



VERA

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and
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Vera tightly knotted her fingers in Shu's fur behind his ears and held on with all her might. Shu stretched out like a pancake, carefully tucked his tail, which you know was very pretty, and folded his ears sleekly back over Vera's hands. Together, their blue eyes flashed and off they rocketed into the sky!

"Let's go past the Big Dipper tonight, we've never been there," said Vera.

Shu aimed for the middle of the handle of the Dipper, doubled his speed, and started singing his favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle. Ku pittle, klu paddle. Gu tittle, glu taddle. Dittle, dittle, tot, tot."

Bitsy stars got bigger. Big stars screamed by. Itsity, bitsy stars became just bitsy. Itsity, itsity, bitsy stars now were visible where before the sky was pitch black. Vera wondered just how many stars there are. Maybe there are more than the hairs on Shu! Maybe not.



"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

Vera started counting stars, but without her fingers, which you remember were tightly knotted in Shu's fur, she soon lost track of where she was. She really wanted to know how many stars there are, so she started over. One, two, three, four, five, six. . .

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

"Oh Shu! That is such a silly song! I can't count my stars with all that dittle, bittle, tittle, prattle, babble. You help me!"

"Two, four, six, eight. Wait! Vera, did you count those?"

"Ohhhhhhh, just sing, Shu!"



Vera decided she had to know how many stars there are, but another time would be better. She would need her fingers and some peace and quiet.

Vera gave her dog an extra big, warm hug as they passed the Big Dipper.

She marveled at galaxies. Some were like whirling pinwheels, others intense clusters of billions and billions of stars, and others tangles of wispy filaments. Some seemed to be merging together and others blowing apart. Vera watched white stars and blue stars and red stars and swirling gases cross the sky.

"Why are stars different sizes? Why are some so bright and others barely glow? Why are some bluer and some redder?" They seemed to subtly change color as Vera and Shu raced past them.

Vera noticed a little green speck of a planet two freckles and a hair to the right of and a smidgen and a half below the red star Alpha Beta Gamma 4. But she didn't think too much about it. It was very late and she and Shu were tired.

BABOOLYA



Baboolya is a wonderful grandma, almost round and three fourths heart. She bounces around her country house gushing love, especially Sunday when her little Vera comes.

Early Sunday morning was cold. Shu was curled up with his long tail, which you know was very pretty, wrapped twice around his head, its tip covering both eyes. He was sound asleep, cuddled by Vera who was wide awake.

Vera had been counting stars. The creeping glow of dawn turned them out just when she reached nine hundred or so. Vera was practicing anyway. Her window wasn't very big.

Vera decided to leave early for Baboolya's. Maybe if they hurried she could see her friend Hu the owl in the forest before Hu went to sleep.

Shu's happy dream of flying through space turned to a nightmare when he heard Vera's whisper.



"Get up, Shu, time to go. Shu! Shu! Wake up, Shu!"

"Maybe if I am very still," Shu thought, "Vera will let me sleep."

"Shuuu!" Nothing. Shu pretended to sleep.

