely right, of course. I wasn't including you in that large number of lunatics who do claim to have the answers to all the questions in the universe, but I certainly wasn't expressing myself very clearly. Let me try it another way. Suppose I came to you in psychology and suggested to you that what was wrong with modern psychology was that you didn't take into account the human soul. What would your response be to that?" This approach sounded much better to my ears and was more likely to receive a more sympathetic response.

"I would say you might be right. Certainly, some psychological schools should consider the possible implication of the existence of the human soul. But what's that got to do with my question?"

I had forgotten that Millsap was not a normal psychologist and that my analogy to the undetectibility of the human soul, which might have raised a point of contact with any other psychologist, would not faze an unconventional one like Millsap.

"Let me try again. Suppose a theory tells you that it will never be possible to analyze an event accurately enough to be able to detect the influence of some variable, or even a concept like the human soul, then wouldn't it be reasonable to leave it out of your theory?"

"Sounds like a circular argument to me. Your theory says the concept doesn't exist, so therefore you leave it out of your theory?" Geri doesn't know physics, but she can sense an illogical argument. I could see that I was still surrounded by three sceptics.

"Suppose the concept, or measurement, is forbidden by your theory, and all the experiments that have been carried out during the past 70 years have confirmed the theory—isn't that pretty good evidence that the theory was right to eliminate concepts or measurements that could not be carried out?"

"No!" The response appeared to be unanimous.

"Suppose even that all other theories that have suggested that it should be possible to find out things like what the electron is doing while it is emitting light have been proven wrong experimentally all these years—wouldn't you then agree that there might be questions that have no answers in physics?"

"No, because you couldn't possibly have eliminated all the other theories that might in the future include these 'forbidden questions' and be better than current theories in physics."

The ladies agreed with Bert for once and got up to make coffee. I still tried to make some further remarks, but Bert had started to poke around in the fireplace so I gave up this argument as a loss. You can't win them all. Besides, Bert was right. We physicists often tend to act as if we possess the only knowledge worth knowing and teach physics in such a way as if students should just sit at our feet absorbing all the valuable knowledge we have to offer. Maybe a little humility would be good for us.

Millsap and the Radioactive Ball

As I was walked into the Faculty Club for lunch one Thursday after a tiring modern physics class, I met Jenny Platt on her way out. I greeted Jenny fondly, she being a long-time friend and colleague from the biological sciences. Jenny occasionally disapproves of me and blames me for some of Bert Millsap's peculiar behavior. I am willing to admit that I may have acted as a catalyst for Bert's activities from time to time, but any encouragement of Bert is, at best, subconscious.

Bert Millsap is, as readers of these stories know, my eccentric colleague from the psychology department, who loves to dabble in the more esoteric regions of the physical sciences. Because Bert is a voracious reader in many fields, experts in other fields, including physics and astronomy, are rather wary of Bert, especially when they come to the Faculty Club to relax.

"By the way, Bert's sitting in a corner, waiting for you. He says he has a surprise for you."

"Thanks for the warning, Jenny. See you tomorrow."

Jenny's warning gave me the opportunity to go upstairs and avoid Bert, but, after a brief hesitation, I decided that, rather than having peace and quiet with my lunch, I needed a diversion more. I joined Bert in the lounge, after picking up a tuna sandwich smothered in a large amount of what looked like dried seaweed.

While I chewed my first bite, Bert inquired about my health and the state of my decision regarding the early retirement incentive package that all older professors, including Bert and me, had been offered. Bert's decision had been simple. He was being paid to do what he most enjoyed doing, so why should he even consider retiring. I, on the other hand, occasionally considered the retirement option attractive.

"But you would miss all the stimulating interaction with your students and your colleagues, Brouwer."

Bert meant himself, primarily, but in a strange way, he was right. The intellectual stimulation Bert has provided me hasn't really affected my career in physics very much but has made my scholarly existence less dull and predictable. Since befriending Bert, I have always felt a bit more intellectual uncertainty, as if I had to continually look over my intellectual shoulder to make sure that some strange new idea wasn't going to sandbag me from behind.

"Examine that ball, Brouwer!"

As I finished my sandwich, Bert judged that I was now ready for a deeper discussion. I looked over the little rubber ball he had tossed to me, held it up in my left hand and tried to give Bert my best Sherlock Holmes imitation.

"This is a rubber ball, of roughly 2.5 centimetres in diameter, having a mass of 23.4 grams and is probably used in the sport of racquetball or handball."

"Don't act so stupid, Brouwer, all I want to know is if you can see anything different about this ball."

"It's just your everyday, ordinary racquet ball, Bert, as far as I can see."

"As far as you can see, Brouwer," Bert answered mysteriously, looking around to make sure no one was listening. "This is a nonradioactive racquet ball!"

I looked at Bert to see if he was really serious, but apart from acting as if he was in possession of a world-shaking secret, he looked fairly normal.

"What do you mean, Bert, a nonradioactaive ball? All racquet balls are nonradioactive."

"That's where you're wrong, Brouwer, all other racquet balls are radioactive, but I designed one that is not radioactive."

I have to admit that, like you readers, I was totally befuddled at this stage. Was Millsap having me on, or was he just simply talking nonsense, as was usually the case? I decided I had to investigate this a bit more systematically.

"Okay, Bert, let's back up a bit. What on earth are you talking about?"

Bert settled back in his chair, very pleased that, for once, he was assured of my total attention. However, pinning him down isn't that easy.

"I'm going to start a new company, Brouwer, to manufacture squash, racquet and handballs that will not pick up radioactivity from the air and become radioactive themselves. I'll bet that, as soon as the public knows that racquet balls become radioactive when you play with them, they'll come out in droves to buy these balls."

At times like this, I sometimes wish that my religious upbringing had not stunted my ability to express myself fully, as the situation demanded. "What on earth are you talking about?" was a pretty weak way to express my frustration. Perhaps I should leave it to you to think of a more trenchant phrase to use. However, Millsap continued before I could find the right words.

"I read in a research paper (Cowie and Walkiewicz 1992) that racquet balls pick up radioactive dust from the air and become gradually more radioactive the longer you play. I think the public will pay to avoid the dangers of radioactive racquet balls, and I had a technician friend of mine develop a smoother ball, which won't pick up dust."

As I should have expected, there is always some factual basis to Millsap's wildest flights of the imagination, and I decided that I would look up the paper Millsap had referred to, to see how much sound scientific factual basis there was to his assertions.

Having found the paper, I learned that of the 10,000 or so radon ions per square metre that seep into a room per second, most of them decay into polonium and then into bismuth and lead very quickly. These ions of bismuth and lead are charged and can be picked up by a racquet ball and will emit beta radiation (electrons) while they decay themselves. But surely the effect is so small that it would be undetectable.

Dave Morris, a physics colleague, and I decided we would play racquetball for an hour, with Millsap watching behind the glass observation wall and making snide comments about our proficiency at the sport. After the hour of play, we rushed over to the Slowpoke Reactor Centre at our university and asked Steve McCann, a radiation physicist, to test the racquet ball for radioactivity.

"Have you guys gone totally mad?" was Steve's reaction. "I will bet you dinner at the best restaurant in town that there is no measurable radioactivity beyond the normal background on this racquet ball. Any takers?"

Dave and I showed our scepticism and weren't bold enough to take the bet. It wasn't buying the dinner but the blow to our reputations that worried us. However, Millsap eagerly took the bet, so Steve actually went to the trouble of analyzing the radioactive spectrum of the racquet ball, while we went back to our offices to do some work.

Two hours later, we got a call from Steve.

"I think you and Dave had better come over and see this."

"What did you see? Did you actually measure some radioactivity?"

"I'm not telling you anything. Just come on over, but don't bring Millsap."

Dave and I took the five-minute walk to the Slowpoke Centre, ran up the stairs and arrived at Steve's office out of breath but very excited. Steve walked toward us with a smile and handed us a sheet of paper with a graph of the racquet ball spectrum.

"So, what does it show, Steve?"

Steve pointed to the large bump near the bottom of the figure.

"That's the signature of the betas (electrons) emitted from the racquet ball. The computer automatically eliminates the counts due to background, so Millsap was right. Racquet balls do pick up a measurable amount of radioactivity during a one-hour game. Are you guys going to help pay for his dinner?"

Dave and I agreed to split the cost of the dinner. In fact, we offered to pay for Steve's dinner also because he had gone to the trouble of doing the measurement.

The next Friday evening, at the most expensive restaurant in town, Millsap was in excellent fettle. He was actually one up on three physicists, who might have been expected to be more familiar with the everyday consequences of radioactivity. However, we were able to convince Millsap that there was not likely to be much of a market for nonradioactive racquet balls because the radioactivity actually picked up by a ball was only up to two or three times the normal background radiation and therefore still less than half the normal background radiation of healthy places like Denver. Millsap didn't seem to mind too much. He was enjoying the finest dinner three people could buy him.

Toward the end of the evening, as Bert was leaning back and massaging his bulging stomach, he asked us if we were familiar with the fact that irradiated golf balls traveled farther than golf balls that had not been irradiated?

Apparently, golf balls irradiated with nuclear radiation can be driven 20 yards farther down the fairway than ordinary golf balls. Steve, Dave and I looked at each other for a moment and got up to go home.

We made Bert pay the tip.

Reference

Cowie, J., and T. A. Walkiewicz. "Radioactive Ball." *The Physics Teacher* 30, no. 1 (1992): 16–17.

Millsap and the Radon Problem

It was approaching 5 p.m. on a Wednesday in November. As we do from time to time, we had invited our physics teaching colleagues to the Department for an evening of physics and pizza. I'm never sure what attracts the teachers more, the impending presentation on how the experimentalists finally identified that last elusive top quark or the pizza and a chance to talk to physics colleagues they haven't seen for awhile.

A number of our colleagues in the Physics Department do what is known as Suitcase Physics. They spend part of the year at our university, teaching and doing research, and spend the other part of each year at far-off places doing their experimental research. In fact, some had been involved in the experiment that identified the sixth quark, competing the set of elementary particles, at least as far as we know now.

When we said goodbye to our colleagues, at about 7:30 p.m., I headed back to my office to get my coat and then go home. When I got there, the phone was ringing. It was Helen Millsap, wife of my eccentric colleague from the psychology department. Helen, though very fond of Bert Millsap, has not been able to live in the same house as Bert for a number of years, but they remain close and often visit with us together. Helen doesn't usually get too excited, but I could sense some stress in her voice tonight.

"Will, where have you been? I've been trying to get hold of you all evening. Bert's been driving me mad. He not only put his house up for sale and threatened to move in with me but also he wants to drive me to the emergency ward at the hospital."

I had hoped we could handle this emergency over the phone, but it sounded rather complicated, and I'd probably have to spend a couple hours trying not only to make sense of what was bothering Bert but also to calm him down from his excited state.

"I'm pretty tired, Helen. Do you think the problem could wait till tomorrow morning, or should I come over now?"

"The problem might wait till tomorrow, but I won't. If you don't come over now, I'm going to a hotel for the night. All I can gather from Bert is that he thinks he has radon poisoning, though he looks perfectly well to me."

Radon poisoning, okay. This was the time when articles warning people about radon gas seeping into houses appeared almost weekly. This radon gas was supposed to be responsible for many lung cancer deaths. I imagined that Millsap must have gone off the rails, as he does once in awhile.

I headed out through the cold night air to the parking lot, where my car had been getting colder and colder all day, and headed across the bridge to Millsap's house. Only when I arrived there did I remember that Bert was not there but had gone to his wife's apartment, back on the side of the river I came from.

After cursing Bert, his house, winter and the frozen car windows, I felt somewhat relieved and arrived at Helen's flat in a better mood. Bert met me at the door and started talking and waving sheets of paper in my face.

"Bert, shut up a moment. First, you're going to make me a drink, then we're going to sit in the easy chairs overlooking the river valley, and then I might be ready to listen."

Bert actually seemed to relax as he headed for the drinks cabinet and started mixing me a very weak whiskey and soda. At this point, Helen came into the room, greeted me and raised her eyebrows to indicate that she had

reached her limit. After a couple sips, I stretched my legs out and faced Bert.

"Now, Bert, I'm tired tonight, so I want you to tell me, in an organized and logical way, what's bothering you."

"Bothering me, bothering me? What's bothering me is that I've been living in a house that has more than 1,000 times the allowable amount of radon in it. And my bedroom's in the basement, making it even worse. The radon concentration is so high that I must have lung cancer. If 20,000 people die each year in the United States due to radon concentrations just over the allowable limit, with the high concentrations in my house, I'm sure to die." Bert was waving about a copy of the *New Scientist* (November 22, 1988), containing the article which presented those results.

Now we knew what the problem was, and the first thing to do would be to calm Bert down so Helen could have some peace, and only then try to get the origin of the problem. So I proceeded logically.

"Bert, listen carefully. I have a lot of articles from Health and Welfare Canada in my files, and you can borrow them tomorrow. They've done a complete survey of radon concentrations in Canadian cities and calculated how many houses in each city should be remodeled to reduce the radon concentration. It turns out that in Winnipeg, probably about 900 houses have more than the allowable limit of radon gas concentration in the basement, but, just listen to this. They calculated, on the basis of their testing, that radon concentrations in Edmonton are so low that probably only one house, count it, one house might need some upgrading to reduce the amount of radon. And I flatly refuse to believe, Bert, that that just happens to be your house."

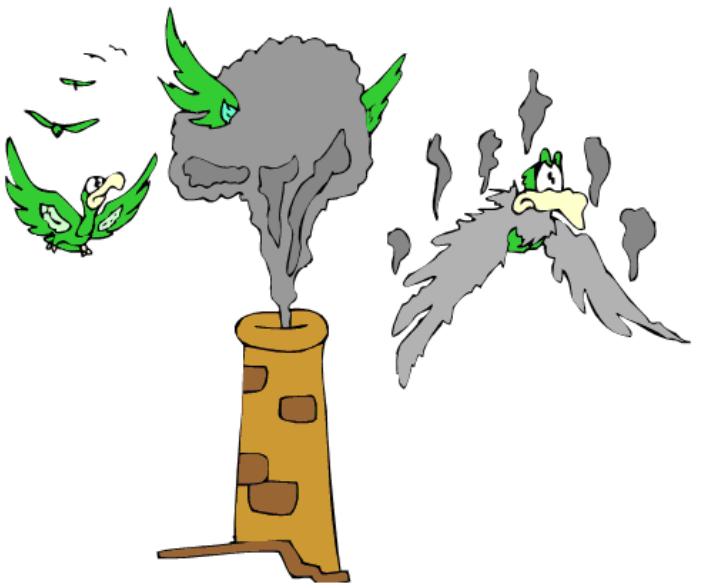
"Brouwer, I measured the radon concentration in my basement. I have the figures here. You can't argue with the data."

I looked at the pages of scribbling that Bert put in front of me. Terms like working level, picocuries, alpha emission and radon daughters danced in front of my eyes. If I had to make sense of this, I would have to spend the night.

"Can you tell me in your own words, Bert, how you measured the radon concentration?"

"Using this device, a Lucas Chamber, I collected some of the air from the basement, let it stand for awhile, and then placed the air filter on the scintillation counter and read off the readings."

I was impressed. Millsap had at least used the right procedure. What the device actually



measures, as a good reference will show you, is the concentration of polonium, one of the elements into which radon decays. Polonium can also be trapped in lung tissue and damage some of the cells, which may then become cancerous. But that was neither here nor there; I had to find out why Millsap got such a high reading.

"So, what did the scintillator read, Bert?"

"Here, see for yourself, it gave the figure of 0.24. I did the measurement several times and got more or less the same results."

I took out my glasses. Everything Bert had done seemed reasonable, but the readings were too high by several factors of 10. I took out my glasses and looked carefully at the dial. Aha!

"Bert, do you see this little *p*? It says pCi, not Ci. That means picocuries, not curies. Do you know how much a picocurie is?"

Bert turned red, realizing what had happened. I was pleased that it hadn't taken too long to discover Millsap's blunder, but I was either too tired or too kind to take advantage of it now. But I would remember.

"What you measured was a radon daughter concentration of 0.24 picocuries, and, if I remember correctly, that should be about 0.0024 Working Levels (WL). Let me just check this paper by Letourneau. The average concentration in Edmonton is about 0.0028 WL. Wow, Bert, I can't say much for your interpretation skills, but your measurements were remarkably accurate."

According to Health and Welfare Canada, houses with concentrations of over 0.1 WL should have some work done to cover cracks in the basement floor or walls to reduce the radon concentration, but Bert's house, like most other Edmonton houses, had less than 3 percent that amount.

Helen was very thankful as she helped me on with my coat. Millsap still sat at the table deep in thought. As I looked back at him, he almost looked as if he was learning a lesson about himself, that he finally realized that he might occasionally overreact to a situation. I wasn't sure that I wanted Bert to become wiser. It would make my life much more boring!

An Astronomy Project Gone Up in Smoke

Mr. Nicoloff parked his car at the north end of the school and switched off the car lights. Two of his students, Alex Walker and Vija Mikkelsen, were waiting at the door of the school, and, after Mr. Nicoloff unlocked the door, they went with him to the science laboratory and up a narrow staircase onto the school roof.

It was a mild evening, and the perfectly clear western sky was still bright with the light of the sun which had set an hour and a half before.

On the school roof was a small shack which housed the pride and joy of Mr. Nicoloff's high school astronomy class and eight-inch refracting telescope. For 10 days, Vija and Alex had been recording the intensity of light from the variable star Beta Perseus, using a photometer they had put together with odds and ends from the local radio supply and an old light meter resting for years on a shelf in the science lab. They had obtained some beautiful results which, when graphed, showed a variation of light output which repeated itself every two days and 21 hours.

Vija and Alex had handed in their results with the accompanying analysis the previous Friday and had received the project back with the terse comment: "The results in your paper are just too good to be believable. They also disagree with the results I obtained last Sunday evening. I can only give you a zero on this assignment because I believe you cooked up the results."

Alex and Vija looked up Mr. Nicoloff as soon as noon hour arrived. They were both puzzled and dismayed. For 10 days straight, they had spent two hours a night on the roof of the school observing.

"What else does he think we were doing up there in the dark," grumbled Alex. And yet Mr. Nicoloff was not the type of teacher to jump to conclusions. He usually allowed students to explain themselves if they had a conflict of some kind with him.

Mr. Nicoloff was in his prep room eating his lunch. He waved the students to chairs and said "Well?"

"How could you suggest that we cooked these results?"

Vija had decided to be the spokesperson because Alex was too angry to be coherent.

"We spent at least 40 hours on 10 different nights observing Beta Perseus and actually got these results. And they agree with the results in the article you gave us."

"That's the trouble," said Mr. Nicoloff, wiping his beard, "Look at the results I got last Sunday night."

Mr. Nicoloff handed them a chart of the measured light intensity of Beta Perseus over four hours.

"Look how washed out the curve is. The light intensity is much less than what you measured, and you can only faintly see the variation. The only thing you should have been able to get more accurately than I did is the two-day, 21-hour cycle. I'll accept that. But not these data!"

"How clear was it Sunday night?" asked Alex.

Mr. Nicoloff hesitated a moment while lighting his pipe.

"Perfectly clear, as clear as any night the last few weeks. I've got complete faith in my data."

"Well, so do we," answered Vija. "I'm sure our results are reliable. Will you come out with us tonight to check our measurements?"