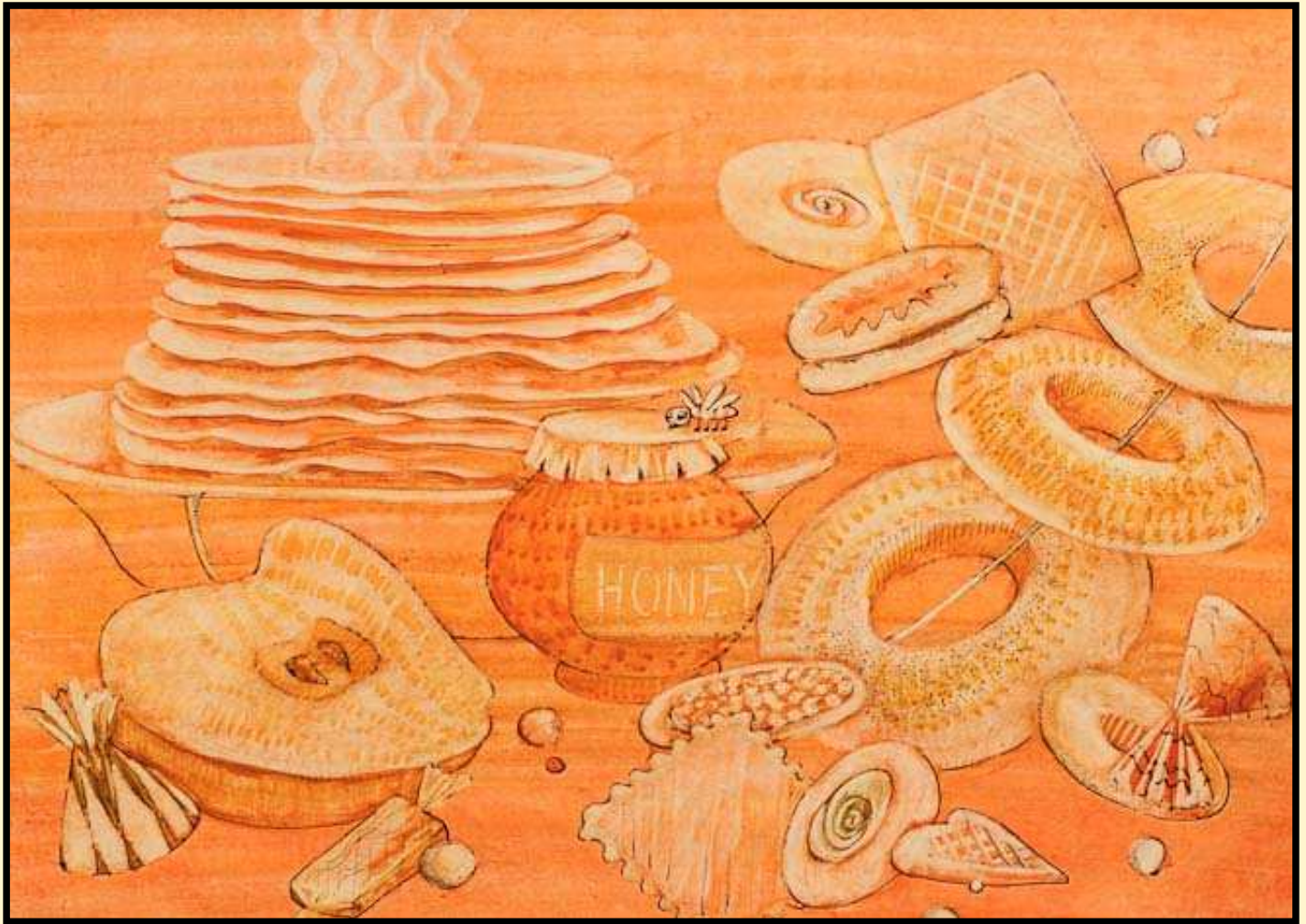
"Shuuuuuuu!" Still nothing. Shu didn't move a hair.

But Vera knew his game and said with a twinkle in her voice, "Very well, I'm leaving without you. But first I am going to dump this glass of ice water on your furry little head!"

In a flash Shu was ready to go! He never knew if Vera was kidding, but he was deathly afraid to find out.

They were too late to find Hu, who had gone to bed, but still had gobs of time to run through the woods, kicking golden birch leaves over their heads.

"Oh! You two are early today! Come in! Come in!" Baboolya bubbled.



Shu headed straight for the wood stove, curled up in a little ball, wrapped his long tail, which you know was very pretty, twice around his head and continued his happy dream. All day!

As Baboolya fried bacon and ham and potatoes and eggs and made pancakes to go with the orange juice and cereal and milk and english muffins and jams already on the table, she asked Vera if a turkey or roast would be best for lunch.

Vera knew this game too and said with a twinkle in her voice, "Whatever you would like, Baboolya!" Vera would eat just a little, like she always did, even as Baboolya urged her to eat more, always more. It was their game of love.

Every Sunday Baboolya asked Vera what she wanted to be when she grew up. Vera never had a good answer. This Sunday she tried a new one.

"I want to count the stars!"



She got a familiar response. "That's nice, but don't you want a good job and family?"

Vera smiled and said "Of course, of course." But silently wondered if she would ever grow up. And wasn't sure she wanted to.

The day ended with Vera pretending to sleep under 16 quilts filled with love.

Around midnight, Vera and Shu slipped quietly into the forest to find Hu.

HU



Deep in the midnight forest, Vera's feet were her eyes. They followed the curves of an old worn path. Two steps behind, Shu's ears followed Vera's rhythmic crunching of leaves. Whispers of star light through the trees guided Hu's flight.

Darkness hid everything from Vera's eyes. Tree roots. Polished rocks. Fallen leaves. Broken branches. But her feet found them.

Every sound, real and unreal, was amplified by imagination.

A leaf fell. Chick. And another. Chick. Two more. Chick, chick.

A startled mouse ran away. Tic, tic, tic, tic, tic. . .tic, tic. . .tic, tic, tic. . .tic. . .tic. . .tic. . .

Chrunch. . .Chrunch, chrunch. . .Chrunch. Something very big walked nearby.

Vera paused and listened.



Was it sound or was it her imagination?

Whish, whish, whish.
Whish, whish, whish. A tiny bit closer.
Whish, whish, whish. Closer yet.
Swhishshshshsh! Hu had arrived.

Vera long ago ceased wondering how Hu knew she was coming. Hu never questioned why Vera came. They were old friends with an understanding as deep as the woods.

When Hu was little Vera had found her in a corn field being mobbed by crows. Yelling and waving her arms, Vera scared off the crows, took Hu home, and nursed her back to health. Hu lived happily with Vera's family most of a year. But one night Hu knew she had to return to her forest. And Vera understood.

Now, their simple hellos remembered all of that and more.

"I've been counting stars."



"How many are there?"

"I counted more than nine hundred from my window. There must be a lot more than that."

"What if you used a telescope?"

"I could count a lot more!"

"Could you see them all with the very biggest telescope?"

"Hmmmmmm. I don't know. Maybe not."

From under the warmth of his tail, which you know was very pretty, a sleepy Shu asked, "Does the universe go on forever?"

"If it does, maybe I can't count the stars."

Slowly closing her big round eyes and opening them again, Hu asked with her touch of mystery "Have you asked the right question?"



"Well, Hu, what is the right question?"

"The one that gives you the right answer!"

"What is the right answer?"

"Only you will know."

Hu had many things to do. Vera and Shu had a long ways to go. With the warmth of family and a good wood stove they said good by.

Whish, whish, whish.

Whish, whish, whish.

Whish, whish, whish. Hu was gone.

Vera was lost in thought. She had only looked at stars, just counting them. Now it was time to think. "What is the right question?" she wondered.

Vera's feet found the trail, but at the fork took the left one, not the right one. Hu knew that would lead to Misha.



Neither looking nor thinking, Shu followed two steps behind his master humming his favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

The forest grew even blacker.



Vera and Shu walked deeper into the pitch-black forest. Vera was lost in thought, wondering about stars and the universe and "right" questions. She was also lost but didn't know it.

Vera long pondered Hu's last question "Have you asked the right question?" Maybe there were too many stars to count, even if she worked very hard, night after night. Maybe the "right" question was about the size of the universe. Or where it came from. . .or where it was going. Or. . . something else. Vera mulled and mulled.

Vera now had rhythm, "seeing" with her feet. She lifted one up and moved it forward just barely off the ground. If nothing was in the way, she touched to the right and to the left, feeling for the edge of the path. When she found it, she took the step. It was slow, but steady, and now instinctive.

Shu securely walked two steps behind, following the rhythmic sounds of Vera's steps. His tail, which you know was very pretty, barely skimmed the leaves with a quiet hiss. He happily hummed his favorite song.