"Oh boy! You want me to spend four more hours on that roof, do you? Well, maybe we should. You've both been pretty good students in the past, so we'll go out tonight, if it's clear.

But you'd better understand, if my results are correct, the zero stays, and you'll do another project and you'll do it properly."

"It's a deal," agreed the students, confident they could reproduce their results.

So there they were, late Monday night, to put their faith in nature to the test. Mr. Nicoloff quickly realized that the students had indeed used the telescope before by the efficient way they slid open the roof and oriented the telescope to the right coordinates. All he had to do was light his pipe and sit back and wait for the first readings. After about half an hour of recording the data, Alex had calculated what part of the cycle Beta Perseus was on. When he compared the data with the data they had collected before, Vija noticed by the expression on his face that something was wrong. As she looked over his shoulder, she noticed that the eight intensities they were measuring were almost identical to those measured by Mr. Nicoloff.

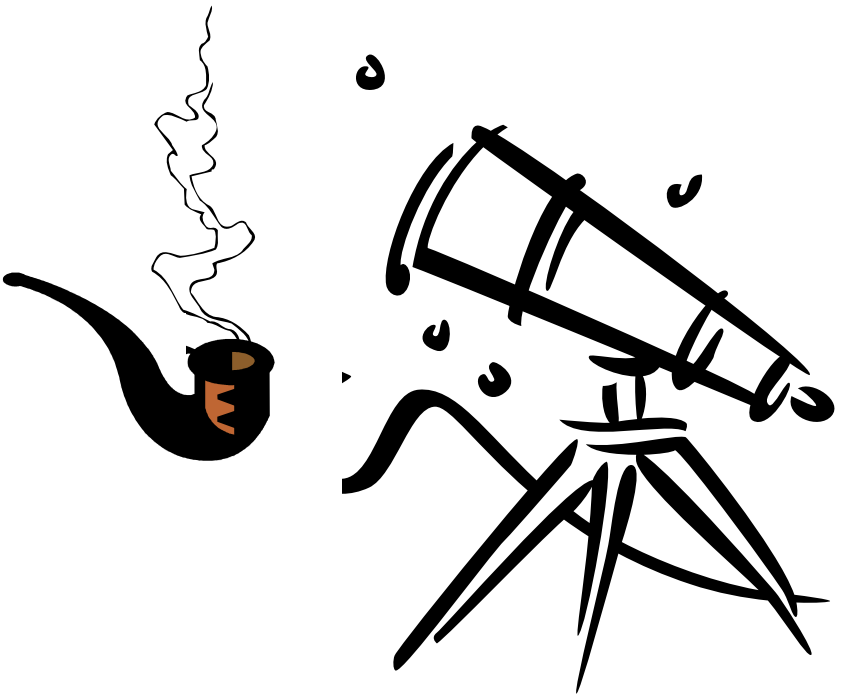
Mr. Nicoloff got up from his chair and quietly looked at the data. He was puzzled also. Certainly, his results were vindicated, but Vija and Alex were not behaving like students who had cooked up their results. They were genuinely puzzled by the results and wanted to spend more time observing.

"Okay, another hour," agreed Mr. Nicoloff, and he wandered off to lean on the waist-high retaining wall on the roof to look at the lights of the city sky. After about 10 minutes, Vija cried excitedly: "Mr. Nicoloff, come here. The readings are going up!"

Indeed, as Mr. Nicoloff read the results Alex was recording, the intensity of light was much higher for the past 15 minutes than before. But as they all watched more data being recorded on the photometer, the readings again began to decline. At least, Vija thought, Mr. Nicoloff would believe that they had recorded reliable data in their previous observations. She looked at her teacher appraisingly. Would he really believe them? Then she noticed the blue curl of smoke rising out of the bowl of his pipe.

"Oh you idiot! No wonder you're not getting the right readings! You're smoking your pipe!"

Suddenly, Vija clapped her hands against her mouth, but Mr. Nicoloff hadn't even heard the word idiot. His eyes opened wide as he looked at Vija, and then, shaking with laughter, he collapsed in his chair.



Millsap and the Scandal in Education

Thursday evening had been one of those special evenings. I had taken some members of my science education class to the top of the Physics Building to look at the night sky through the 12-inch telescope stationed there.

With the help of the student volunteers, who are there every Thursday evening, we had managed to observe Jupiter and three of its moons, probably Io, Ganymede and Europa, before Jupiter followed the Sun beneath the horizon. We then switched the telescope to Saturn and managed to see its magnificent ring, with Titan nearby, circling the planet.

I'm not sure what it is that makes observing these two planets so impressive. Maybe it's the fact that Jupiter and its moon orbiting it in a miniature solar system played such an important role in convincing Galileo to make public his belief in the Copernican system. And imagine the first time Christiaan Huyghens saw the ring system of Saturn in the 1550s. Astronomy, more than any other area of science, has the ability to bring the amateur scientist into that timeless community of observers of the night sky, from the ancient Babylonian priests to the modern seekers and quasars and collapsing black holes.

"But what does this have to do with scandals in education," you ask?

I would answer, "very little," because it wasn't until the next morning that Bert Millsap burst into my office with his latest obsession.

Millsap is, as you are doubtless aware, my tubby little colleague from the psychology department, who plagues me from time to time, with various conundrums and puzzling little problems, which he picks up from the strangest sources. As one senior administrator once put it, Millsap had once caused a faculty meeting to end prematurely when his experiment with coffee balls had malfunctioned with disastrous consequences (see elsewhere in the Millsap files for details).

On this Friday morning, Millsap was looking unusually dishevelled. To my greetings and inquiries as to his health, he shrugged impatiently and asked me how I , as well as my older colleagues in the Faculty of Education, managed to justify our existence while the education system was failing as badly as it was.

Well, we in education are used to criticism. With regard to education, all human beings over the age of eight consider themselves experts, and this was not the first time Bert Millsap had berated me for all the ills of the education system.

In fact, I often get a little steamed about how I, innocent and inoffensive as I am, am often considered responsible for the shortcomings of others. Whenever the Faculty of Science does something that offends the Faculty of Education, who gets the blame? Brouwer, who has a joint appointment in science.

When I protest that it is impossible for any living being to justify the action of anyone in the office of the death of science, my colleagues accuse me of evasion.

And guess what happens when I have a cup of coffee with my physics colleagues? Who is then held responsible for all the ills of the education system? Right! You got it in one. Back to the scandal in education, if any.

"Get out of here, Millsap. This is my physics office, and I'm not in the mood for any ranting and raving about education this morning."

"Are you familiar with the developmental theories of Piaget, Brouwer?" Bert never listens to my objections. He reminds me of Hyacinth Bucket (that's "Bouquet" for those of you unfamiliar with public television).

"Well, of course, Bert. Anyone in education has to be familiar with Piaget's work."

Bert sat down. He is often too excited to sit while he expounds on his latest interests, but he was sufficiently composed now to sit and light a cigar. I know, I know, it is illegal to smoke in any building on campus, and you can be severely reprimanded—you tell Bert, I've tried.

"Brouwer, I came across a piece of research carried out by Ball and Sayre in 1972 that has me very upset."

"Ball and Sayre? I've heard those names before. Didn't they do some work on concrete and formal operations among junior high kids?"

"That's right, Brouwer, and they found that most of the students receiving As were formal operational; most of the students receiving Bs were concrete operational."

"That's right, Bert. Formal operational children are able to do better at the more advanced problem-solving skills in science."

At this point, Bert jumped up again and waved his hands about.

"How can you sit there so calmly and say that, Brouwer? If that's true, it represents the greatest scandal possible in education."

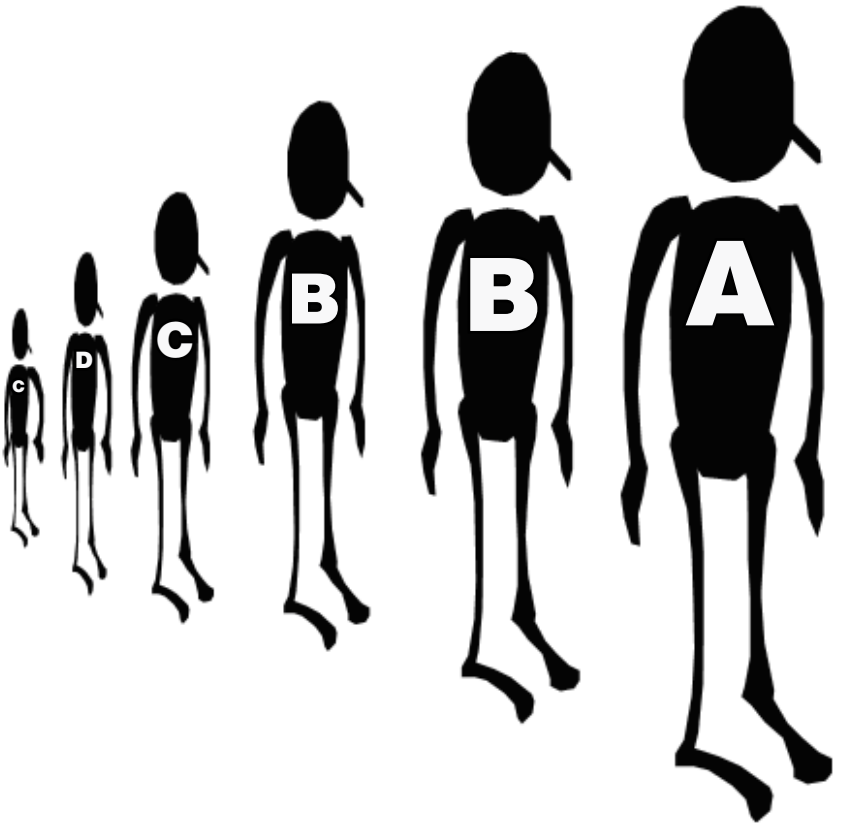
I hadn't quite caught his drift yet, so I asked Millsap to explain.

"How would you feel, Brouwer, if we awarded grades of A only to students who had reached the height of 160 cm by the time they reached Grade 8, Bs to the students between 140 and 150 cm, and Cs and Ds to those shorter than 140 cm?"

"What on earth does that have to do with the issue we're discussing?" (I admit I wanted to ask, "What the hell…?" But I was raised a respectable Calvinist boy and swearing just doesn't seem appropriate—yet. I could learn…)

"Brouwer, how tall were you in Grade 8?"

"Well, actually, Bert, I was only 5'4", one of the smallest boys in the class, and the bigger



guys used to bully me. But then I grew 7" in Grade 9, and almost daily I could see the bullies get more polite."

"Precisely, Brouwer. Some of them grew to their adult height more quickly that you did, but you caught up and passed them. Your being 5'4" in Grade 8 did not prevent you from being the big gorilla you are now."

At this point, Bert stopped and glared at me. He felt sure that the analogy had by now got home to me, and I'm sure you have caught Bert's point much earlier. If intellectual growth occurs at different rates for different children, and, if we get the slow developers used to failure early and inhibit their self-confidence and intellectual development, we educators may be as much responsible for crime among young people as the young people themselves are.

"Bert, I warn my student teachers to be sure to give all the children in their classes lots of opportunities to experience success in their science activities. What more do you want?"

"What more do I want? Brouwer, while you educators sit on your duffs, generation after generation of our kids are going to the dogs. What I want you educators to do is to go on strike until schools are organized on the basis of the intellectual stage of development of children and not on chronological age."

"On strike, Bert? You want us to go on strike? What you're demanding would mean that kids of different stages of social development would be in one grade. You might have kids from 7 years old to 13 years old in Grade 4, for example. It would be a shamble."

"Do you have any evidence, Brouwer, that kids of different ages can't learn together and help each other learn better? I'll bet there would be fewer problems in classrooms with kids of different ages than we have in junior high schools now, with kids the same age but at very different stages of development."

"But Bert, schemes of testing kids for school readiness have been tried before, and parents and politicians won't stand for it. Parents don't want to be told their 13-year-old belongs in Grade 3."

"Parents and politicians will have to be convinced that their children's ultimate good will be served by having them learn at their appropriate rate. And educators, if they really believe that schools should be organized more on the lines of children's intellectual development, should stand up for their professional responsibility and refuse to work until the education system is organized properly."

"But Bert, do you really believe that much of juvenile crime is due to the fact that our educational systems makes failures out of children who are not dumber but probably just slower to reach their intellectual maturity?"

"That's right, and any educator who doesn't do something about it doesn't deserve to be called *educator.* Excuse me, I've got a class to teach."

And off he went leaving me with the wreck of my career. But that's Bert, spreading doom and destruction all around. And I had started the morning in such a good mood. But secretly, Bert has a point. What if we did organize our schools solely on the basis of students' intellectual maturity? What if all students could reach their intellectual potential, even if it took some longer than others? What if we educators and teachers were the ones to decide what a proper education was, and not the politicians?

Damn Bert Millsap for disturbing my intellectual peace.

Reference

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Millsap and the Great Void

"So what is left when you take all the matter out of the universe?"

We were sitting around a table at the Faculty Club, discussing evidence for the equality of women in the early Gnostic churches in the New Testament era, based on some of the recently discovered papyrus scriptures in the Sinai Desert, when Bert Millsap, our eccentric colleague from the psychology department uttered the ultimate question.

When we, Jenny Platt, Evan Hunter, Millsap and I, had arrived at the Club, we found our regular table had been usurped by a couple of chemists. It is quite amazing how out of sorts senior professors can be when their regular routine or expectations are thwarted. We eventually grudgingly sat down at another table, but the conversation was rather sporadic until Bert, out of the blue, came up with his question.

Of course we all turned to Bert and demanded what the hell he was talking about. Bert has a habit of straying on to physicists' turf, and our experience had taught us that Bert's questions were never that easy to answer. I remember the time he had asked us how a black hole lets us know how strong its gravitational field was when nothing could escape from the black hole. And Bert hadn't been impressed when six cosmologists we managed to talk to gave six different answers.

In this case, we were reasonably well armed to discuss this question because Evan Hunter is our resident astronomer, and I have a pretty broad background in physics. Jenny Platt is an extremely well-respected biologist who had recently beaten me to a Faculty Teaching Award, who didn't know much physics and didn't always have as much patience with Millsap's questions and other shenanigans as Evan and I have. In fact, Jenny blamed me—unjustly—for Millsap's catastrophe when he studied the creation of balls of coffee at a recent faculty meeting.

"Don't interrupt, Bert," was Jenny's rejoinder. "We're not interested in nothing, so tell me instead why the early Christian church suppressed all these writings on the equality of women."

"I read an article recently that Aristotle was right after all, that the void does not exist." Jenny should know better. There is no known way to bend Bert's brain back to an earlier topic if his mind is made up. He gets a kind of knot in that connecting tissue between the two sides of his brain, his corpus callosum, and factual information related to a topic he finds uninteresting does not reach its proper destination.

Although physicists do not ordinarily spend much time arguing about such classical philosophical questions, the nature of the vacuum has puzzled a number of great physicists for quite a while now so that Evan and I were quite willing to change conceptual directions.

"I think the physicist's answer to the question," ventured Evan, "is that nothing exists if you take all the matter out of the universe."

"So you think Aristotle was wrong. The void does exist?"

"No, I said nothing will be left if you take all the matter out of the universe, including the void."

"Just a minute, just a minute, my head's spinning," Jenny got into the conversation. "What I hear Evan saying is that nothing will exist if you take all the stars and planets and everything else out of the universe. But empty space will be left, won't it? The universe will be empty. And isn't that the void?"

Jenny's argument sounded reasonable, but then when is physics reasonable?

"What these guys are claiming, Jenny," Bert contributed, "is that empty space isn't nothing, it's something. Nothing will be left if you take the matter out of the universe, not even empty space."

"Stop it, please, you guys are doing this just to confuse me. You must be talking nonsense!" Jenny was shaking her head and threatening to join the chemists unless we started to make some sense out of this discussion. So I decided to give it a try despite the fact that my contributions, even if they made sense some of the time, usually had the effect of making the discussion much duller.

"Actually, Jenny, physicists probably believe nowadays that what we used to call empty space isn't empty anymore. If you think of a totally empty jar and remove all matter from it, you would have a vacuum. But if you could put a little ball in the jar, it would fall to the bottom, which shows there is a gravitational field in that vacuum. It wasn't empty."

"That's all well and good, Brouwer, but, if we remove all the matter from the universe, there will be no gravitational fields. So now what?"

Millsap had pointed out a minor but crucial weakness in my argument, so I looked to Evan for help. However, the despised chemists had pulled their chairs over to our table and insisted on joining our discussion. One of them, Ted McCall, claimed to have read about a paper a Dutch physicist had written many years ago, who predicted that if you put two neutral conducting plates close to each other in empty space, they would attract each other as if there was a dielectric material between them. "It's called the Holstein Effect, or the VanderHeimer Effect or something like that."

"It's called the Casimir Effect if you really must know," I added. "It turns out that it's actually been measured. There is a model of the vacuum which assumes that it's full of antiparticles with negative energy, which can be observed only if you give them enough energy to pop out of the vacuum."

"Particles of negative energy, that's a hoot! I'm going home to make an anti-salad with anti-lettuce and anti-tomatoes. I'm going to use a nice anti-Caesar dressing to spice it up." Jenny grabbed her purse, wished us a pleasant weekend and left, shaking her head. We, however, were only getting started.

Evan agreed with me that physicists were puzzled about what the vacuum really was. He mentioned that if you had a space full of gravity and electromagnetism, and set these fields to the lowest values possible, that value was not zero. You could not make the vacuum empty.

Meanwhile, what about Millsap? It was rather unusual for us to have such an intellectual discussion without Millsap introducing some outrageous notions. In actual fact, he also had lost interest and was now arguing with McCall which of us had the right to sit at the corner window on Friday afternoons. "After all, if you don't have some respect for tradition at a university, where are you?" seemed to be the gist of his argument.

The two chemists just laughed and went on their unregenerate ways while Bert and I also got up to leave for our respective domiciles. As we left the building, Bert sounded rather wistful: "You physicists have a lot of the more interesting questions in life. Of course psychology is much more important, but you guys have more fun!"

Well, I'm not convinced that psychology is more important than physics, and I was parading the faces of my more grumpy colleagues through my mind to determine whether Millsap's second conjecture was correct or not, but I'll leave it to the reader to make a more intelligent and unbiased judgment. But that vacuum now, empty space filled with particles we normally don't experience, through which we travel with no resistance—this empty space was going to fill my weekend, and I had Millsap to thank for it.

Millsap and Lifelong Schooling

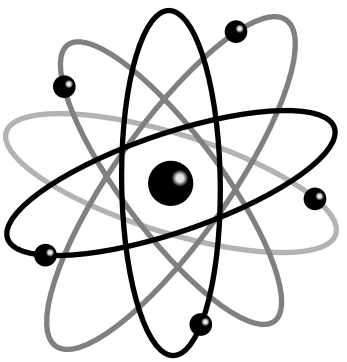
"So you've found the last of the elementary particles, have you? So now what?"

Jenny Platt, a colleague in the biological sciences had just asked this question, and Evan Hunter, my astronomy colleague, and Ernst Finegold, an elementary particle physicist, were mulling it over.

It's actually fun to ask an elementary particle physicist what he or she's going to do now that the last of the elusive quarks has been identified. Elementary particle physicists like to measure and experiment. They don't like thinking about the cosmic significance of their findings.