"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

Slowly, imperceptibly, the path disappeared. At first, Vera didn't notice and continued walking. Suddenly her right foot kicked something hard. Startled, she felt it first with her foot and then with her hands. It was a tree!

"Why is there a tree in the trail?" Vera thought with a first twinge of fear. With growing anxiety Vera slowly and carefully searched with her feet in every direction for an hour for the trail. Alas, there was nothing! They were lost!

She wanted to run! But she knew she would quickly hit a tree with her nose. She wanted to sleep under 16 quilts of love at Baboolya's! But she didn't have the faintest idea where to go.

She wanted to cry! She did for a long time, holding Shu tightly in her arms. What to do? Yes, Vera wondered, what to do? She now realized the mistake she made when Hu left, but that was hours ago.



Try as she might, she couldn't change that. Vera and Shu were lost.

"Next steps are always possible," reflected Vera.

Her mistake was a big one. She couldn't change it now. What's done is done. She could only take the next step.

"Well Shu, what is our next step?"

Shu answered Vera by curling up in a little ball, wrapping his long tail, which you know was very pretty, twice around his head and going to sleep. Since Shu couldn't see anything either, he decided they must wait for daylight. It was the best thing to do.

Shu was right. Vera curled up around her favorite dog and was lulled to sleep by the blissful hum of Shu's favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

MISHA



Misha is a wonderful bear, almost round and three fourths heart. He bounces around his cozy cabin gushing love, especially when he has guests.

Misha was almost ready for his winter's nap. He had eaten his last apples, blue berries, and salmon. All he had left was to finish mommy's last box of cookies.

"What an interesting smell," thought a surprised Misha. Following his nose he soon found Vera and Shu, sound asleep, curled up in a warm little ball.

"Ahhummm! Ahhummm!"

First one eye popped open! Then another! And another! And another! Four big, surprised blue eyes stared up at gigantic Misha.

"GGGGooooood mmmmmorning," sputtered Vera.

"I hope this is a dream!" thought Shu.



"Come along. It's time for tea. My place is just over there near the mountain Mechta." And Misha ambled off.

Half afraid but with no other plan, Vera and Shu followed the bear.

Misha's friendliness and cozy cabin instantly made Vera feel at home.

But Shu wasn't sure. He had never seen anything like Misha! Shu curled up in a little ball by the fireplace, wrapped his long tail, which you know was very pretty, twice around his head and just stared at the bear through the tip of his tail, which you know was very pretty.

Misha and Vera were soon in deep conversation.

"That's just like Hu to ask 'Have you asked the right question?' She never has been quite normal you know. She lived with humans when she was little!"

"I know! Well, Misha, what is the right question?"



Misha rolled with laughter. "It really is very simple. The right question puts fire in your belly! It's like love. If you gotta ask, you haven't found it!"

"I want to understand the universe, but I don't know what to do. I wanted to count the stars, but now I'm not sure."

"Well. . .you can do two things. You can look. And you can think. The astronomer Veed has a wonderful telescope and she can help you look. Veed is just outside my cabin on top of Mechta. But thinking? That is much more difficult."

Misha was deep in thought as they had another cup of tea and more of those delicious cookies Misha's mommy sent him every fall.

"Thinking is tricky. If you ask the wrong question, you can waste 16 lifetimes trying to answer it. You do need the right question. . ."

"Just like Hu said!" thought Vera.



"Yes, thinking is very tricky. You can also search 16 lifetimes and never find anyone who can teach you how. . . Yuummm! I do love my mommy's cookies!" Misha ate yet another plateful.

"Tomorrow we'll see Veed. Looking is a start," Vera decided.

"You must start early. Mehta is very high."

"Is it hard to climb?"

"I don't know. No one has ever climbed this side."

Vera fell asleep, excited about climbing a mountain to look at the sky. A little fire burned.

Shu didn't know what to think. He just watched Misha eat cookies.



Crunch, crunch, crunch.

Crunch, crunch, crunch.

Crunch, crunch, crunch.

Each step across the frosty meadow took Vera and Shu further from Misha's cabin.

Crunch, crunch, crunch.

Crunch, crunch, crunch.

Crunch, crunch, crunch.

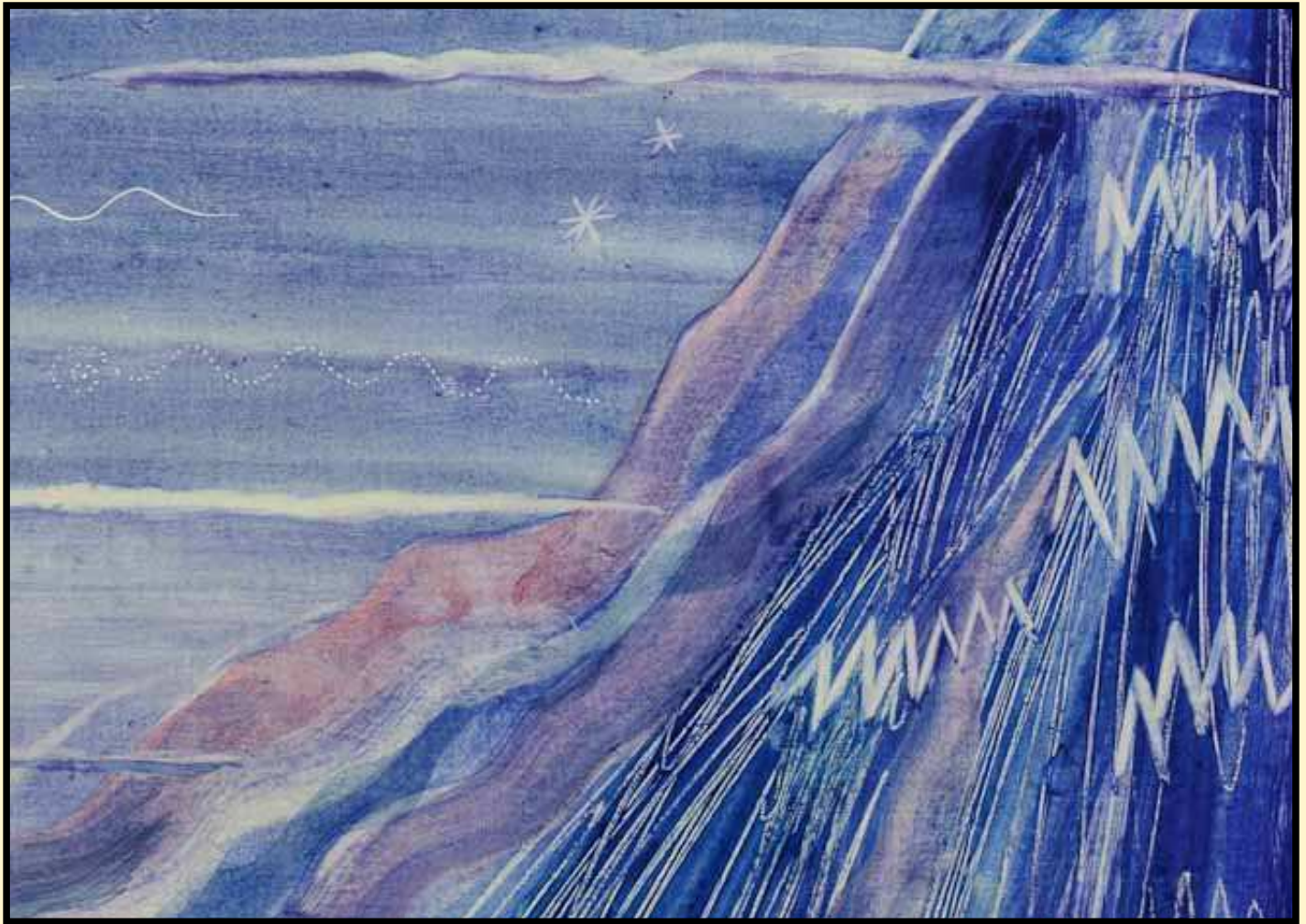
Each step took Vera and Shu a little closer to Mechta's snowy summit, silver in predawn light.