In the good old days we just had protons, neutrons and electrons, and everybody could more or less understand what nature was all about. But now we had broken up the proton and neutron, each into three particles which had a greater combined mass than the proton or the neutron. What's going on here? And who's fooling whom?

Ernst tried to explain how these elementary particles fit into the grand scheme of nature developed by the physicists, but to the noninitiated, the whole effort has an aura of unreality. What are these elementary particles, the quarks, which can never be observed directly, but are so necessary to the structure of matter? Why do the smallest constituents tend to get bigger and bigger the more deep you delve into nature? And if this is as far as we can go, is physics finished? Does nature have no more surprises for us?



"Move over, Jenny, I've got to get in on this." Here was our old colleague Bert Millsap, ready to join our discussion, or change it as the need arose.

"Ernst is just explaining to us how there are these elementary particles which make up our everyday, normal world, and two more layers of unnecessary particles, which could make up other worlds, but don't seem to do so." Jenny is quite bright for a biologist, and she had got the nub of the discussion, but didn't seem to think much of it.

"Oh, yes, I've read about those," replied Bert, "but I suspect that if physicists developed different theories, they would find different particles. I don't believe they're discovering particles at all, they're inventing them."

"You must be absolutely crazy, Millsap! Our experiments have clearly identified the six basic quarks out of which all matter is constructed." Ernst was a realist through and through, and, if his experiments identified quarks, then quarks existed, whether Bert Millsap believed in them or not.

Bert was waving to the waiter to bring us another jug of Heineken. For those readers who may occasionally wish to join us for a discussion, the newcomer always orders the next jug. It's just as well to get the etiquette clear up front, just in case.

"Have you done anything about the matter we talked about the other day, Brouwer?"

Bert was onto a new topic and was referring to a previous discussion on schooling based on students' intellectual ages (or stages) rather than on chronological ages (see the archives, previous issue). I explained the gist of Bert's arguments to our colleagues, and they actually received Bert's ideas quite sympathetically. In fact, they were intrigued by the notion that students might well develop intellectually at different rates just as they do physically, and that schools should take that fact into account much more seriously than they had done in the past.

"But what if some children developed so slowly that they would spend the rest of their lives in school." As I have said previously, Jenny comes up with interesting notions.

"What's wrong with that?" retorted Bert. "As far as I am concerned, no one should ever graduate!"

"No one ever graduate? Who's going to do all the work that needs to be done?"

Millsap took a deep sip.

"We all spout a lot of nonsense about lifelong learning, but none of us have ever taken it seriously. If I had my way, no one would ever leave school. By far the greatest fraction of people who leave school don't learn anything new after age 18. In my society, the minimum amount of education any person could be involved in at any particular time would be one day a week."

Ernst Finegold hadn't met Millsap before, although he did know of Bert's fondness for wild ideas. He pointed out one of the weak points of Millsap's scheme.

"But even if we wanted to do this, how could our society afford it? We're already having trouble paying for health care, education and so on. This would only make it worse!"

"Nonsense. Lifelong education would be free. You could fulfill the requirements in a variety of ways. You could get credit for your educational experiences either by taking a program, or by teaching some program or by teaching a useful hobby."

"But how could you organize such a massive educational program, Millsap?"

"Well, first of all, children would go only to school on Mondays, Wednesdays and Fridays, and work on Tuesdays and Thursdays. That by itself would free up the schools for a considerable amount of time. And of course schools are available on weekends and in the evenings."

"You would have children work, Millsap?" I had been silently observing my colleagues' reactions to Millsap but felt it was time to ask some questions myself.

"Of course I'd have children work, Brouwer. Any research that's ever been done on the effect of work experience on children's learning shows that children learn much better when they have a reason for learning."

"So in your society, children would work two days a week and adults would go to school at least one day a week. An intriguing notion."

At this point, Bert spotted the dean of science and was off to argue about not being recommended for a double increment this year. The dean tried to sneak out the side door, but I could have told him it was no use. You can't get away from Millsap that easily.

As for us, we tried to go back to our discussion on elementary particles, but somehow, our hearts weren't quite in it anymore.

A Matter of Some Gravity

"So, just because there are too many competing schools of psychology you claim that psychology is not a mature science?"

"Exactly," we answered Millsap who, for once, we had on the defensive.

"Would the gentlemen like another round?"

It was 4:30 on a Friday afternoon, and we had retired to the Faculty Club, as usual. It had been a very busy week and, like most of my colleagues, I still had a lot of marking left to do on the weekend. We were sitting in a corner by the window overlooking the river valley which was covered with the fresh green of early spring. While Bert Millsap was still thinking of a reply, I ordered his usual mixture, while Evan Adams, our colleague in astronomy, ordered a Tuborg, and Jenny is one of our more famous biologists who, besides being an excellent researcher, was also one of the most popular teachers on campus.

On Friday afternoons the emphasis in our discussions is not usually on knowledge or truth, but rather on winning an argument. As the reader has no doubt realized, we were discussing the nature of science, and had found psychology sadly lacking in the most important characteristics of science–agreement among psychologists as to what knowledge psychology actually possesses. Because three out of four in our group were from the natural sciences, we had pounced upon Bert Millsap, whose discipline is, of course, riddled by dissension and controversy.

"Well, what about gravity? There doesn't seem to be much agreement these days about gravity." Bert was using a very effective argument technique, which shifts the discussion to the weaknesses, if any, in the opponents' position. I say "opponents" in the plural, but of course Bert was aiming squarely at my field, physics.

At this point the waiter arrived with three drinks, claiming that I had forgotten to order one for myself. While I was trying to straighten out his error, Evan took up Millsap's challenge.

"Don't be absurd, Millsap, we've known all about gravity since Isaac Newton's time, and even Einstein's model made only small corrections to Newtonian gravity. There's no controversy about gravity."

Unfortunately, you don't catch Millsap out that easily. He has the nasty habit of reading the latest literature in everybody else's field, and is usually well up on the latest.

"Then what's all the fuss in the science literature about a fifth, or even a sixth force, correcting the force of gravity?"

At this point an author with a sense of duty has a problem. How much, he asks himself, do his readers really want to know about all the trouble the force of gravity is in these days? Disappointingly few, he imagines. However, because my colleagues also did not seem to know much about it, some explanation appears to be necessary. Besides, even Jenny appeared to have heard something of the controversy.

"Yes, Evan, I read an article in *Science Digest* last month that suggested that everything you and Brouwer teach about gravity in undergraduate physics might be wrong."

Jenny had clearly joined the opposition, and Evan and I would have to stand shoulder to shoulder to defend the integrity of our field.

"Oh, come on," I ventured, seriously perjuring myself, for *Science Digest* is actually a very reliable magazine, "you can't believe everything you read in *Science Digest.* Just because somebody has repeated an undergraduate experiment on gravity deep inside a mine, or inside the polar icecap, and got slightly different results than expected, there's no need to get

excited. Probably nothing but experimental errors."

"Experimental errors, my foot!" exclaimed Millsap, sensing perhaps some uncertainty in my defense of physics, "These experiments were very carefully done. The gravitational acceleration was measured in many different locations and different depths, and the experimenters found a much larger difference than could be explained by experimental errors."

The reader may as well know that, at that moment, I felt like Napoleon must have felt at Waterloo. Millsap was right, and the physics community was concerned in these early years of the '90s, that our beautiful picture of gravity was about to be shattered beyond recognition. However, I didn't have to let Millsap know this.

"Come on, Millsap. Do you know how difficult it is to interpret those measurements?" How can the researchers know the precise distribution of matter around and below the mind shafts? There are so many ways that small differences in the types of rock could make a big difference in the measurements."

Millsap wasn't convinced and now one of the more unfortunate coincidences that dog these Friday afternoon discussions, occurred. Millsap spotted Martin Hewitt, a colleague specializing in cosmology, which meant that he knew all about gravity, and that was the last thing we needed at that moment.

"Martin, come and sit down. Here, this chair is free. You've met Jenny Platt, haven't you? We need your advice on these latest experiments on gravity and Brouwer and Evan here have not been too forthcoming."

"Yes, the slackers haven't kept up with the literature in their own field and keep on poohpooing the experimental results." This was not from Bert, but from Jenny, so it hurt twice as much.

"Well, I'm a little thirsty, Bert. I don't know if . . . oh, thank you Bert. Yes, that hits the spot. Now, what is it you wanted?"

Bert explained the disagreement, while I tried to signal Martin with my eyebrows, to string Bert along a bit but not to desert his colleagues completely.

Well, Bert, I'm impressed by your knowledge about these experiments. It should teach Brouwer and Adams that, just because they don't study cosmology, they shouldn't keep up with their reading. But what Brouwer said may, purely coincidentally, turn out to be correct. The trouble with these experiments isn't that they aren't carefully done but that the results are too conflicting. If the results are right, they would almost suggest that gravity is different on Mondays and Wednesdays than on Tuesdays and Thursdays. Well, we wouldn't want that, so I expect that in a couple of years the experiments will improve, the furore will die down and Einstein and Newton will sleep soundly again."

Well, that was better than I could have hoped for or deserved. I patted Millsap on his back and suggested that we depart for home. As for Martin Hewitt, I owed him one.

Millsap at Zero Velocity

On a bright, sunny Saturday morning last June, Bert Millsap and I were flying to Quebec City to attend the annual meeting of the Learned Societies. Even then, we would not normally be traveling together because the physicists and psychologists don't often meet at the same time. However, this year for once the meetings overlapped, so we decided to leave on the same day and share a room at the Auberge des Gouverneurs.

Both Bert and I were scheduled to give a paper at the Learneds, with my paper summarizing my work on "The Effect of Pressure on the Transition Temperature of High-Temperature Superconductors," and Bert's paper entitled "The Effects of Dream Deprivation on Single Adult Males." The black eye Bert was sporting was due to the fact that one of Bert's experimental subjects had expressed the effects of dream deprivation in a nonverbal way.

Bert was quite proud of that result. He had clear, demonstrable proof that dream deprivation of single adult males led to violent behavior, and the proof was much more dramatic than just having 95 percent confidence limits.

I had tried to throw some doubt on Bert's conclusion of the validity of this particular outcome of his research. I reasoned, I believe justifiably, that any six-week long interaction between Bert and 20 normal single adult males would, most probably, also lead to a number of violent interactions. In fact, it might well be that dream deprivation depressed the violent instincts of young adult males, because the experiment had resulted in only one black eye.

Bert's confidence was not shaken by my arguments, but, as we were now cruising at 11,000 metres and just finishing a breakfast of reconstituted powdered eggs, it was clear that something was bothering Bert. Bert, not being a relaxed traveler at the best of times, had already asked me earlier what these various strange noises were, but this was clearly something new. I leaned over to ascertain what might be the problem.

"At what speed do you suppose we are traveling now, Brouwer?" Bert responded to my question.

As the reader no doubt knows, Bert Millsap has the power to totally disorient me. With Bert's answers never appearing to relate in any way to the questions I have asked, I often have the feeling that I'm being whisked out of this world into another dimension for an unpredictable duration. The reader, being more intelligent and perceptive than I, may have guessed what Bert was driving at, but I could not.

"Why on earth do you need to know what speed we're going at, Bert? Is what's bothering you related to the speed of the plane?"

Bert swallowed a couple of times, and I could see that he was really concerned about something. However, I remembered a time before when he had had a panic attack when he believed that the laws of physics were breaking down, because not enough people believed in them anymore. That's one reason why I don't let him drive whenever we head somewhere together.

"Are you scared because you think the plane might fall, because some of the passengers don't believe enough, Bert?"

I felt as stupid as the question sounded, and hoped nobody else could hear me, but, after all, my good friend appeared to be headed for some kind of conniption.

However, my question served seemed to cheer Bert up considerably, not, as became evident, because I had identified the problem,

but I had given Bert an opportunity to shelve his anxiety momentarily, so he could ridicule me.

"Brouwer, that's the stupidest thing you've ever said to me. What could the beliefs of these people possibly have to do with the plane's ability to fly? Gee, you are dense sometimes."

Bert's color was returning to normal, but I was starting to feel a bit offended. After all, I had only tried to help him. But I learned something that I promised myself to remember. Whenever Bert gets into a snit, say something stupid, and it restores him to normality.

"Well, what's bothering you then, Bert?"

"Tell me how fast this plane is traveling."

I should have known. No force on earth can divert Bert Millsap from a train of thought for long. Like General Douglas MacArthur, Bert will return.

"Well, Bert, as far as I know, we're traveling at about 550 km per hour."

Bert contemplated for a moment and took a little time to digest this information before assuming the questioning.

"And how fast is the earth turning eastward, while we're flying above it?"

Of course we all know the earth is rotating on its axis and has to make a complete rotation in 24 hours, so it's not too hard to come up with an estimate.

"Hmm, we're a bit more than halfway from the equator to the north pole, and at the equator the surface speed had to be about 1,500–1,600 km per hour, so I would estimate that the earth's surface at our latitude is traveling eastward at about 550 km per hour."

Halfway through my answer, I was beginning to get a glimpse of what might be bothering Bert, so I estimated the speed of rotation to be the same as the plane's speed, to see the impact the answer might have. The result was that Bert turned pale again.

"Brouwer, does that mean this plane is not actually moving?" Bert whispered.

"Aha!" I said to myself, "Bert thinks that if the net speed of the plane is zero, the plane would probably have no means to keep itself up in the air. Trust a psychologist to confuse relative velocities with absolute velocities!"

"No, Bert," I responded, "with respect to an observer above the earth we could seem to be moving with a speed of about 1,100 km per hour."

Bert now seemed to relax and opened up a magazine to catch up on his reading. But surely I couldn't leave it at that? Why should Bert be so reassured that the plane was "actually" traveling at 1,100 km per hour, whatever "actually" might mean, rather than at zero km per hour. Do you suppose….? Surely no one in his right mind would think the airplane would fall if the "actual" speed were zero?

Bert refused all my attempts at trying to get him to open up. He would not explain his momentary panic either then, or after we arrived in Quebec City.

I gave my talk on superconductivity on Monday afternoon, and then began to relax and explore Canada's most interesting city. I did take some time off my sightseeing to hear Millsap's talk on Tuesday morning, but, although I got there reasonably early, I had to stand at the back because the room was filled to overflowing. The bearded fellow standing beside me, explained that Millsap always drew the largest audiences, because Millsap's choice of research topics and original findings were often the highlights of the psychology conferences. He mentioned an earlier presentation by Millsap at a Mexican psychologist convention where Millsap had investigated the phenomenon of levitation, and had suffered two broken ribs.

Millsap's talk on Dream Deprivation was actually quite well received, and his black eye got loud cheers and a standing ovation.

Because our conferences only partially overlapped. I left Quebec City on Thursday morning and arrived back home later that day. As far as I know, Bert was expected home Saturday afternoon, but when he didn't show up, I received a phone call from Helen Millsap on Saturday evening when she asked me if I knew why Bert had canceled his airplane reservation and was traveling back by train.

Did I know?

P.S. The intelligent reader will have worked out the explanation for Bert's strange behavior. However, for the minority of my readers, I will explain what I think went through Bert Millsap's mind. If the two velocities of the plane and the earth add when you go eastward, then they would cancel when the plane went westward. And then there would be nothing to hold up the plane. Of course in most cases the two velocities are not exactly the same, but Bert didn't want to take the chance. Of course this is only my supposition. Bert keeps totally silent on the matter.

The End of the Human Race

"Aggression is a very useful evolutionary instinct. It is responsible for most of the technical and cultural advancements of the human race. Even medicine would not have advanced as far as it has, if it wasn't for war. Your life expectancy, Brouwer, would still be around 35 years, if it wasn't for war. So stop marching around with those peace groups and let the world take its course."

It was Friday afternoon again, some years ago, and Bert Millsap, my longtime colleague from the psychology department, was in a belligerent mood. He and I disagree amiably about most topics under the sun, but there are a few topics, including the one on nuclear disarmament, on which Bert and I disagree somewhat acrimoniously.

Bert and I were sitting around with two other colleagues, Nigel Davies from chemistry and Jenny Platt from biology. As we did occasionally on Friday afternoons, we had gone to the Faculty Club for a drink before walking to our nearby homes for the weekend.

Millsap called for another round, a light pilsner for me and the usual for him. The "usual" was his own concoction of equal parts of dry sherry, Cointreau and vermouth whose calories, for reasons I could not follow, were supposed to counteract each other. But then, Millsap isn't a psychologist for nothing.

"How can you talk such nonsense, Millsap?" asked Jenny, sparing me the need to counter Millsap's argument. "The way the human aggressive instincts seem to be operating these days, the human race could well destroy itself."

"And what if it does? If the human race destroys itself, the race would have shown itself to be unfit for survival, like the dinosaurs, and evolution would have to develop a fitter species."

I've always had some difficulties replying to this particular argument of Millsap's, but again I was spared the effort. Nigel Davies, the chemist, entered the fray.

"The human race won't destroy itself, Brouwer. What will likely happen in a nuclear war would be that the rich northern nations would destroy themselves, giving the rest of the human race the freedom and the opportunity to develop into a more humane society. I hate to admit it, but I agree with Millsap on this issue."

Up to the last part of his statement, I had been impressed with Davies's views, but you can never tell which way a chemist will turn. I looked at Jenny expectantly, and Jenny rose to the challenge.

"And I suppose when the rest of the human race has caught up to our level of development, they should be free to destroy themselves just like we did?"

"Exactly," said Millsap, "the process will go on and on until some part of humanity will survive its ultimate crisis without war, or another species will develop that is not as destructive as we are."

This seemed to be an appropriate moment for me to wade in.

"But why shouldn't we be that part of humanity that survives? Why shouldn't we choose this moment in evolutionary history to learn to cooperate with each other internationally so that war would no longer be necessary?"

I was so impressed by my own argument that I thought there could be no reasonable reply.

"Dream on, Brouwer, you must have your head in the clouds to imagine that today's political leaders are going to put the common interests of humanity before their interests to get re-elected. And politicians don't get elected by

promising international cooperation and nuclear disarmament."

"But don't we have other instincts besides aggression? Don't we have our instincts to belong? If we could only find a reason to "belong" to the whole human race, instead of our own little countries, wouldn't our instincts for cooperation win out over our aggressive instincts?"

Well done, Jenny, I thought, but I should have realized that on Friday afternoons reason does not win arguments. Bert countered with an argument worthy of William Golding, the author of *Lord of the Flies*.

"Look at the animal kingdom for a minute. All conflicts in nature are settled by violence, aren't they? That's all we are, animals, only we have better weapons now to destroy each other.

"So we just give up, do we, Millsap? We just do our research here in isolation, mind our own business and let the world go to hell?"

"That's right. Do your pure research, enjoy it and don't worry so much about what happens to it. That's why we elect politicians. They're supposed to make the big decisions in life, not you."

A depressing thought and totally against my way of thinking, but at the moment I couldn't think of much of a rebuttal. Besides, the waiter was bringing us some snacks, which required our full attention.

As I was walking home I agonized over the possibility that maybe there was no resolution to the dilemma of how the human race could live peacefully, with reasonable prosperity for all its citizens. But couldn't we at least try a little harder to find some possible answers? Maybe if our best thinkers were taken out of the universities and set the task of devising an economic system that would distribute the earth's wealth more equitably, and allow the nations to cooperate with each other rather than compete. Maybe if…….