Crunch, crunch, crunch.

Crunch, crunch, crunch.

Crunch, crunch, crunch.

Vera intensely examined Mechta in the creeping dawn. It was crystal clear in some places where to climb. In others, she couldn't tell.



Could they climb it at all? Vera didn't know.

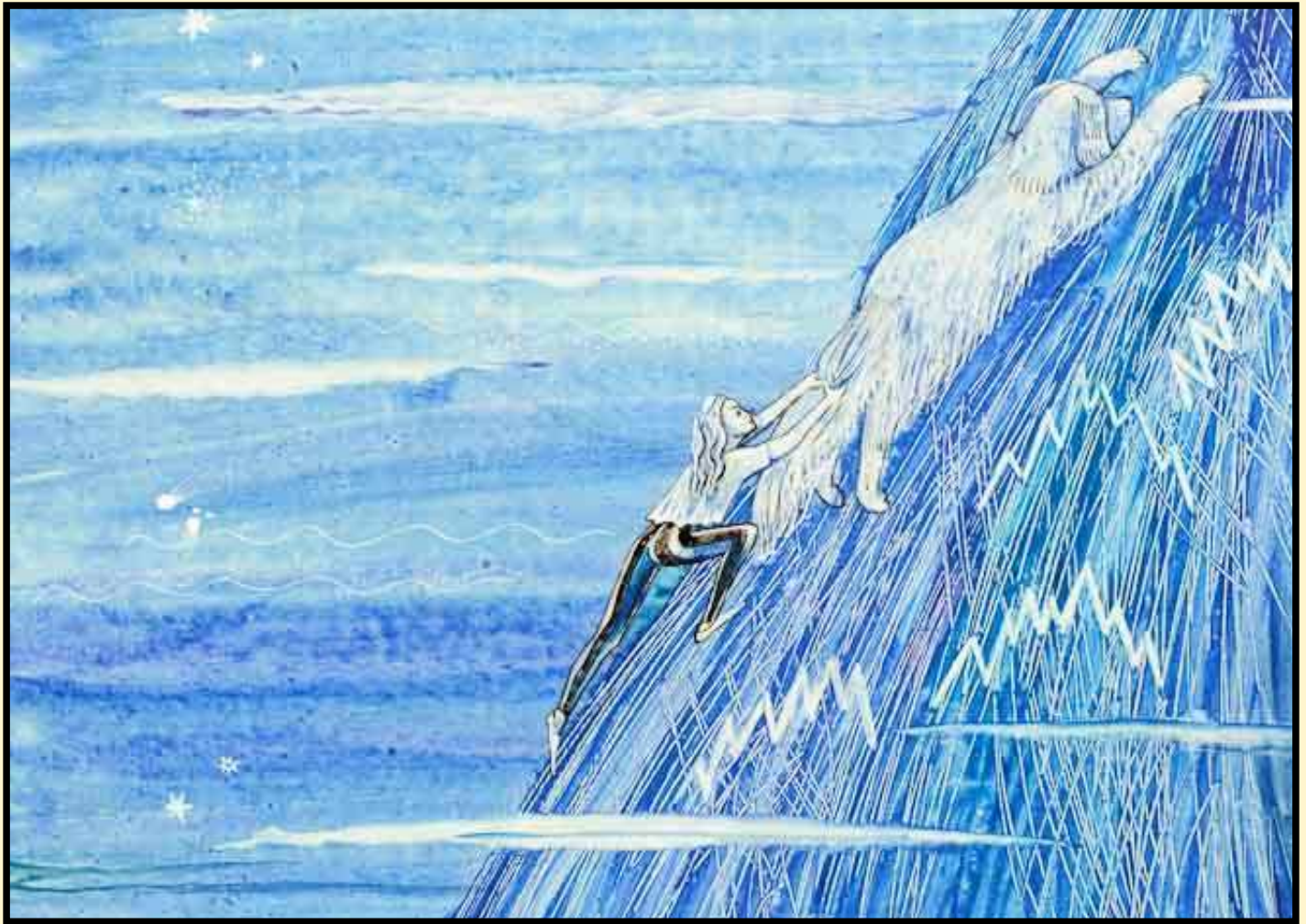
Crunch, crunch, crunch.