Millsap and the Solar System

It had been a long time since my colleague, Bert Millsap, the rather eccentric psychology professor, had spilt coffee over me at a faculty meeting. Most of my colleagues have forgotten the incident—or at least have stopped referring to it each time they see me. I have to admit, however, that Millsap's study of the stability of coffee balls on the surface of a cup of coffee had a way of remaining fresh in *my* memory.

For quite a number of faculty meetings, I had avoided sitting next to Millsap, and he had behaved himself admirably during the year-and-a-half interval. He did upset the dean by moving that all faculty washrooms be open to both males and females, as is the practice in some European universities, but that had been the extent of his eccentricity for a while.

Lately I had been getting into the habit of sitting next to Millsap again, and I felt comfortable enough to relax and let my mind wander as the faculty's business affairs were discussed.

Now, it had long been a regular habit for Millsap to bring a thermos of coffee to the meetings, and on this fateful afternoon, I saw him come in with two thermoses and several coffee cups. That the coffee cups were not styrofoam reassured me, because it is much harder to create coffee balls in ordinary coffee cups than in styrofoam cups. I assumed that Millsap had simply decided to be amiable and wanted to share his coffee with me.

"Forget it, Brouwer," was his response, however, when I asked him for a cup, "I need both thermoses for myself."

As the dean introduced a motion to amalgamate the Departments of Chemistry and Religious Studies, if my memory serves me correctly, Bert poured some black coffee into a cup and started stirring it, rather noisily. After receiving an elbow from Jenny Platt, one of our favorite biology colleagues, Bert did try to stir without touching the sides of the cup, but, as anyone who has tried it will tell you, you cannot do it consistently. Bert stopped eventually, took out an eye dropper and carefully placed a drop of cream near the outside rim of the coffee cup. He observed it for awhile and made a note on the back of the minutes of the last meeting. He then drank the coffee quickly, filed the cup with coffee and repeated the process.

This went on for quite awhile, and more and more faculty members were turning around to find out why someone who should be paying attention to the important discussions kept stirring coffee, adding milk with an eyedropper, making some notes and then drinking the coffee.

Eventually my curiosity got too much for me, and I whispered: "What on earth are you doing, Bert?"

"I'm investigating the formation of our solar system, Brouwer."

That held me for awhile. Stirring coffee, dropping a few drops of milk, what could that possibly have to do with the origin of our solar system? I knew Bert Millsap well enough to know that he often had eccentric ideas, but I had never yet seen him in a situation in which there was not some germ of a scientific idea behind his schemes. Despite the danger of attracting the dean's attention, I had to follow this up.

"What on earth has this got to do with the solar system, Millsap?" I whispered back.

"Do you remember the seminar we went to last week, Brouwer? The astronomer talked about the origin of our solar system and he stated that all solar systems in the universe had to have planets revolving about the central star in the same direction?"

"I remember."

"He said," and now Bert's voice was getting uncomfortably loud, "that it was impossible for a gas cloud in the universe to condense without some net rotation. I disagree with him and I want to prove him wrong."

I must have looked mystified, but Bert continued to explain, modifying the tempo of his voice as if he were talking to a rather slow learner.

"I decided that if I could stir a cup of coffee randomly so that a drop of cream would not rotate around the cup but would remain stationary or zig and zag, I will have proven him wrong."

Not bad, I thought to myself, the situations are probably pretty good analogies. Could a star system collapse without some net rotation? It would make the formation of a solar system impossible, but why not?

"So what have you found so far?"

"I've stirred 16 cups of coffee as randomly as I could, but I found that the drop did revolve around the centre of the cup in each case, 9 times counterclockwise and 7 times clockwise. Excuse me, I have to go to the bathroom."

Bert left for a moment, and I was sufficiently impressed by the implications of what he had found that I did not even reflect on the fact that Bert had also had to drink 16 cups of coffee. But the little analogy did appear to show that our visiting speaker had been right: it might indeed be almost impossible for a gas cloud, which is put into some form of motion, to collapse completely symmetrically without rotating. And of course, if it rotated a little bit when it was big, it would, like a figure skater, rotate much faster when it condensed and became much smaller. And obviously any planets that formed would revolve around that star in the same direction.

Bert was back, and I was quite pleased that we had gotten through this rather informative episode without drawing too much attention to ourselves. However, Bert was not finished yet. He now opened the second thermos and poured what I quickly deduced was tea into the cup and started stirring. I was watching the tea leaves swirling when a colleague jostled my elbow:

"Pay attention, Brouwer, your motion is coming up."

Of course, my motion. The dean looked impatiently in our direction. Whatever one may say about our dean, one thing is true—he likes to keep the meetings moving and is impatient with anyone who disturbs the regular decorum of the meeting.

"Mr. Dean, colleagues. As you see from the agenda, I move that the Faculty of Science recognize general science as a prerequisite science course for entry into the Faculty of Science equivalent—watch it, Millsap—equivalent,

Mr. Chairman, to physics, chemistry and biology. General science is an academic science course that treats topics in physics, chemistry and biology at a scholarly level and, moreover, integrates these topics with currently relevant societal problems."

Hands went up and a number of my colleagues expressed the view that accepting a general science course as equivalent to the more specialized disciplines would be to water down the academic quality of the program.

"It's not working, Brouwer; the heavy planets should be closer to the sun and the smaller ones father away." Millsap was tugging at my sleeve trying to obtain my attention.

"Leave me alone, Millsap," I hissed, "This is an important motion."

"But it's not working. The more dense tea leaves are revolving on the outside of the teacup and the less dense ones on the inside. The astronomer was wrong."

Bert was trying to demonstrate the visiting speaker's hypothesis that in all solar systems, the more dense materials would be pulled in toward the inner solar system to form small, dense planets and that the less dense materials would drift toward the outer regions of the solar systems and form large, gaseous planets. A very reasonable hypothesis, I would think.

"So what's wrong, Brouwer?" Millsap insisted.

"Dr. Brouwer, we're waiting for your response." Response? What was the question?

"I'm sorry, Mr. Dean, my attention was distracted for a moment. What was the question again?"

"Dr. Brouwer, we are not meeting here for our amusement, nor for yours. If you can't pay attention to the discussion on your own motion, we must assume it's not very important to you."

Jenny Platt pressed her button requesting the right to speak.

"Mr. Dean, you must forgive Dr. Brouwer, he is laboring under a large handicap. Dr. Millsap is endangering our well-being with one of his coffee-cup episodes, and Dr. Brouwer's concern is understandable." God bless Jenny Platt.

"Dr. Brouwer is fully aware that there are many places to sit in this hall, and if he chooses to sit next to Dr. Millsap, he must suffer the consequences willingly. The motion is tabled until the next meeting and Dr. Brouwer had better be prepared to pay attention to the discussion.

My ears were burning on our way home, and the fact that a number of my colleagues smiled sympathetically at me did not help in the least.

"Why did you have to bother me at that point, Millsap? It's important to me that the Faculty of Science recognizes the value of general science, and now I'm behind the eight-ball."

"Well, tell me then if I'm wrong. The large planets should be in the inner solar system and the smaller planets on the outside."

"You've got a one-track mind, Millsap. All right, I'll tell you. What is wrong with your tea leaves analogy is that you have got a rotating system all right, just like the solar system, but you do not have an attractive force at the centre, like the sun. So your teacup analogy is more like a centrifuge—the more dense stuff goes to the outside and the less dense stuff on the inside. For our own solar system, our speaker is correct, the gravitational force pulls the denser materials toward the centre, and the less dense stuff like hydrogen is forced toward the outer regions, almost by buoyancy."

"Why 'behind the eight-ball,' Brouwer? I wonder what the origin of that expression is?"

For the reader who is not yet familiar with Millsap's way of thinking, this change of topic implied that he accepted my argument, without acknowledgment, of course, and promptly lost interest in the issue. As for me, I knew that, sometime during the next week, I would learn from Bert Millsap why I was behind the eight-ball rather than the seven- or the nine-ball.

Millsap and the Flow of Time

Just when you think you have heard it all, Bert Millsap comes up with a new one. As the reader knows, Dr. Bert Millsap is a colleague from the psychology department. Bert is short and tubby, and he tends to wear old sweaters. When Helen, his wife, still lived with him, she managed occasionally to make Bert presentable, but since they separated from bed and board, Bert's sartorial splendor became, to say the least, very muted.

My wife Geri and I had just had Helen and Bert over for a dinner, and Bert had advised us that he had moved to an apartment on the 21st floor of Totleigh Towers, an apartment block near campus.

"I wouldn't want to live so high up," ventured Geri. "Was it worth all the moving expenses and the fuss just to move from the 5th to the 21st floor?"

"I like the view," responded Bert, and changed the topic by asking me whether I thought a vodka drinker like Boris Yeltsin should have been given open heart surgery.

A couple of days later, I was having lunch when Sigmund Pallfy walked up to my table. Not the Sigmund Pallfy who plays hockey, but the Sigmund Pallfy who is chair of the psychology department.

"Say, Brouwer, you're a friend of Bert Millsap's, aren't you? Can you tell me what's up with him these days?"

"Sit down, Sig," was my reply, "but as far as I know, Bert has been fairly normal lately."

"Well, he keeps requesting a new office. He's got a perfectly nice office facing the quad. I'd gladly trade my office with him, but he wants an office on the 15th floor."

"Why the 15th floor? What have you got on the 15th floor that might entice Millsap to move?"

"Absolutely nothing but stuffy storerooms. One of them could be remodeled into an office, I suppose, but I'd need a good reason to go to that expense for Millsap."

I couldn't help Dr.Pallfy, so he went off to do some more administrating, while I went back to my lab to see if I could explain the strange specific heat readings for my superconductor.

That evening, we had some friends over to celebrate my birthday. I usually receive books as gifts and tonight wasn't any different. From Jenny Platt, I received a copy of Shirley Tobias's *They're Not Dumb, They're Different*, which reminded me of someone I knew, and from Evan Hunter, an astronomer and friend, a copy of *Einstein's Dreams*.

"A lovely little book: said Evan. "The author plays around imaginatively with some of the stranger ideas flowing out from relativity theory. In one story, people decide to live in houses on high stilts so that they pass most of their lives in lower gravitational fields. There time travels more slowly, of course."

"You mean these people would choose to live on the highest possible points so that they would live as long as possible? That sounds so stupid: My wife has the strange view that the quality of one's life is more important than the quantity of years one manages to exist.

I glanced at Bert. Bert looked the other way. I willed him to look at my eyes, but Bert's ability to fidget and look everywhere but at me won out. Unless I wanted to confront Bert here in public, I would have to wait till another day.

Bert is subject to obsessions, as his recent escapades with radon concentrations, and with traveling at zero velocity (see Archives) showed, but would he be so daft as to think that moving his apartment and office to the highest

floors of the building would make a difference in how long he lived?

The next morning, as I walked to work, I detoured past the psychology building. I counted the floors and, as I expected, the building had only 15 floors. So how do I convince my good friend, Bert Millsap, not to bother moving, while not making him feel completely stupid? Although, as I remembered, Bert had always managed to overcome the feeling of complete stupidity faster than anyone I'd ever known. Nevertheless, I wanted to do this tactfully.

"Are you folks familiar with Einstein's time transformation formula? Where the time elapsed in a moving frame is related to the time in a stationary frame by a formula involving the square of a body's velocity over the square of the velocity of light?"

They all nodded their heads, so I assumed they understood.

"Well," I said, "one of my students developed a neat little technique of making it possible to calculate the time elapsed in a gravitational field using this formula. What he did was replace the square of the velocity by the kinetic energy of the body and make the corresponding change for the speed of light. This makes the formula look as if it involves the kinetic energy of the body divided by another energy. Then why not replace the kinetic energy by a potential energy, *mgh*, and you can easily calculate how time elapses anywhere above the surface of the earth, compared to how time flows at ground level."

"Would you write that down for me, Brouwer?" Judging from the glazed expression in their eyes, the others did not seem to be impressed but I wrote it out for Bert, and he folded it away carefully in his vest pocket.

A week later I met Sigmund Pallfy, Bert's chair, again and hailed him.

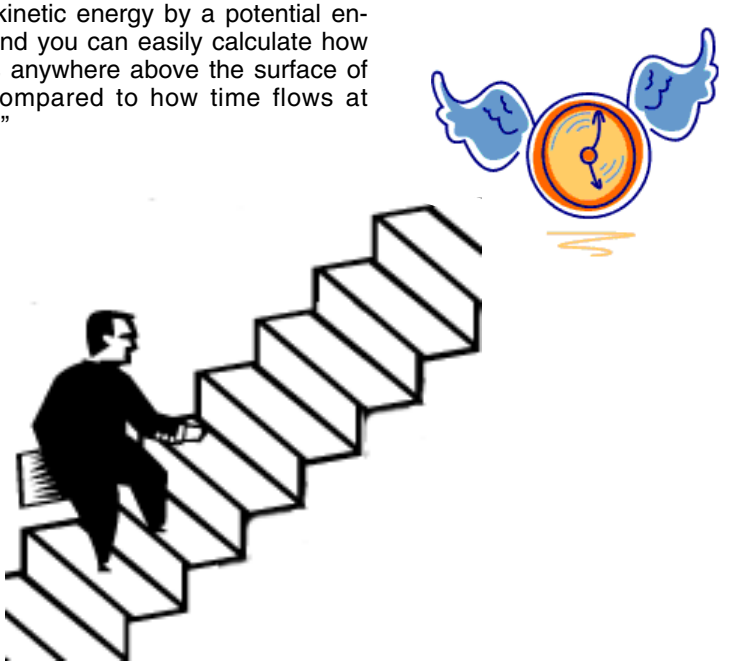
So, Sig, has Bert been bugging you about moving his office lately?"

Sig sat down and ordered a traditional ale.

"It's a bit of a coincidence actually, Brouwer, but I just dropped into his office this afternoon. After bothering me all of last week, he's been quiet. He seems to have been busy doing a lot of strange calculations on the blackboard. I asked him if he still wanted to move, but he's completely lost interest in moving his office. Do you know he's planning to write a paper on black hole physics?"

Well, it looked as if my stratagem had been successful. Using my student's formula, Bert had been able to calculate that if he moved his office to the 15th floor, he would live about one trillionth of a second longer than if he stayed where he was. Unless, of course, the decreased amount of oxygen at the level compensated for the relativistic effect.

But black hole physics in just a week? I wondered what Bert would make of that.



Millsap and the Speed of Light

The sun was shining, the grass on the quad was greening nicely and spring was in the air as we walked to the Faculty Club on an April afternoon. I had just finished marking the final exams in my Modern Physics course and felt that a cooling drink would feel perfect before heading home.

Although it was already 4:30, our table was still occupied and the Club was cheerful and noisy. I ordered my usual beer and lemon, half and half, and waited quietly for my colleagues to arrive.

The first one to arrive was Dave Adams, our physics education specialist. "Hi, Brouwer, why didn't you order a jug?"

"Order your own. I'm on a diet."

Having done so, Dave asked me if I had received the latest *Physics Teacher*, a magazine to which those of us who love teaching physics subscribe. "There's an article in there showing how to measure the speed of light using marshmallows."

"Marshmallows?"

"Yeah, what you do is cover the bottom of a rectangular dish with marshmallows. You plunk it into the microwave long enough for the marshmallows to begin to melt in several places. Then you take out the dish, and measure the distance between the places where the marshmallows are melting, and you have the wavelength of the microwave radiation. Read off the frequency of the radiation from the side of the microwave and multiply it by the wavelength and you have the speed of light."

"Have you guys ever read Erasmus's Educating a Prince?"

Obviously Bert Millsap, our eccentric colleague from psychology, had arrived and ordered his Rosemary Sunset, equal parts brandy, Cointreau and kirsch. "Erasmus challenges the prince's father not to waste his son's early years, but to begin his education even before the boy is weaned. Erasmus had the same ideas on education as I did if you remember our discussion from a few weeks ago. (See the archives: "Millsap and the Scandal in Education.")

"Forget about Erasmus, whoever he is. We're talking about measuring the speed of light." Dave obviously had little sympathy for philosophical discussions this afternoon and didn't yet realize the inevitability of Millsap's trends of thought.

"Measuring the speed of light? I thought you guys were well beyond that nowadays."

Dave patiently explained the idea of measuring the speed of light with marshmallows to Millsap, who normally would appreciate such intriguing approaches to science.

"That's not measuring the speed of light!" Millsap snorted.

"Why not, it seems like a perfectly good method."

"What you're doing is measuring the wavelength," Millsap insisted.

"So, we measure the wavelength and use the known frequency of the radiation to calculate the speed. What's wrong with that?"

"You're inferring the speed of light from your measurement of the wavelength of the radiation."

"You're crazy, Millsap. If you're going to take that attitude, then we never measure anything in physics. We infer everything." I had been rather quiet, as one gets after sitting all afternoon watching students scratch their heads for two hours, but I had to butt in at this point.

"That's not true, Brouwer, Fizeau measured the speed of light directly." I'm sure Millsap hoped to confuse us by referring to an obscure experiment carried out around the year 1851 that was so crucial to the theory of relativity that every physicist knows about it.

"No way, Millsap, I'm sure Fizeau had to infer the speed of light from more basic measurements." We never gave up an argument on a Friday afternoon, especially when we're right.

Millsap did not give up easily either: "Fizeau wanted to measure the speed of light through flowing water and all he had to measure was a distance and a time interval. Ergo, the speed of light."

"What you mean, Millsap, is that Fizeau measured a distance, and a time interval, and divided the distance by the time interval and determined the speed of light. He did not measure the speed of light any more directly than he did with the marshmallows." Despite his disdain for philosophy, Dave is a logical thinker.

"And besides, the speed of light is a defined quantity, 299 something million metres per second. All you're really measuring is the frequency of the radiation, and that you could have read off the side of the microwave."

We accepted this as Millsap's capitulation since a shifting of the argument away from the central focus is a well-known way to avoid admitting defeat, but since Millsap had started the argument, we were not quite willing to abandon it.

"You know," I mused. "Millsap does raise an interesting question. Do we ever measure anything directly, without the intervention of theory? Even if we measure a time interval, say one hour, aren't we making many assumptions which we usually don't bother to think about?"

"Such as what, Brouwer? Don't we just look at our watch and let an hour pass?"

"Yes, but this watch of mine depends on the precise oscillations of a tiny crystal, and I have to assume that nothing I do changes the period of these oscillations."

"That's pretty farfetched, Brouwer, we couldn't do anything if we couldn't depend on the basic regularities of life." Dave Adams had joined the opposition, but I knew I was on to a good line. I remembered an interesting example of Michael Polanyi's that illustrates that even just looking at things means looking through the eyes of theory or experience.

"Can you guys tell me which is blacker—Millsap's black leather blazer in the midsummer sunlight or the freshly fallen snow on a cold winter night?"

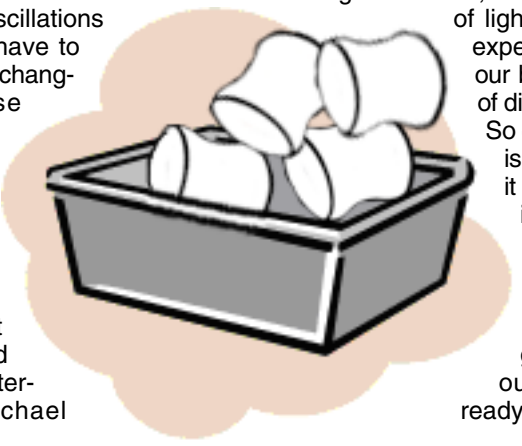
"What are you talking about, Brouwer, even for a Friday afternoon, that's a pretty inane question."