Shu was happy to be on the road again, sharing adventure with his beloved Vera. He quietly hummed his favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

The meadow ended in an uphill slope leading to the first rock cliffs. The route Vera had seen from below wasn't too difficult. First left. Then right. Then further right. They made steady progress.

Shu and Vera took a break at the top of the cliffs to watch sunrise. The air was so clean that Vera wasn't sure where the sun would be until it peeked over the ridge. It was a wonderful time to watch the earth turn.



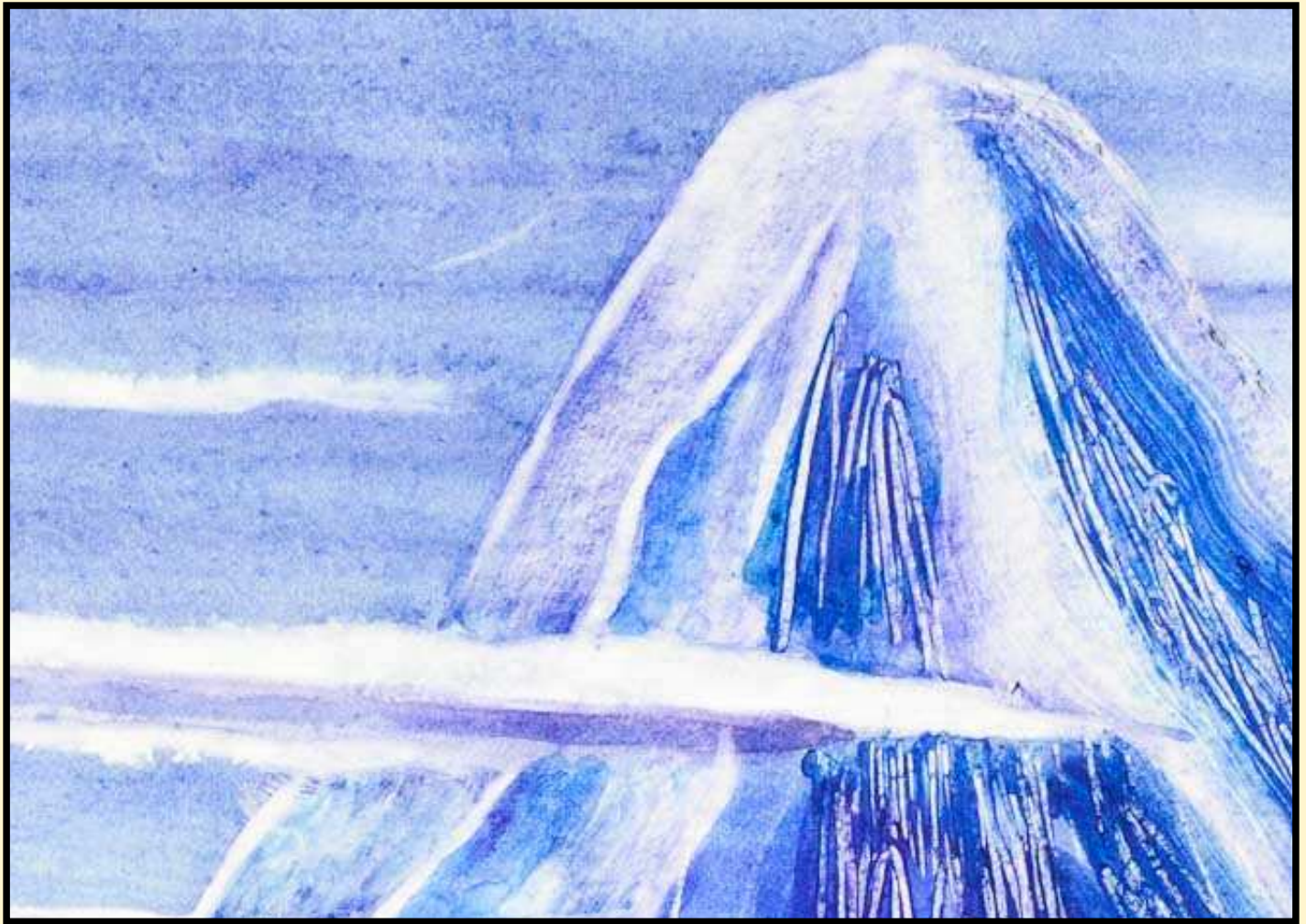
Now there was snow. From below Vera thought this part would be easy. With her first step she knew she was wrong. This snow was old and as hard as stone. Vera couldn't climb it. She tried. She took two steps. She knew that if she even breathed too hard she would slip and fall. Vera just couldn't do it.