"You don't have to get abusive, Millsap. Let me explain. You know an object is black if it absorbs light and white if it reflects light. Now Millsap's jacket reflects a lot more light toward our eyes than the snow in a winter night. Yet our brain interprets the observations and fools us into thinking that the snow is whiter than the black jacket. So even our seeing is inferring in some sense."

Millsap perked up. "For once, you're on to something, Brouwer. I remember reading about the painter who lost his color vision as a result of an automobile accident. The painter didn't just see things in black, white and greys, but noticed tremendous changes in the shadings of objects that to us remain the same color all day. A banana could look almost white in bright light, but almost black when it was cloudy. Tests show that the painter accurately detected changes in the wavelengths of light emitted by the banana, even though our brains interpreted the color of the banana to be yellow all the time."

"You mean the colors we see aren't just simply related to the frequencies of light?"

"Right, Brouwer, it's as if our brain reinterprets the light received, and even if the frequency of light changes dramatically, experience has programmed our brain to 'keep' the colors of different objects constant. So even simple observation is not seeing the world as it is but is seeing the world interpreted by our experiences."



"Haven't we strayed a long way from marshmallows?" Dave was getting impatient with our discussion and was ready for a game of snooker.

Millsap in Contempt of Court

I was just rubbing the sleep out of my eyes and having my first coffee of the morning when Geri, my wife, gave a cry.

"Will, have a look at this headline: Bert Millsap's been arrested!"

Geri showed me the headline: "Professor Jailed for Contempt of Court." I ungraciously grabbed the paper to read how an irate judge had decided to jail the chairperson of the jury in the breaking of confidentiality trial of a Mr. Gordon McClintock, a research scientist from ChemCell Enterprises.

The article did not describe the offending incident very clearly, but I gathered that the jury had ignored a specific direction by the presiding judge and had declared the research scientist innocent of any crime. When the judge questioned the jury's reasoning and the right of the jury to dissent from the judge, the chairperson of the jury, our good friend Millsap, had apparently lectured the judge on the "independence of the jury." The judge promptly jailed Millsap until such time as he was ready to apologize to the judge and to the whole legal system.

I had classes to teach, but I put aside some time in the early afternoon to visit my colleague, partly to commiserate with him, but mostly out of plain curiosity. I had been aware that Bert had been selected for jury duty in this interesting confidentiality case, but I had assumed that, as one of 12 good men and women of the jury, Bert could not possibly get into any mischief.

The local medium-security institution is an interesting place. I had never before had an opportunity to visit anyone incarcerated and, like most people entering such a place, hoped that the officials would let me out into the open air again after my visit was concluded.

When I was finally allowed to see Bert, we found ourselves in a rather comfortable room with a couple of easy chairs and a window looking out over the city. Apparently they were not treating those in contempt of court too harshly these days. Maybe the prison officials had some sympathy for those like Bert who occasionally questioned the legal system.

"Well, Bert, how's the old convict doing today?"

"Spare me your humor, Brouwer. Did you bring me any cigars?"

"For the sake of your health, Bert, I did not bring you cigars. I brought you the latest *American Psychologist*. There's an interesting article—"

"I don't need your *American Psychologist*, Brouwer. The jail subscribes to it. In fact, the library here is more up to date than the university library. I've got half a mind not to appeal the conviction and stay here. Here, at least, I don't have to teach. I can read all day if I want to."

"Don't you have to work to earn your keep? Clean the halls or the bathrooms or something?"

"Brouwer, you're still in the Middle Ages. There are not chain gangs anymore. Today, we prisoners have rights and can't be forced to do anything we don't want to. All I need to make my life here perfect is the occasional good cigar. So when you come again, Brouwer…"

I got the impression that Bert had settled into prison life rather quickly and treated it like a stay at a quiet inn, with an indoor pool and all the amenities. I had expected him to be upset by the conviction and ready to fight it to the Supreme Court, if not the International Court of Justice at The Hague.

"But what happened in court, Bert, to make the judge so mad that he sentenced you to jail?"

"It's a long story, Brouwer. Do you really want to hear it now?"

"Well, of course, Bert, why do you think I am here?" And Helen, your wife, in case you've forgotten, is dying to know what exactly you did

to end up here—and she wants to know what she can do to help."

"Tell her to bring me some cigars."

"Millsap, sometimes I despair of you. Why don't you tell me what happened and we'll try to help make your stay here as short as possible. I may even bring you some cigars."

"Cuban?"

"Bert, forget the cigars now and tell me how you ended up here. My visiting time is probably up by now."

I glanced through the glass panel in the door, but the guards seemed to have other things to do and were not in any hurry to end my visit.

"Well, you know Gordon McClintock as well as I do, and you know he takes his job as emission control officer very seriously. Apparently an extremely serious emission of furans occurred at the chemical plant because the oven temperatures were too low to decompose the PCBs completely. Gordon wanted to notify the leaders of the aboriginal people in the region not to hunt or fish within 25 km of the plant for a month, but the administration of ChemCell refused to allow him to make the spill public. So Gordon notified the Native leaders himself, and the company had him arrested."

"Surely any court would judge that Gordon's responsibility to the public outweighs his responsibility to the company?"

"Not here. Like all scientists working for ChemCell, Gordon had signed a confidentiality document, in which he promised not to release any information the company administration did not want him to release. And since he broke the terms of that confidentiality document, ChemCell had him arrested."

"But surely the defence lawyers argued that the health of the Natives was more important than a bit of adverse publicity for the company?"

"Well, the judge said that he sympathized with Mr. McClintock's motives and that he thought there should be a law here protecting the right of scientists to notify the public in cases like this, but he said that in the current situation, the defendant had clearly broken the law and that the jury had no choice but to find him guilty. And he told us to retire and to come back with a guilty verdict."

"Hmm, I can see your dilemma. If I had been in your shoes, I might have ended up here, too."

"It's not so bad here. We actually have three choices for breakfast and tonight we're having Swedish meatballs. You know, if we advertised, I'm sure we could make the prison system quite economical. I'm sure many people would love to spend a couple of days in a jail."

"Let's forget the prison system. Tell me how you managed to convince the other jury members to defy the judge."

"It wasn't easy. The foreperson of the jury simply read out the verdict of guilty to us and asked if we had any comments before we went back in. I said I had and that we should find McClintock not guilty. The foreperson patiently explained that we couldn't do that—hadn't I listened to the judge? I said that I had, but that I would on no condition find McClintock guilty.

"There were some other people on the jury who agreed with me in principle, they said, but they felt that we should listen to the judge. I then quoted a ruling by a British judge, in 1688, that a jury always had the God-given right to dissent from the judge, that trial by a jury of one's peers was in fact created to provide an independent arm of the judicial system."

"I' didn't know you were so well versed in your legal history, Bert. You must have done a lot of research to discover such an old ruling."

Bert actually blushed a little. "Well versed in your legal history, Bert. You must have done a lot or research to discover such an old ruling."

Bert actually blushed a little. "Well, there might not have been an actual ruling like that in 1688, but there should have been. Anyway, it was getting near five o'clock and I wanted to get home to do a little more reading overnight. So we went back into the courtroom and told the judge that we needed more time to reach a verdict. He seemed a bit mad and said that we shouldn't need any time to reach a verdict. Did we want to hear his conclusions again? Every member of the jury looked at me, but I shook my head. I told the judge that we appreciated his summary statements and that we would certainly consider them seriously in reaching our verdict. He told us to be back in court at nine o'clock the next day."

"So how did you spend your last evening of freedom?"

"I went to the Faculty Club and the bartender told me that he had read of a law in his native Slovenia that people guilty of releasing confidential information would be punished by having their tongues cut out. But since they don't have a jury system in Slovenia, I ignored him."

"But didn't' you find out anything about the rights of the jury?"

"Well, I did look the jury system up in my 1964 edition of *Encyclopaedia Britannica*, but aside from a few general comments on trial by one's peers, it didn't help much. So I decided I would stick with my reference to the trial of Aubrey Jergenson and the Stand Leather & Tanning Company of 1688. I doubt if judges actually study history very much anyway."

"Bert, Bert, why didn't you call a lawyer?"

"They all stick together, Brouwer. It wouldn't have gotten me anywhere."

"So, what happened the next morning?"

"We met for the full day, and by evening I had everyone convinced but the foreperson. He was willing to go along with us but didn't want to be the foreperson anymore. So we had to go into court and ask the judge to appoint another foreperson. He didn't want to, but our foreperson said that he didn't feel that he could do the job and that I should be foreperson. The judge glared at me and told us that, in his opinion, we had another 15 minutes to meet to come up with a guilty verdict or to face contempt of court. Well, when we got back to the jury room, the other members of the jury weren't so sure that they wanted to find McClintock not guilty anymore, but I kept on arguing and promised that I would take full responsibility for the verdict. So that the rest of the jury would not be found in contempt of court, I had to ensure that the judge would get mad only at me."

I tried to picture the jury stalking into the courtroom the next morning, most of them probably looking anywhere but at the judge, but Millsap walking in, chest, or rather stomach, proudly preceding him…

"How do you find the defendant?"

"Not guilty, Your Honor."

"Not guilty? You have no right to go against my instructions. According to the law, you have no option but to find the defendant guilty."

"We found him not guilty, Your Honor."

The judge took a deep breath. He then spoke very quietly, "Mr. Foreperson, I require from you a reasonable explanation of your behavior. If I do not receive that, I will find you guilty of contempt of court and sentence you to jail until you are ready to give me an explanation."

"Your Honor, as an independent agent of the judicial system, a jury is required to reach a judgment in situations such as this and owes no one an explanation of its actions."

"Mr., er, Millsap, I find you in contempt of court and sentence you to prison until you are ready

to apologize to the court and to explain the jury's actions. The jury is hereby dismissed"…

"So you were successful, Bert, in deflecting the judge's wrath from the jury to yourself. Are you going to apologize to the judge sometime?"

"Never. I'm quite happy here, and the pressure is going to be much greater on the judge than on me. I've got nothing to worry about."

Surprising as it may seem, Millsap was right for once. An appeal of Bert's contempt of court conviction was upheld by an appeal panel just three days after Bert's incarceration. Although the chairperson of the panel suggested that Dr. Millsap might have tried to give an explanation of the jury's reasoning to the judge, his argument of the independence of the jury was essentially correct, although often overlooked in North American courts. Moreover, the judge reasoned, it had, since the Bushell case in 1670, no longer been the practice of imprisoning members of the jury for making decisions contrary to the judge's wishes. In fact, the appeal panel chair underscored the need to better educate juries as to their duties and very real responsibilities, as an independent arm of the judicial system.

That afternoon, at the Faculty Club, Millsap was the man of the hour. He was toasted widely by many friends and well-wishers. Bert restricted himself to only one Rosemary Sunset, however. He said that he felt like a man whose sabbatical leave had been terminated after just three days. After all, unlimited access to a library, with no teaching responsibilities *and* a cell considerably more comfortable than a professional office, isn't that what every academic dreams of?

Millsap and the Missing Planet

It was Friday afternoon again and I was relaxing at the Faculty Club after an extremely busy week. I was sitting in a corner, very near the fireplace, oblivious to the noise my colleagues were making as they discussed the affairs of the week or played billiards or darts.

One of my students had asked me whether Newton's third law—To every action there is an equal and opposite reaction—was still valid in modern physics, where gravitational and electromagnetic waves travel with the speed of light, so that cause and effect are not always simultaneous. As with all such philosophical questions, I promised the student that I would think about that question over the weekend.

Just as I had decided that I would have to talk a bit about the concept of fields in physics, I noticed Bert Millsap storming into the room waving a sheaf of papers above his head. At the risk of boring regular readers, let me say that Bert Millsap is a colleague of mine from the psychology department who is always more interested in the abstruse questions of the physical sciences than in his own field. Bert is about 1.7-m (5'6") tall, and his weight would be appropriate for an offensive lineman with the Green Bay Packers.

"Get me a drink, Brouwer, I have to talk to you."

I raised my hand, got the attention of our bartender and pointed at Millsap. The bartender shook his head in dismay and headed for the liquor cabinet to prepare Millsap's favorite drink, a Rosemary Sunset. Since I have given the recipe for this revolting drink in previous episodes, I refuse to repeat it here.

The drink having been brought and the bill signed—by me, of course—Millsap proceeded to relate his latest bit of arcane research.

"Did you know that there is a missing planet, Brouwer?"

"What do you mean by 'missing,' Millsap? Has Mars disappeared or has Jupiter eloped with Venus?"

Millsap sat back.

"Listen, Brouwer, if you're going to be sarcastic, I can find lots of other people to talk to."

Personally, I doubted that there would be many people in the Faculty Club just then who would have the patience to both talk to Millsap and pay for his drinks.

"Sorry, Bert, I'm a bit tired. Tell me, please—which planet has gone missing?"

"You're an ignoramus, Brouwer. No planet has gone missing. This planet has been missing from the very beginning."

"Ah, I understand. You're talking about Vulcan, the little planet that was supposed to be between Mercury and the Sun to explain why Mercury wasn't moving in the right orbit."

"There was supposed to be a planet between Mercury and the Sun?" Surprisingly, Millsap hadn't heard about Vulcan before, perhaps confusing it with the fictional planet home of Mr. Spock.

"Yes, Bert, Einstein actually explained very accurately why Mercury's orbit was different from what you'd expect from Newtonian gravity."

"Well, that's not the planet I'm talking about. This planet is the one that should be between Mars and Jupiter."

"All right, Millsap, tell me why you think there should be a planet between Mars and Jupiter, but before you do that, it's your round."

Grudgingly, Millsap ordered me another shandy (half lemon-lime, half draft) which was my usual drink. Like Millsap, I also have to suffer the constant abuse of my colleagues on account of my choice of drinks, but I have a weak head.

"Brouwer, maybe you learned this as a student and promptly forgot it, but, about 200 years ago, a fellow by the name of Bode discovered a neat little relationship that predicts the orbits of the planets, but only if there is an extra one between Mars and Jupiter."

At times like this, I always find myself in a quandary. It's much more entertaining to give Millsap his head and not to interrupt him or correct him, for which there is often a need. In fact, Bode has long been given credit for inventing a relationship that was actually discovered earlier by J. D. Titius. However, I refrained from commenting.

"Look at this neat little formula, Brouwer. With only one adjustable number, you can calculate the radius of any planet's orbit." Bert showed me the formula:

$R = (3 \times 2^n + 4)/10$

$n = -\infty, 0, 1, 2, 3, \ldots$

"Neat little formula, Bert, but what does it tell you?"

"Well, Brouwer, you've got to take the distance of the Earth from the Sun as 1 astronomical unit (AU) and then for the $n = -\infty$, you get the orbit of Mercury as 0.4 AU, $n = 0$ for Venus gives you 0.7 AU, $n = 1$ gives you the Earth's orbital radius as 1 AU and so on. Here's the whole table for the planets with the actual radii beside them." (Here I should mention that physicists never say *radiuses*. It may sound better, it may even be more understandable, but our self-respect demands that we try to remember our classical roots.) Millsap spread the table of values in front of me.

Planet	***n***	**R(predicted)**	**R(measured)**
Mercury	$-\infty$	0.4	0.39
Venus	0	0.7	0.72
Earth	1	1.0	1.00
Mars	2	1.6	1.52
?	3	2.8	?
Jupiter	4	5.2	5.2
Saturn	5	10.0	9.54
Uranus	6	19.6	19.2
Neptune	7	38.8	30.1
Pluto	8	77.2	39.4

"Don't you see, Brouwer, that most of the actual distances of the planets from the Sun fall very close to the predicted values?"

"It looks impressive, Bert, except for the fact that you fudged a bit by making Jupiter $n = 4$, rather than $n = 3$. And as for the outer planets . . ."

Millsap was bouncing up and down in his chair.

"Stop talking so much, Brouwer. If you take that gap seriously and search through the space between Mars and Jupiter, you will discover a large asteroid belt, with tens of thousands of asteroids, at an average distance of get this, 2.77 AU. Impressive, isn't it?"

"It is impressive, Bert, but couldn't it just be a coincidence? After all, the outer planets don't seem to follow the law very well."

"I don't think so, Brouwer. You know that the orbits of Neptune and Pluto overlap so that Pluto is sometimes closer to the Sun than Neptune is. Something must have happened early in the history of the solar system to disturb the equilibrium at the outer edge and cause Pluto and Nepture to disturb each other's orbit."

"So you think that the Titius-Bode law hints at a deeper structure for our solar system than we can explain right now, do you?"

"Titius Bode, Brouwer—who's Titius Bode?"

Oops, I'd had a slip of the tongue and now had to confess to Millsap that every physicist was familiar with this interesting coincidence of numbers and that most physicists do think there are many interesting things we still have to discover about our solar system. I also urged Millsap to read a fascinating story about the "missing" planet in the essay "The Fifth Planet" by Loren Eiseley (1978).

"Don't look so despondent, Bert. It's fascinating to discover something mysterious about our solar system. Who cares if others have also enjoyed this mystery? What you might want to try is to see if the major moons of Jupiter, or Saturn, also obey a law similar to the Titius-Bode law. If it's true for the satellites of these planets, too, we can be pretty sure there's more to the structure of the solar system than we now know."

"I'm going to do that, Brouwer, and I predict that a similar structure holds for the moons of Jupiter and the moons of Saturn."

"OK, Bert, I'll hold you to that. Here, let me buy the next one. You deserve this one."

Reference

Eiseley, L. "The Fifth Planet." In *The Star Thrower.* New York: Times Books, 1978.

Millsap and the Missing Moons of Saturn

As the attentive reader knows, Millsap has been fascinated by our solar system for a few years. He first got excited when he learned that the movement of the planets around the solar system can be modeled by the motion of tea leaves in a cup of tea. More recently, he has been intrigued by how you can calculate the orbits of the planets with a simple formula and at the same time be pointed to the location of a "missing" planet, where astronomers found more than 100,000 asteroids, perhaps indicative of a planet that couldn't quite make it. (See the Millsap archives.)

But Millsap never sticks to a program of research for long—at least, not since one of his sleep deprivation subjects bopped him in the eye. Somehow, it seemed safer for him to hop from topic to topic before things got too serious. Besides, Bert had recently gone on a winter cruise in the Caribbean with Helen, his wife. Normally, Helen lives apart from Bert, but they have remained good friends and see each other for dinner at least once a week. Just like most of us, Helen has found that she can best take Bert in small doses.

I next saw Bert at the president's dinner, an annual event at an expensive downtown hotel for those friends of the president of the university who had donated at least $1,000 to the university in the past year. I was surprised to see Bert there because he had been very critical of the president when the university had cut our salaries by 5 percent three years ago, but I suppose that we all forgive and forget from time to time.

Because this was a black-tie affair, most of us academics looked much more respectable than usual. One's sense of smell gave probably the only clue that most of these formal clothes had not been worn regularly, but the visual effect was stunning. Even Bert looked respectable. The discrepancy between his height and weight had the effect of making his pant legs drag along the floor somewhat, but above the waist, Bert's jacket, vest and tie were immaculate.

Bert headed for me the moment he saw me. Colleagues who know me best have let me know that I don't possess that kind of personality that draws one and all to me, but something about me certainly drew Millsap like a magnet. There may be truth in Jenny Pratt's assertion that I am the only one who encourages Millsap. Jenny is one of our colleagues from the zoology department, and she points to the episode of the coffee balls at the faculty meeting (see archives) to illustrate her point.

Bert led Geri, my wife, and me, drinks in hand, to a small table far from the head table.

"This way we can talk," was Bert's reasoning. "Helen will be along in a minute. She's over there talking to the deputy minister. He's the afterdinner speaker."

"Tell us a bit about your cruise, Bert." Geri usually tries to channel the conversation in more social directions than Bert and I are used to.

"Well, the cruise wasn't bad, but Canada Customs, as usual, ruined the trip. I wasn't allowed to bring in my bottles of mescal from Mexico."

"How many bottles did you carry with you?"

"I had only 20 bottles, but I assured the customs officers that I wasn't going to drink the alcohol. I wanted to dissect the worms that are put in the mescal, to see the effects of alcohol on the bacteria normally carried by these worms, but there was no way those ignoramuses would accept that."

Knowing Millsap as I do, I was probably the only person alive who actually believed him. I've known Bert to have the strangest notions

and I've known him to be wrong—quite often—but, as the archives will attest, I've never know Bert Millsap to tell a lie. He doesn't even have the social graces to tell the little white lies that make society livable. If Millsap doesn't like your hat, he'll say so, and that's that.

So we murmured a bit in sympathy and warmly greeted Helen as she joined us.

"What a wonderful tan, Helen."

"Thanks, Geri. It's good to be back, but I had a great time in the sunshine and the warm weather. We did a wonderful day trip to a native village in Aruba, and I just loved the market in Puerto Vallarta. You'll have to come over to see some of the clothes I bought."

"How did Bert enjoy the trip?" For the answer to that question, one would normally ask the person himself, but Geri knew that she would get a much more accurate and reliable answer from Helen.

"Oh, Bert. I tried to drag him along on our day-trips and the activities on the ship, but he spent all his time in the ship's library on the Internet."

Geri was too polite to ask what Bert might have been doing searching the Internet when he could and should have been enjoying the cruise, but I had no such inhibitions. Besides, I knew it wouldn't be something trivial but had some potential for enlivening the evening. After all, we had by now finished the coffee and the deputy minister showed signs of getting ready to speak.

"I'll show you," Millsap answered my question and started writing on the tablecloth.

"Bert, stop that! You can't scribble on these linen tablecloths—they'll throw you out of the hotel."

Good try, Helen, I thought, but I knew that nothing could stop Millsap from explaining his latest all-consuming passion in his own inimitable way.

"Look at these figures, Brouwer." I leaned over Bert's plate as he scribbled the last of a table of numbers onto the tablecloth.

Moon	n	Predicted	Actual
Mimas	2	184,000	185,000
Enceladus	3	240,000	238,000
Tethys	4	309,000	295,000
Dione	5	393,000	377,000
Rhea	6	497,000	527,000
	7	624,000	—
	8	780,000	—
	9	971,000	—
Titan	10	1,206,000	1,221,000
Hyperion	11	1,494,000	1,479,000

"Notice how well the predicted figures fit the actual ones?"

"How did you predict the distances of the moons from Saturn?"

"I used a formula I found in, let me see, Tomley—1979, I think, as follows:

$$R = (164{,}100 \times 1.233^{n}) - 63{,}200;\ n = 2, 3, \ldots$$

"Well, I have to admit, it looks pretty good. What about the gaps though? Three empty orbits is a bit too much, isn't it?"

"No, no, Brouwer, notice where the gaps occur: just before the biggest moon in the system, just as it does for Jupiter and the asteroid belt in our solar system."

"Excuse me, sir. There appears to be too much noise in this neighborhood. Could you please pay attention to the speaker? And I can bring you some paper if you want to continue to write."

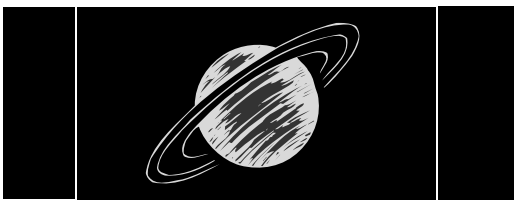
Geri and Helen look embarrassed and I whispered to Bert that we should continue our discussion later. After all, the deputy minister was still speaking on education policy. I however thought about Bert's effort for the rest of the evening. Of course, many scientists have played around with these numbers in the last couple of hundred years but have not gotten to a full explanation of why this type of order exists in our solar system, or perhaps in any system of planets around any star.

I was thinking that the topic would make a great high school science project. Let students investigate these regularities and check the Internet to find out if the Pioneer, Voyager or Galileo probes have discovered any small asteroids in these empty orbits near Saturn also.

At the end of the evening, a waiter approached me and suggested that for $50 I could take the tablecloth home. When I replied that I didn't want it, he said that, in that case, it would still cost me $50. I looked around for Millsap, but he was, of course, nowhere in sight.

Reference

Tomley, L. J. "Bode's Law and the 'Missing Moons' of Saturn." *American Journal of Physics* 47, no. 5 (1979): 396–98.



Millsap and the Existence of Pi

"Have you ever noticed any signs of insanity in Brouwer, Jenny?"

Bert Millsap, my short and tubby colleague from psychology, was relaxing in the Faculty Club lounge, late on a Wednesday afternoon in early January. Despite the fact that it was 4:30, the sun had already been down for an hour, and the landscape around the club looked very frosty. For once, Jenny Platt, a colleague from the zoology department, had joined Bert in the corner near the fireplace. Normally Jenny would have avoided Millsap, because she does not approve of his many misadventures. She was especially critical of his coffee cup experiments at faculty meetings, as described in an earlier episode. She doesn't approve of me, either, feeling that I encourage Millsap in his frivolities. Nevertheless, Jenny is a caring person and has won a prize as best lecturer after her appreciative undergraduates nominated her for the honor.

"Apart from his association with you, Bert, I've always found Brouwer to be a very rational person."

"I suppose so," replied Millsap, "but I've been reading about the famous Dutch mathematician L. E. J. Brouwer, and he certainly was crazy."

"Well, Bert, do you even know if this mathematician is a relative of Will's?"

"Oh, I imagine he must be. How many Brouwers can there be in the world?"

"In any case, how was this mathematician crazy?"

"Well, for one thing, he didn't believe in pi. And he also thought that women in the workplace were ruining society."

"What do you mean, he didn't believe in pi? How can anyone not believe in pi? I don't even know what it means not to believe in pi? Pi is just a number. One doesn't believe or disbelieve in numbers, does one?" Jenny obviously wanted some enlightenment and hoped that, for once, Millsap could supply it. As always, of course, Millsap was happy to oblige.

"Apparently, from my reading, this guy didn't believe in negative numbers either. He said that math should be based on natural numbers, only."

"But here's Brouwer himself. Let's ask him."

I brushed the last of the snow off my coat as I ambled into the lounge and found Bert and Jenny in the most comfortable places.

[The perceptive reader, if he or she has been paying attention, may be asking him- or herself how the author, if he just entered, has been able to accurately re-create the conversation between Jenny Platt and Bert Millsap. My only response is simply that we authors have such great insight into human nature that we are able to do this instinctively. And besides, it's none of the reader's business.]

"Ah, Jenny and Bert, what are you drinking?"

"Just a soft drink, Will," was one response.

"A Carolina Sunset, Brouwer," was the other.

" What's wrong with your usual drink, Millsap?"

"My doctor told me to cut down a bit on the alcohol, Brouwer, so I've reduced the amount of grenadine in proportion to the malt whiskey, as well as the Drambuie. The bartender knows what I drink."

After the drinks were delivered and we had our first sip, Jenny asked me whether L. E. J. Brouwer was a relative of mine.

"L. E. J. Brouwer, now how did you guys stumble on him? Actually, I've been researching our family tree for some time, and I think I did discover a connection. My great-grandfather's family lived in a small village in the rural north of the Netherlands. They were very poor and very religious, and were all buried in the village

graveyard, except for one brother. This fellow was considered the black sheep of the family because he left the village to find his fortune in Amsterdam. Naturally, no one in the family ever mentioned his name again, and only lately have I been able to figure out that this black sheep had a grandson, whose name was Luitzen Egbert Johannes Brouwer. It's rather nice to have a famous mathematician in the family."

"Famous? Try crazy," was Millsap's reply. "The fellow had the weirdest ideas about mathematics. He didn't even believe pi existed."

"Moreover, he was a misogynist, and paranoid to boot." Jenny added. "I wouldn't be so proud to have him in my family."

"Well, I don't know any great mathematicians who weren't a bit weird at times. For someone who shut himself up in a little hut in the fields and published more than 200 papers in his lifetime, he wasn't all that bad. Besides, parents who saddle their children with weird names have a lot to answer for."

"But he didn't even believe the things every high school student knows today, Brouwer. How can any reasonable person say he doesn't believe in irrational numbers like pi?"

"Brouwer had the idea that human beings had intuitions about natural numbers, based on experience with reality. We see apples growing on trees and we see people in the Faculty Club relaxing after a long day. So we develop an idea of numbers—1, 2, 3 and so on. All Brouwer wanted is to have mathematics based on these real numbers that we meet in nature. From these natural numbers, we can make 1/2, 1/3 and so on, all the fractions you want. But you can't make pi."

"But everybody knows that the ratio of the circumference of a circle to its diameter is pi."

"And what is pi then?" was my response to Jenny's assertion.

"Pi is 3.14 to the best of my knowledge," interjected Millsap, "but of course pi itself has an infinite number of decimals."

"Well, I can do even better. Try pi = 3.14159265358979323. But this is still a real number. Pi itself doesn't exist, at least according to my distant relative."

Of course, I couldn't convince Bert that simply.

"Look, Brouwer, pi is the ratio of the circumference of a circle to its diameter, and it's an irrational number with an infinite number of decimal places!" People were beginning to stare as Bert's voice rose in volume. I heard some colleagues at a nearby table wondering why we should argue about pie. After all, some people like banana cream, others like apple. It's a simple matter of taste, after all.

However, I had another try at defending my illustrious relative.

"Listen carefully, Bert. For any real circle that you've seen in your experience, the ratio of the circumference to its diameter is an actual number without an infinite number of decimal places. If you claim there actually exist ideal circles, in Plato's ideal world, for which the ratio of the circumference to its diameter is pi, you're welcome to do so, but it's not the only possible choice you could make."

You might think such arguments about the actual existence of numbers like pi don't make much sense, but I remembered at this stage a curious situation in a seminar many years ago, when a visiting professor showed us that the sum of a series of calculations led to infinity. At this point, a new colleague who had fled from what was then the Soviet Union jumped up excitedly and shouted, "No, no, no! You are not permitted to say that. Infinity does not exist. It is a fiction."

As I related this little episode, Millsap's eyes, of course, lit up. He was intrigued to note that the Marxist philosophy of mathematics was very close to that of my distant relative. He seemed to enjoy this further blemish on my family tree: "I've always claimed you were a Communist, Brouwer. Now we see it is in your genes."

"Actually, Bert, I'm probably more of an idealist in mathematics than my namesake. To me, *pi* and *e* and *infinity* are reasonable, logical concepts in mathematics and have been very fruitful in the development of modern mathematics. But to give Brouwer credit, if you imagine the mathematics done by a computer, you realize very quickly that a computer deals only with rational numbers, and that all the computer's logic and other operations are based directly on operations with the natural numbers. But who wants to argue about mathematics anyway? How's your low-fat diet going, Bert?"

"Low-fat diet—Millsap's on a low-fat diet? Don't make me laugh! Bert wouldn't recognize a low-fat dish if you brought it to him on a plate with large-print labels on it."

Jenny voiced what we all suspected. Millsap even has his own interpretation of doctor's orders and was not about to be drawn into a discussion of his health.

Millsap and the Chemists' Dilemma

Millsap considering early retirement? We were shocked into silence trying to imagine the university, and especially the Faculty Club, without Bert Millsap's presence to liven up what is otherwise a rather staid institution.

"You're seriously considering early retirement, Bert?" We had to get to the bottom of this and possibly stop Millsap from making a rash decision. Millsap had been a psychology professor for more than 20 years, but his greatest value to his colleagues during the years had been his wide-ranging interests in fields other than his own. Although Bert had been told to mind his own business (researchwise) more than anyone in the history of the university, those of us who counted ourselves his close friends and keepers would miss his lively discussions and adventures more than we could ever publicly admit.

"Well, Brouwer, I sometimes get the feeling that I'm reaching the end of my creativity. At my last annual review, the dean of science suggested that I become more computer literate and do more statistically significant research and use more technology in my teaching. That sort of talk makes me think I belong to a bygone generation."

"Oh, Bert, you've got to fight such impulses. Just because the university administration seems to prefer number crunching to creative thinking doesn't mean you and I have to follow along. After all, we've got tenure, and that makes it pretty hard for the dean to get rid of us while our teaching remains good and we still publish our research."

Bert started to relax a bit as we were sipping our late afternoon drinks at the Faculty Club. As usual, Bert had a Rosemary Sunset (recipe available on demand, with waiver of responsibility required) and I, because of general weak-headedness, was drinking a mild shandy.

We were joined by Dr. Frank McKnight, a colleague from the chemistry department. Despite the fact that the chemists were guilty of occasionally grabbing our favorite table near the fireplace, we were on friendly terms with most of them. After all, what is a chemist but a frustrated physicist?

We had heard that Frank had won a national prize for research on the synthesis of hydroxyacyl tRNAs, and we congratulated him on the award.

"Aside from the award, though, how can you spend your life concentrating on such a small area of reality? It seems to me that a scholar should be interested in laws and principles, not in tiny details in which nobody else is interested." Millsap had put aside his concern for early retirement for the time being, since a discussion (read *argument*) with a chemist could liven up the afternoon.

Frank replied, "Look, Bert, you just while away your time reflecting about the universe. When I go home at night, I know I've done something useful, something that helps us understand the chemistry of life and that might have some nice applications."

Millsap mulled this over. I could almost sense the internal struggle in his mind. On another day, he would have agreed that a good university is best served by people who are not all interested in the same types of research—but on a Friday afternoon?

"I've often wondered about the difference between chemists and physicists," Millsap observed. "Physicists seem to be interested in laws and theories—the reasons why things happen, while chemists are interested only in making new chemical compounds, detail work for smaller minds."

"Get out of here, Millsap. Remember Linus Pauling, Watson and Crick, J. J Thomson, Millikan, Rutherford and so on. These were all great chemists, and they had great minds."

"Great chemists!? What on earth do you mean? At least three of the people you mentioned were physicists, and the others could be called biologists or at least biochemists. I'm not sure you could name a great 'pure' chemist."

Frank shrugged his shoulders and did not immediately respond to Millsap's challenge, and I just sat back and watched things develop. Despite Millsap's exaggeration, it is admittedly difficult to define chemistry as a distinct science. We think we can define physics and we think we can define what makes biology distinct, but what is it that makes chemistry distinct from physics?

At this point, we were joined by Sander Foster, a pure mathematician, whose presence would probably skew the discussion further against the outnumbered chemist, so, after hinting that the newcomer order the next round, I decided to take Frank's side of the debate.

"You know, I've often wondered about the difference between chemists and physicists. I've come to the conclusion that there are probably no fundamental differences between chemists and physicists, but some physicists do seem to be a bit more global in their interests in that they want to know what makes the universe tick. Chemists seem to restrict their questions of why things happen to the atomic and molecular level and tend to be more Edisonian in their research."

"Edisonian, what on earth [this being a public document] are you talking about, Brouwer?" This was Millsap, of course, who is never very impressed by my arguments, but the others seemed to be prepared to listen.

"I think physicists and chemists are both very interested in the nature of things, in developing theories and laws. But I think more chemists than physicists are interested in developing actual new materials. More chemists tend to be inventors than physicists."

Sander Foster, having revived himself with a scotch and soda, joined the debate, "Despite your grammar, Brouwer, you make an interesting point. Mathematicians do invent new systems but usually aren't interested in applications; physicists invent laws and theories and are interested in applications; chemists are more interested in applications and make more new materials and compounds that might be useful. Sounds rather neat, doesn't it?"

While we were momentarily basking in our self-congratulations, Millsap had been getting impatient. However, having choked for the moment in a draught of his lethal alcoholic mixture (we should let the chemists analyze that sometime), it took a few moments and some vigorous slaps on the back to restore him.

"Bull!" was his first uttering and he collapsed in further coughing. We started looking around for some medical colleagues because Millsap's face was getting dangerously red, but he slowly recuperated and marshalled his thoughts.

"Maybe this idea of early retirement isn't so bad, Millsap," opined Frank. "These discussions seem to be becoming too much for you."

"Never mind my retirement. I think you guys wouldn't be able to get along without someone to keep the discussion from getting too fuzzy. Whatever Brouwer said, I still don't know what makes chemistry distinct from physics."

Maybe the reader can help. Is chemistry a distinct science from physics? Is chemistry just applied physics? Or might we with equal justice reply that physics is nothing more than theoretical chemistry? I have to confess that, on that Friday afternoon, we did not completely answer the question. Differences exist between chemistry and physics, but when we say that physicists are more interested in basic theories, we can point to theoretical chemists with similar interests. And when we say that chemists are more interested in *inventing* new compounds, we can point to physicists interested in *inventing* new superconductors, new transistor materials and such.

"You know something, guys?" Millsap looked excited again. "I want to look into this problem for the next few years. What makes chemistry, chemistry and what makes it distinct from physics. There should be some good papers coming out of this."

Shrugging off the comment that there must be enough problems in psychology to occupy him with the comment, "Listen, I can research whatever I want to, and the dean can just lump it," Bert put on his jacket and wandered off for the weekend, all thoughts of early retirement gone from his mind.

Millsap and the Dean's Ultimatum

Bertram Millsap

I must confess that I share a small part of the responsibility for Dr. Brouwer's expulsion from the most recent Faculty of Science council meeting. A wiser dean would have tempered mercy with justice and allowed Brouwer to continue to participate in the discussion and allowed him a few moments to dry off, or perhaps change his pants.

The regular reader will probably remember a previous episode in which a Faculty of Science meeting was interrupted when a vociferous neighbor nudged my elbow and caused me to spill coffee over Brouwer's clothes. At that time I was engaged in studying the longevity of coffee balls on the surface of a cup of coffee sliding along a rough surface. At that time the dean also accused Brouwer of disrupting the meeting and strongly rebuked him.

The thing about Brouwer is that he always looks guilty and embarrassed even when it isn't his fault. In my experience, most physicists are shyer and more reserved than my closer colleagues in psychology. I haven't been embarrassed since the time I presented a seminar on my research on sleep deprivation and one of my subjects hit me with a right cross as I was attempting to keep him awake. That incident actually made me world famous in psychology circles, and I even received an invitation to Dave Letterman's show with the sleep deprivation volunteer.

In previous missives, Brouwer has of course described me as his short, plump, somewhat scatterbrained colleague from the psychology department, who is more interested in the research others do than in his own, and I have to admit there is some justice to this. I am somewhat scatterbrained, but I ascribe this to my curiosity for all things going on in this wonderful world of ours. I am the kind of person who should be pursuing four careers simultaneously without having to report to any authority, and fortunately, once you have tenure, an academic position just about allows you to do that. I do get occasional reminders from my chair or dean that my research would benefit from being more focused, but life is too short to listen to chairs and deans.

Brouwer, on the other hand, is more conservative than I am. He is a pretty good teacher, or so I hear, and his research, which started with pure mathematics and physics, is now most concentrated in physics education. I would judge him to be a pretty average, mainstream sort of scholar, who doesn't have more imagination or creativity than is good for him.

However, on the fateful day of the faculty meeting, Brouwer was passionate about the faculty's new emphasis on better teaching. To give him credit, any fuss Brouwer has ever gotten into with the administration has always been

due to his taking some student's side in an administrative battle. On this particular afternoon, the committee on the improvement of teaching, of which Brouwer was a member, was making a presentation to the faculty council. As for me, I find such discussions rather dull and need to find some amusements to keep my mind occupied while others drone on about faculty policy.

In particular, I had gotten interested in why water freezes from the top down, rather than the other way around. If water behaved like any other liquid, the cooler water would be more dense and sink and our lakes and rivers would freeze from the bottom up, probably killing all aquatic life each winter. It is my well-considered opinion that when God created everything, rested the seventh day and set the universe running on its own, he suddenly said "Oops! This isn't going to work!" God then fiddled around a bit and then made water expand when it cooled to 4°C and lower. After this, water froze from the top down, and life could develop and everything became as it is now.

One interesting phenomenon with water is that it has a surface tension. If you fill a glass with water, really fill it, and ask the question, How many pennies can I still put in the glass without the water spilling over?, you've got a cute little problem that will help pass the time while you're at a particularly boring meeting. This little experiment also had the supposed advantage, in contrast with the coffee balls (do check the archives for the story; it throws a blinding light on the rigidity of the dean) that I wouldn't have to move the glass, thus making it much safer for me and more innocent bystanders.

I had predicted that I could add 37 pennies to a full glass of water without spilling a drop and was quietly carrying out the experiment when I ran out of pennies at 23. In future, I will probably use a styrofoam cup because the pennies did make a ringing sound when they hit the bottom of the glass. Some faculty members sitting near us were beginning to turn around and wonder *what* I was doing, but such things never bother me. The neighbor on my right was generous enough to dig 8 pennies out of his pocket, but these too were soon used up and I needed more. I nudged Brouwer, who was sitting on my left, but he just muttered, "Don't bother me," and continued to pay attention to the discussion. In fact, he was just getting ready to ask for the floor when I nudged him again. After all, I did need more pennies.

Brouwer impatiently brushed me aside again and caused my hand to upset the water glass, which hit the back of the colleague sitting in front of us, turned upside down and emptied the water on that colleague and on Brouwer.

If Brouwer had simply taken this as just one of the vagaries of life, to be borne patiently, or even muttered quietly, all might have been well. But to shout "Son of a bitch!" just at the moment when the dean was summarizing the discussion was simply unwise. Brouwer should have known better.

I have seldom seen the dean angrier. Even at the best of times, our dean looks as if life has handed him a lemon, but at moments like this, he excels. Even the minor prophets of the Old Testament could not have thundered about the sins of the people of Israel the way the dean expressed all his grievances about Brouwer's behavior at this and previous faculty meetings. In fact, he invited Brouwer to leave and not come back until he officially apologized to the whole council.

Brouwer hasn't talked to me since. I have made every effort to apologize for my small part of the debacle, but surely he didn't have to brush me aside as abruptly as he did? I feel somewhat affronted, however, that everyone I meet seems to take Brouwer's side and feels that the dean should have excluded me from the meeting. In fact my own wife, Helen, usually a very understanding spouse, accused me of being a public menace and suggested that the dean should permanently ban me from future faculty meetings.

I carry on alone, with the firm knowledge that it usually takes Brouwer about three days to get over these incidents and that we will become firm friends again. In fact, I don't see how he can get along without me as long as that.

Millsap and the Straight and Narrow

Here we were again, Bert Millsap and I, at the Faculty Club two days in a row. I don't want to give the reader the impression that faculty members at respectable universities spend all their time drinking and discussing strange topics at their faculty club, but once in a while we find it a restful place to be after a busy day.

As we were settling down to my shandy and Millsap's Rosemary Sunset, a bit lighter on the Cointreau due to Millsap's diet, Jenny Platt and Dave Adams came and joined us. The Faculty Club is usually busy in early April as instructors frantically try to finish their courses, plan the final exams and, even if they are more dedicated than average, plan remedial sessions for students. As a result, many of us are just beat late in the afternoon, and we like to stretch our legs in the easy chairs at the Club.

"We've been wondering, Millsap," opened Jenny, "it's been about six months since you got Brouwer kicked out of the faculty meeting (see the archives for details) and any time we've seen you since then, you've been involved with rather serious topics. Are you straightening out your life?"

"What are you talking about, straightening out my life? My whole life has been lived according to a very consistent principle—follow your curiosity wherever it leads. I haven't changed."

"Well," Dave suggested, "I've noticed Brouwer look a lot more relaxed the past few months. He doesn't have that hunted look anymore. And you've been positively respectable. We even admired you for getting jailed for contempt of court. That took courage and clear thinking. Even what Brouwer's been telling us about your hobby of researching the secrets of the solar system was relatively respectable. Did you ever pay Brouwer the $50 he had to pay for the tablecloth you wrote on at the Hilton?"

"Of course not, if Brouwer thought he had to reimburse the hotel simply because I did what every scientist would do in my case, that's his problem. What did you do with the tablecloth, by the way, Brouwer?"

"I have it hanging in my rec room along with the superconducting wheel you built. I had to rescue that from the fire department. I also have your radon readings from your house the night you panicked when you misread the detector."

Jenny Platt was astounded. "You have a museum of Millsap's follies in your rec room?"

"Oh, yes, I have the teacup Millsap swirled to show the formation of small and large planets, the coffee cup he spilled coffee from when he was studying the formation of coffee balls at the faculty meeting and got me in the dean's bad books the first time. I even have a picture of the gentleman who participated in Bert's dream deprivation experiment and gave a dramatic proof of the negative effects when he bopped Bert in the eye. You should have seen how popular Millsap was at the conference in Quebec when he presented his paper. His black eye was the highlight of the conference."

I just realized that this was probably the longest uninterrupted speech I had ever made in the company of Bert Millsap. However, Bert looked dumbfounded.

"You mean to say, Brouwer, that you've catalogued all the simple accidents that have occurred to me in the past few years? You put me on display before the world so you can gloat over me?"

"No, no, Bert, I've simply enjoyed your adventures so much, even if I've often suffered the consequences, I just want to keep a memory of the more outrageous part of your scientific

adventures to liven up my boring evenings. Even though it seems I'm making fun of you, I told Jenny yesterday that my own career has become much more lively and flexible since I've known you. Even my teaching is livelier and my student ratings have gone way up. And I have you to thank for this. So don't worry about my little museum. It's a credit to you."

Millsap wasn't convinced yet. "Do you have the photographs I took of the circular rainbow when I broke my leg?"

"Yes."

"You don't have the recordings I made when I investigated the sound made by the Northern Lights, do you?"

"I do."

Jenny was also surprised at Millsap's good behavior: "I'm even more amazed at how respectable Millsap has been lately when you remind us of all his misadventures. Do you ever invite friends to your rec room?"

"No, that area is for my private enjoyment, but Bert can come and see it sometime. But it does pose the question of why Bert has been traveling the straight and narrow path for some time. What's up, Bert? Is it your diet that has you reflecting on the meaning of life and on getting older?"

"I wish you people would stop treating me as a zoological specimen. I'm just an ordinary person who wants to be left alone to live a peaceful life. Why don't you focus on Brouwer's adventures sometime? Haven't you heard what happened when he demonstrated the Vande-Graaff generator to his physics class this year? That should be in his museum."

"Why, what happened, Brouwer? Did you get a shock when you forgot what you were doing?"

I suppose I had to relate the little episode that had ended a class of mine prematurely because neither I nor my students were in any condition to concentrate on physics afterwards. As the intelligent reader undoubtedly is aware, the VandeGraaff generator is sort of a big metal ball that you can charge up by plugging it in to an electrical outlet. The idea is to stand on an insulating stool and put your hand on the ball and charge yourself up until your hair begins to stand on end. A simple experiment and nothing can go wrong, right?

"I started charging up the generator, had my hand on the metal ball and was standing on the little stool while waiting for my hair to rise. The whole class was watching intently."

"So what happened, Brouwer?"

"Imagine the most embarrassing thing that could happen, and double it."

"You stepped off prematurely and you got a big shock?"

"No, that happened to a colleague of mine when I showed him how to do the experiment. At one point, as he was being charged up, he said he understood how to do it and stepped off the stool. A giant spark flashed from his toes to the floor, and he spent the next few minutes hopping up and down while I was enjoying myself. But, as I often discover, when you laugh at someone else's discomfort, nature is just waiting to pay you back."

"So, get to the point, Brouwer, what happened?"

"Well, just as I charged up the generator to try to get my hair to rise, a big spark shot from my zipper to the metal sphere and I jumped about a yard into the air, mainly from the surprise, but partly from the sensation."

"A spark from the zipper on your pants to the sphere? That must have been hilarious."

"Well, hilarious it was. The students were rolling in the aisles, and I didn't know where to look. Fortunately, after a few minutes the humor of the situation hit me, and I joined the class in laughter. But there was no way I could continue lecturing without the class breaking out again and again."

"Are you going to add this to your museum, Brouwer?"

"Of course not, Jenny. Such little accidents are best consigned to forgetfulness. My museum is devoted to Millsap and eagerly awaits his further adventures."

Millsap and the Unpopularity of Physics

"You know, Brouwer, I've always wondered how your friend Millsap ever got tenure. He always seems to be involved in something in the physical sciences. Does he ever publish in his own field?"

Jenny Platt, a distinguished geneticist and good friend, and I were sitting at a table near the fireplace at the Faculty Club, around 5:30 on a Thursday afternoon in early spring. I had been busy in the lab till late, and Jenny had been holding an extra workshop for students in her biological sciences course. Despite Jenny's reputation as an excellent researcher, she still put her major emphasis on her teaching, and her students appreciated her efforts.

"Well, Jenny, despite appearances, Millsap is quite productive. He seems to spend a lot of time on frivolous topics in fields he should probably keep out of, but since he works about 18 hours a day, he still has time for psychology also. His work on dream deprivation has actually made him quite famous. He's got about 80 publications in his field, although even there his dean has suggested that he could be more productive if he were to concentrate on a specific research program instead of switching from topic to topic."

"How did you ever get so close to him? I would have thought that you and Bert Millsap have diametrically opposed personalities."

"That's an interesting point, Jenny. I wonder if deep inside each of us there isn't a bit of an intellectual rebel like Millsap. After all, didn't even Einstein say that a good researcher needs the unspoiled outlook of a bright 16 year old? That certainly fits Millsap."

"If you make that an inebriated 16 year old," was Jenny's response. "I've often accused you of encouraging him in his madcap schemes. Do you really do that?"

"Well, you know, that might be true. I've realized that since I've known Millsap my own teaching and research have actually improved. Of course that might be due to my growing maturity, but I think I've developed a bit more of an irreverent attitude toward physics myself, and it has allowed me to take the hallowed theories of physics, how can I express it, less seriously, more tentatively than when I was young. And Millsap has helped me do that."

"Can I get you another drink?"

"Sure, Jenny, just a shandy will do."

While Jenny got the drinks, who should arrive but the man himself, Bert Millsap. I've described Millsap before as a short offensive lineman for the Packers, but recently he had lost a bit of weight, and if you looked carefully you could see a bit of evidence of that. However, his circumference was still comparable to his height.

"Bert, get yourself a drink and join us. Jenny is getting mine."

When Bert and Jenny joined us, I asked Bert how his planetary research was going. Bert had recently been intrigued by some regularities in our solar system (see the archives) and had done some respectable work on the planets and moons of our solar system.

"Oh, that's old hat, Brouwer. I've been reading an article of yours on the unpopularity of physics in North America. As usual, it's taken you most of your career to see the obvious."

Here I should remind the reader unfamiliar with our adventures that, besides being a physicist, I have also taken on some responsibility for the improvement of physics teaching which, as Bert has stated very vocally at times, needs

all the improvement it can get. The article Bert was referring to appeared in *Physics in Canada* in late 1999.

"So you agree with my recommendations, Bert?"

"Whether I agree or not is irrelevant, Brouwer. Your recommendations aren't going to have any effect on the teaching of physics whatsoever."

"Why not, Bert? If Brouwer's paper is so good, why won't it improve the teaching of physics?"

"Jenny, Brouwer showed that physics is the most unpopular subject at all major universities in North America, even behind such subjects as accounting, statistics and even military sciences, if you can imagine that. And I predict that if you did this study in 20 years, the situation would be the same."

"Why, Bert?"

"For one thing, Brouwer recommended that physics lecturers got to know the history of their own field to give a little perspective to their teaching. I have never met a physicist who had any appreciation of the history of science. They all have their heads in the theories and laboratories of today and don't have a clue about the past. Why, I met Dave Adams a few days ago—he's supposed to be a good physicist—and I asked him if he knew James J. Waterston."

"What did Dave say?"

"He said he thought there might be someone in phys. ed. by that name but nobody in physics. When I told him Waterston was the father of kinetic theory, Dave said I was talking through my hat."

"Well, were you?" This was Jenny, not me.

"No, I wasn't, but I suppose you couldn't be expected to know Waterston. He was a young engineer, who in 1846 wrote probably the first good paper on kinetic theory and sent it to the Royal Society of London for publication. They returned it with comments that such nonsense wasn't fit to print in the Royal Society. Almost 50 years later Lord Rayleigh found the paper and forced the Royal Society to print it in 1892, with an apology, although Waterston was dead by then. And even now, physicists don't know about Waterston. I bet even Brouwer hasn't heard of him."

"Give me a little credit, Bert. I do mention Waterston in my modern physics course each year, and do you know there is a James J. Waterston society in the Netherlands that gives out a yearly prize for the most unappreciated discovery in physics for that year?"

"Have you ever won it, Brouwer? You're pretty unappreciated."

"Thanks for the vote of confidence, Bert, but no, you have to make a pretty major discovery, which is not recognized by the mass of scientists, but presumably only by a few with a bit more insight than the others. But I think you're wrong about the young physicists and their interest in teaching. I've met many young physicists who seem to have a more healthy historical perspective on their field and who appreciate the teaching part of their job."

"I challenge you, Brouwer, to do this same research in the year 2020, and I will buy you drinks for the rest of your life if physics is more popular than any other subject under the sun."

"Seems pretty safe, Millsap. Brouwer will be in his dotage by then. Even if he can still do the research, the liquor bill for the rest of his life will be pretty small."

"Enough already, Jenny, don't make me old before my time. Let's just enjoy these spring days without looking ahead too far."

Millsap and the Least-Appreciated Physicist

"Say, Brouwer, I nominated you for the J. J. Waterston Award."

"You did *what,* Millsap?"

We were sitting in the Faculty Club late on an unseasonably mild winter afternoon. We go to the Faculty Club to relax, so I was unprepared for an emotional or mental shock of the type that Bert Millsap occasionally gives me.

"What the hell's the J. J. Waterston Award?"

Jenny Platt, our biologist colleague, and Dave Adams, the university's lone astronomer, were with us. They had obviously never heard of the obscure J. J. Waterston Award.

Millsap took a sip of his foul cocktail and settled back in his chair. He had an audience.

"The J. J. Waterston Award was named in honor of a poor deluded physicist who lived a century ago. Waterston was dismissed by his fellow physicists as a crackpot but was later shown to be correct. Some society in the Netherlands now gives an annual award in his honor to unappreciated physicists. Because I figured Brouwer is pretty unappreciated, I nominated him for the award this year."

"Millsap, I hope you're kidding! You're not going to embarrass me on a global scale this time, are you?"

"Why not? Brouwer, you don't mean to tell me you're not underappreciated?"

This was too convoluted for Dave. "You're either confusing me, Millsap, or you're talking nonsense. Make up your mind which it is."

"You guys amaze me," muttered Millsap. "You're physicists, and you don't know your own history. Waterston was the greatest physicist since Newton, but his work was ignored until it was rediscovered 100 years later. I'm surprised you don't know this, Brouwer. You usually pride yourself on knowing the history of your subject."

"Well, you're right about one thing, Bert: I don't know the history you're reciting, because most of it is pure fiction. I was objecting not because I don't respect Waterston but because I don't consider myself in his class."

"What do you mean 'pure fiction'? I read about Waterston in a respected journal, I'll have you know."

"Okay, Millsap, but you've forgotten most of the details. John James Waterston was a Scottish physicist who, in 1846, submitted a paper to the Royal Society for publication. In his evaluation, one of the referees wrote that the paper was 'nothing but nonsense, unfit even for reading before the Society,' and the paper was put in the Royal Society's archives, where it remained unread for more than 45 years. In 1892, Lord Rayleigh discovered the paper and insisted that it be published, even though 46 years had passed since its writing. Lord Rayleigh suggested that the development of chemistry had been delayed by as much as 15 years as a result of the referees' inability to recognize the value of Waterston's paper."

"Well, what was the paper about, Brouwer?"

Before I could answer, the waiter appeared with refreshments. There appeared to be some reluctance to take responsibility for the bill.

"Come on, Millsap, it's about time you paid for a round. You're always freeloading off the rest of us." Dave, though not known for his tact, was correct in his assertion that Bert usually manages to evade his financial responsibilities.

While Bert searched his pockets for money, I continued: "Well, as I remember it, Waterston's paper was the first modern approach to the kinetic theory of gases. He showed that the

kinetic energy of gas molecules is proportional to the temperature, and that this is true for all gases. Then he did a bit on specific heats and other topics, most of which were rather new relationships."

Jenny commented, "Well, since Rayleigh's time, physicists have known about Waterston, haven't they? Why isn't he well known and recognized as a great physicist today?"

"That's what I was getting at," ventured Millsap. "There's no excuse for physicists not knowing about Waterston now, is there?"

"I have to admit, it is hard to understand why textbooks don't give Waterston the credit he deserves. For reasons I don't understand, the Royal Society's blunder has not been fully corrected, even after Rayleigh's efforts. There's only this small group of Dutchmen who decided to give the J. J. Waterston Award to unrecognized innovators of today."

"So, why has Millsap nominated you for the prize, Brouwer? What have you accomplished that hasn't been recognized?" Jenny asked.

"I'm happy with the recognition I have received over my career, Jenny, but maybe Bert knows something we don't."

We waited for Millsap to reveal his motivation. What was it I had done that he thought hadn't been sufficiently recognized and deserved a prize? Had I done something so unappreciated that even I had forgotten about it?

"Come on, Millsap, we're waiting."

"Well, Brouwer, didn't you once write a paper showing that all the papers published on particles traveling faster than the speed of light ignored the fact that such high speeds meant that effects would come before causes, and that you could change the past just as much as the future? And wasn't your paper rejected by the referees as not adding anything new to the discussion? And hasn't it pretty well been admitted by now that there probably aren't particles that travel faster than the speed of light?"

So that was it. Millsap's erratic memory had dredged up a little effort of mine from the early '70s that had been rejected, for what I had always thought good reasons, by the discerning referees. It wasn't so much that what I said was wrong but, rather, that others had said it much better by the time my paper would have come out.

"Bert, it's not that I'm not a bit proud of that little effort, but the rejection of my paper, unlike that of Waterston's, had no impact whatsoever on the development of relativistic dynamics. The research on tachyons, as they called these faster-than-light particles, just had to run its natural course, and, apart from a few places in the world, this research has died a pretty natural death."

It was time to disperse: I was going home for supper, Dave and Jenny were staying at the Faculty Club for dinner, and Millsap was headed for the airport. Millsap had been invited to present a major paper on his sleep deprivation research to the American Psychological Society. We wished him well, refraining from reminding him of the time a surly subject, for whom the sleep deprivation experiment had gone a bit too far, had given him a black eye.

Millsap and the Blue Heron

"Welcome back, Millsap."

Bert Millsap and his wife, Helen, were dining with me and my wife at our favorite Vietnamese noodle house. Bert had just returned from New Orleans, where he had presented a paper on the effects of sleep deprivation on human behavior. (The perceptive reader will remember that, early in the research study, one of the subjects had given Millsap a black eye when Millsap had prodded him awake one too many times.) Bert had already presented earlier findings of his study at a Quebec conference, so most of the conference participants at New Orleans were probably eager to hear his latest revelations.

Our standard procedure at a Vietnamese restaurant is to order six dishes: three for Millsap and one for each of the rest of us. We have learned from experience that, despite the heaping portions of lemon grass chicken and other delectable foods served at the restaurant, dinner with Millsap would resemble a fast unless we ordered what seemed an excess of dishes.

"So tell us a bit about the conference, Bert. How did your talk go?"

"Would you believe it?" Helen interjected. "The goofball missed his own talk! He tells me he fell asleep on a parkbench outside the conference centre and didn't wake up until after the scheduled time for his talk had passed."

Helen was laughing and shaking her head. She has experienced so many of Millsap's misadventures that she now lives in a separate apartment. But she still regards him fondly, more or less as an irresponsible but lovable child.

"You missed your own talk, Bert? That must be the first time that has happened at a major conference. That must really hurt your reputation as a scholar."

"Oh, not at all, Brouwer. When I noticed the time, I had an inspiration. I called an ambulance and had myself driven to the hospital, where I was pronounced completely healthy (apart from some uncalled-for remarks about my weight). I then attended the evening session of the conference, where I was given a standing ovation for recovering my health so quickly."

"Millsap, you devil! You're the only person I know who could do something like that and come out smelling like a rose."

At this point, my wife, Geri, tried to get a word in. That's often difficult to do when Millsap and I are together. But both of us were struggling with our noodles, and Geri grabbed the opportunity to speak.

"What I can't understand, Bert, is how you could fall asleep just before giving a paper at a major conference. When my husband has to present a paper, he can't sleep for several nights before the event because he is so nervous. Yet you're so relaxed that you drift off at almost anytime."

Millsap leaned back and scratched his head. He looked a little puzzled, as if he were not quite sure what to say.

"To be honest, I didn't actually fall asleep. I might have been dozing a little, but I was just sitting there in the noontime sun, watching the Mississippi flow by. It was so peaceful and warm, and I started thinking about how beautiful life can be and so on. And then this heron landed about 20 feet away."

Millsap reached for the shrimp and vegetable dish and started filling his plate anew.

"Well, don't stop now! Leave the food alone for a minute and tell us what this heron had to do with you missing your talk." Even Helen had not yet heard the details of Millsap's little adventure.

However, nothing could interfere with Millsap's appetite, and he chewed contentedly for a while before continuing.

"This blue heron had probably flown from way north in Canada to the Gulf of Mexico, just like I did, and I saw in him a fellow traveler through life. The heron was standing on one leg, watching the Mississippi just as I was, and he was probably thinking similar thoughts. And then he started to talk. Pass me some tea."

"Forget the tea, Millsap. What do you mean the heron started to talk?" I moved the teapot to the far end of the table to force Millsap to focus on what we all wanted to hear. Millsap has the knack of riveting your attention on his stories no matter how quietly they begin. At some point, you never know when, an irrational moment takes you into Millsap's world, a totally different universe from the one the rest of us inhabit.

"I know it sounds improbable, and I might have been dreaming, but this heron asked me if I was happy with what I'd accomplished in my life."

"Well, what did you answer?"

"If I remember right, I told him I was quite happy about my career as a professor, although some of the dreams I had as a young man did not quite come to pass. I told him that I was probably not as appreciated by the university administration as I would like to be, and so on. But then the heron asked me if I thought those were the most important things in my life.

"'What else is there?' I asked the heron.

"The heron turned his beak in my direction. 'My life has been one of travel from Canada to Louisiana for many years. I have brought up about 45 offspring, most of whom have managed, like me, to avoid the hunters and to establish their own families. That I consider a full and useful life.

"I told him that I also had children, a son and a daughter. My son was a computer scientist and my daughter a microbiologist, and they seemed to be doing well.

"'And do you have a partner in life?' the heron asked.

"I'm afraid I felt a little embarrassed to answer him.

"'I am married—to Helen—and we love each other. But Helen has chosen to live apart from me, undoubtedly due to my shortcomings,' I answered.

"The heron looked at me and shook his head. 'My friend Millsap,' he said, 'you do not appear to have the right priorities. After all, would your science of psychology have suffered much if you hadn't done all your research?'

"'That is a totally inappropriate question,' I replied. 'If every scientist asked himself that, there might well be a lot of depressed scientists around.'

"'But doesn't that suggest that most scientists look in the wrong direction when they assess whether or not their lives are satisfying? Aren't the facts that your children are well and happy and that you still have a good relationship with your wife and your friends more important than any of your achievements in psychology?'"

At this point, I interrupted. "I think, Millsap, that this bird must have been a reincarnation of Confucius."

"Be quiet, Will," said Geri. "Let Bert finish his story."

Helen had stopped eating, and she was very quiet and almost misty-eyed. Such moments of reflection were rare in Millsap's life. "So what did you say to the heron, Bert?" asked Helen, after a long silence.

"The bird flew away, and I just sat there and thought. Then I looked at my watch and realized that I had missed my talk."

"So you phoned an ambulance and pretended that you were sick? Didn't you learn anything from what the bird told you?"

Bert didn't react to my question. He was sipping his tea and still looking thoughtful.

"I've thought a lot about this episode. I wonder what might have caused a hallucination of this sort. One intern at the hospital thought I might have had a small stroke. But I'd rather look at it as a gift, a moment of reflection that does not come often in one's life. Maybe I should change my priorities, or think a bit more before acting on impulse, as I have been known to do occasionally."

"Did the heron say anything about me, Millsap?"

"Yes, Brouwer, the bird told me to avoid people like you who always lead me into trouble."

On this note, we left the restaurant, but the story did not leave us. The question of what is important in one's life returned to me often in the weeks to follow. Even Millsap seemed to be more considerate of others, especially of Helen. Only around me did he continue to be the same old Millsap.

Millsap and the Heating Crisis

I could sense the excitement as I entered the Faculty Club late one Friday afternoon. I had just finished teaching my modern physics laboratory session with my second-year students, and I was dead tired. I needed to stretch my legs and mull over the new term's events with some colleagues. Friday afternoons are usually quite boisterous at the Faculty Club, but today groups of visitors were standing around obviously discussing some riveting topic.

"What's going on?" I asked one of the professors as he was putting on his coat in preparation for heading home.

"Oh, some joker sent the university administration a bill for heating, and he got a cheque for $1,500."

"That doesn't sound as if it would put the Faculty Club into an uproar. Why shouldn't the university pay its bills?"

"The guy sent the university a bill for the amount his body heated the university buildings during his career. I'd say that's pretty innovative."

I was still somewhat befuddled as I proceeded into the main meeting room (otherwise known as the bar), and ordered my usual shandy. I realize that my colleagues think of me as a wimp, or whatever the modern term is, but I just can't handle pints of Guinness the way they do. I noticed quite a crowd of people in the corner by the windows overlooking our beautiful river valley and, proceeding closer, I saw Bert Millsap at the centre of the commotion.

"Well, Millsap, I should have known that if there's a rumpus somewhere, you'd be at the bottom of it."

"Ah, Brouwer, read this and weep," Millsap retorted, and waved a cheque in front of my face.

Pay to the bearer Dr. Bertram Millsap the sum of $1,500, signed by the vice-president (finance) of the university.

"Well, congratulations, Bert. What have you done to deserve this?"

"If you want me to go through the story again, Brouwer, you'll have to buy me a drink. My throat is dry from everyone wanting me to repeat the story."

So I signalled the bartender to bring Millsap his foul drink, which he calls a Rosemary Sunset, because of the grenadine he includes to soften the effects of the Drambuie and Scotch, not to mention the occasional crème de menthe which Millsap has been known to add.

Millsap graciously accepted his drink, hitched up his stomach and settled back into one of the soft leather chairs that are spread throughout the room.

"Well, Brouwer, do you remember last month when we found out that the university administration had declared a financial exigency, as they called it, and lowered the thermostats in all the office buildings by one-and-a-half degrees? We all complained but as usual someone said, 'What can you do about it?' so I decided to do something. I got so fed up with the cold that day, that I decided to charge the administration with all the body heat I've been contributing to help heat the building for the past 30 years."

"So how did you settle on $1,500?" This came from over my shoulder from one of the engineering profs who was listening in on the conversation.

"Well, anyone can calculate how many calories per day he uses up. That's all converted to heat, and at today's prices that came up to about $1,356, which I naturally rounded up to $1,500."

I'd been mulling over Millsap's idea and entered the conversation again at this point: "I wouldn't have thought the total would amount to that much, Millsap. I remember doing a calculation similar to this a few years ago, and came to a few cents per day."

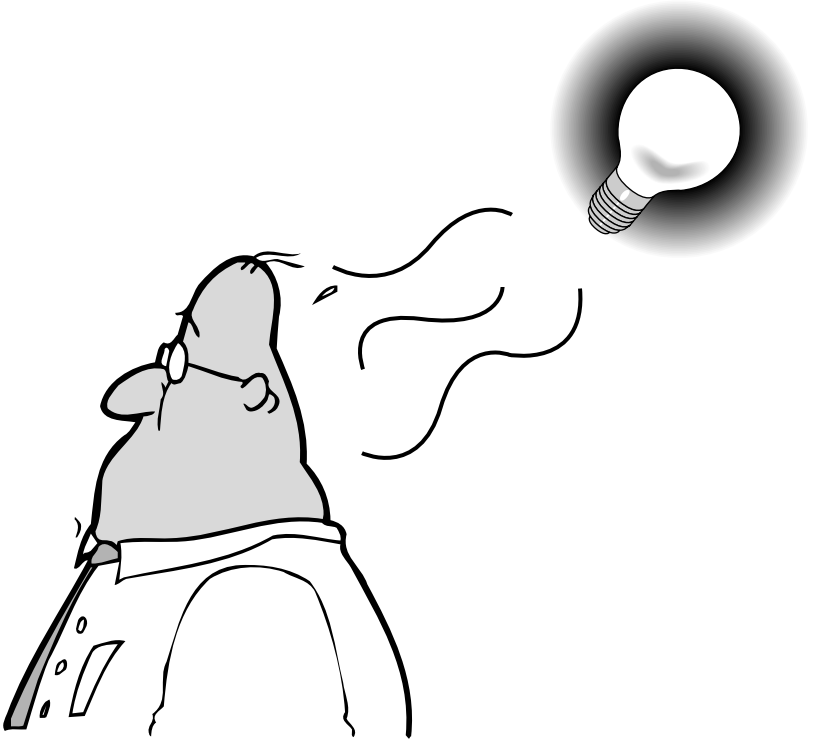
"Ah, but Brouwer, some lights shine brighter than others. I'm sure you don't burn 4,500 calories per day! That made my energy output about equal to a 200 watt light bulb. I would judge you to be about a 60 watt bulb, much dimmer than me." Millsap was merrily chuckling as he came up with that one. "I've been burning like a 200 watt bulb for eight hours a day, 250 days per year, for 30 years. Actually, I work for about 12 hours a day; maybe I should ask for an additional amount."

"Hmm, only two weeks holidays, eh Millsap? Oh well, that's only a minor adjustment. But how is it possible that some bureaucrat at the VP's office didn't catch this and stop payment, or call you on the carpet?"

"I've heard nothing from them so far, but I'm sure when they hear about the uproar they'll demand the cheque back. But they're not going to get it. I'm going to frame it and hang it here in the Faculty Club, where we can all see what a clever bunch of administrators we have."

Apparently Millsap did not hear from the vice-president's office till later in the week after the local news and television stations picked up on the story. Millsap was summoned to the university administration offices and verbally reprimanded by the vice-president. But, as Millsap gleefully told us later, "there wasn't a thing they could do, without making themselves look more ridiculous."

I wish I'd been the vice-president," I mused. " I would have charged you for all the chalk you used and for all the water you drank all these years, Bert. I wonder if you would have owed them money?"



Millsap and the Chemist's Gold Medal

It was Tuesday afternoon and, though it was unusual for me to head for the Faculty Club this early in the week, I had just sent a periodical on the nature of chemistry education off to the printer, and I felt like celebrating.

I was quite proud of myself. Being a journal editor can be very hard work, especially for a periodical that solicits articles from science teachers, science educators and, occasionally, scientists. In this case, the word *solicit* is a synonym for *hound:* an editor hounds his friends and acquaintances for articles on a specific topic. I've often seen people ducking into alleyways or hiding behind trees as I approach. Nevertheless, the issue was completed, and I hoped that the articles would have some impact on chemistry teaching in the future.

As I entered the lounge, I noticed Bert Millsap, from the psychology department, and Frank McKnight, from the chemistry department, relaxing over a couple of refreshing drinks at our usual table.

I hailed the waiter, who was ready with my usual diluted shandy, and I joined my colleagues. Millsap had recently got over his decision to retire and had decided that the dean of arts could put up with him for a few more years. As a result, he looked a lot more chipper than he had lately.

As usual, Bert was drinking a rosemary sunset (recipe available on demand, with waiver of responsibility required), and Frank was drinking a grasshopper. Despite the fact that the chemists were guilty of occasionally grabbing our favourite table near the fireplace, Frank was a valued friend and could be counted on to enliven a late-afternoon discussion.

We had heard that Frank had recently won a national prize, a gold medal, for his research on the synthesis of hydroxyacyl tRNAs, and we congratulated him again on the award. Gold medals are awarded annually to the best young researcher in a scientific field. However, Millsap, not overwhelmed by such awards, had some sage words for his younger colleague.

"So, you've won a chemistry prize! But how can you can spend your life concentrating on such a small area of reality in a smelly lab? It seems to me that a scholar should be interested in laws and principles, not tiny details that nobody else is interested in."

Frank was quick with his reply. "Look, Bert, you may be content just to while away your time reflecting on the universe, but when I go home at night, I know I've done something useful, something that helps us understand the chemistry of life, something that might have some nice applications."

Millsap mulled this over for a while. I could sense the internal struggle going on in his mind. On another day, he might have agreed that a good university is best served by people who are not all interested in the same types of research. But these get-togethers at the Faculty Club in the late afternoons are not normally the occasions for agreement and compromise.

"I've often wondered about the difference between chemists and physicists," Millsap went on, ignoring Frank's reply. "Physicists seem to be interested in laws and theories—why things happen—while chemists are interested only in making new chemical compounds, detail work for smaller minds."

"Get out of here, Millsap. Remember Linus Pauling, Watson and Crick, J. J Thomson, Millikan, and Rutherford? These were all great chemists, and they had great minds."

"Great chemists? What on earth do you mean? At least three of the people you mentioned were physicists, and the others could be

called biologists, or at least biochemists. I'm not sure you could name a great pure chemist."

Frank shrugged his shoulders and did not respond to Millsap's challenge right away, and I just sat back and watched things develop. Although Millsap was exaggerating, it is admittedly difficult to define chemistry as a distinct science. We think we can define physics, we think we can define what makes biology distinct—but what makes chemistry distinct from physics?

At this point, we were joined by Sander Foster, a pure mathematician, whose presence would probably skew the discussion further against the outnumbered chemist. So, after hinting for the newcomer to order the next round, I decided to take the chemists' side of the debate.

"You know, I've often wondered about the difference between chemists and physicists. I've come to the conclusion that there are probably no fundamental differences between them, but some physicists do seem to be a bit more global in their interests in that they want to know what makes the universe tick. Chemists seem to restrict their questions of why things happen to the atomic and molecular level and tend to be more Edisonian in their research."

"Edisonian? What the heck are you talking about, Brouwer?" This was Millsap, of course, who is never very impressed by my arguments. But the others seemed prepared to listen.

I had recently read an article suggesting that chemists' approach to research is more like that of inventors, and I had been rather impressed by the analogy between inventors and chemists, so I was happy to respond.

"I think physicists and chemists are both very interested in the nature of things, in developing theories and laws. But I think more chemists than physicists are interested in synthesizing new compounds and materials. I would guess that more chemists tend to be inventors than physicists."

Sander Foster, having revived himself with a Scotch and soda, joined the debate. "Despite your grammar, Brouwer, you make an interesting point. Mathematicians do invent new systems, but pure mathematicians, at least, aren't interested in applications; physicists invent laws and theories, and are more interested in applications; chemists are more interested in applications and in making new materials and compounds that might be useful. Sounds rather neat, doesn't it?"

While we were basking in self-congratulation, Millsap had been getting impatient. However, having choked on a draft of his lethal alcoholic mixture (we should let the chemists analyze *that* sometime), he required a few moments and some vigorous slaps on the back to revive him.

"Bull!" was his first utterance, and he collapsed in further coughing. We started looking around for some of our medical colleagues because Millsap's face was getting dangerously red, but he slowly revived and marshalled his thoughts.

"Maybe this idea of early retirement isn't so bad, Millsap," opined Frank. "These discussions seem to be becoming too much for you."

"Never mind my retirement. I think you guys wouldn't be able to get along without someone to keep the discussion from getting too fuzzy. Whatever Brouwer said, I still think chemistry is just applied physics."

Of course Frank disagreed. "Come and visit me in my lab sometime, Millsap. Then you might understand something about chemistry and not come up with all these generalities that don't mean anything."

Having read the submissions on chemistry for the journal, I was ready with a new hypothesis. "How about this, guys. Physics and chemistry don't differ that much in terms of what is being studied, but chemists are very different people from physicists. The best definitions of the fields might be that physics is what physicists do and chemistry is what chemists do."

"What utter nonsense, Brouwer. You've just given the best example of circular reasoning I've heard in the last decade." I turned around to face Jenny Platt, an outstanding biology researcher. I value her opinion and was, therefore, stung by her response. "How can we ever define anything with such a vapid approach?"

"Let me put it a bit differently, Jenny," I tried. "I think that students who go into chemistry are more practically inclined than those who go into physics. That's why you could say that chemists use more practical reasoning and physicists use more theoretical reasoning. The fields themselves are not that different, but the researchers have different goals and interests."

"Give it up, Brouwer. This isn't your day. Maybe if you went home and had a nap, your reasoning powers would improve a bit." That, of course, was Millsap, who has never had a high opinion of my intellectual ability.

However, help came from an unexpected corner. Frank waved his left arm as if to keep Millsap at bay and said, “Hold it a minute, Millsap, or we’ll have to talk a bit about reasoning, if any, in psychology. I think Brouwer might have something there. We’re quite interested in matter and forces, just like the physicists, but we study different aspects of the same things. And it’s true, I often feel more like an engineer, or an inventor, when my students and I try to synthesize new compounds and analyze their properties. And we almost always keep the possibility of interesting applications at the back of our minds.”

At this point, I decided to head for home. Leaving a discussion at the psychologically optimum moment is an art, and I was content to leave with the warm feeling that not everything I had said had been total nonsense.