Shu had an idea. His first step confirmed that his sharp little claws would give perfect traction. And Vera? She knotted her fingers in the fur of Shu's tail, which you know was very pretty, and held on tight.

In this way Shu and Vera climbed. For hours. And hours.

How many steps does it take to get somewhere? When "somewhere" is far away, it takes a whole bunch. On Mehta each and every one had to be perfect. Each and every one was.

At the end of the snow Vera and Shu ate some cookies from Misha's mommy and gazed over the forest, past their city, to the edge of the world and beyond. Their universe was beautiful.



A final wall of rock separated Vera and Shu from Mechta's snowy summit. The cliff wasn't high, but it was very smooth and very steep. They looked right. They looked left. Hmmmmmmmmmmmmmmmmm. It seemed impossible.

Vera searched and searched. At last she found a few tiny crystals she could squeeze with her fingertips. She hoped there would be more above.

"Let's go, Shu," and like a favorite rucksack Shu clung to Vera.

It was difficult. But Vera always found another tiny crystal. Slowly and carefully she took another step. Each and every one had to be perfect. Each and every one was.

Sunset from their summit was magnificent.



Doctor Veed works alone on the summit of Mehta with the single-minded intensity of the sun. Her telescope isn't big, but it has the soul of the master who crafted it. Together they dance to the music of the universe.

Knock, knock, knock.
Knock, knock, knock.

Veed jumped and bounded for the door! It was the first time that anyone had ever knocked!

"Who are you?"

"I'm Vera and this is Shu."

"Where did you come from?"

"There," Vera said, pointing down.

"Ohhhh! What do you want?"

"To count the stars. . . I think."



"HMMMMMMMM. . .Please come in, but don't touch anything!" Veed made a few adjustments to her telescope and set her alarm. "I'm free for 27 minutes. Let's have coffee."

They went to a warm little room in the corner of the very cold dome. Veed was as curious and interested in her uninvited guests as Vera was about Veed. Shu wanted a nap.

"My name is Veed. I'm very pleased that you are here, but when it is dark, I must work. Tonight I'm measuring red-shifts so I must change my telescope frequently. Please stay as long as you can, and forgive the interruptions."

Vera's mind raced with zillions of questions for Veed, but knew it would be impolite to jump on her like Shu does his favorite bone.

"So, you want to count the stars," mused Veed. "I did too. Every clear night for 6 years I counted stars."

"How many are there?"



Veed laughed and laughed. "One night I checked my work. I went back to the region of Alpha Beta Gamma 4 and counted the stars again and got a new number! When I compared my old photograph with my new one, I saw new stars and blank places where stars had been! The number of stars was changing!"

"Oh. . ."

Veed laughed some more. "Then I looked through a bigger telescope and saw that some 'stars' were really galaxies with billions of stars. I gave up."

"Ohhhh. . . What is red-shift?"

"Atoms emit little chunks of light called photons. Photons from far away are redder than the ones emitted by atoms here in my observatory. The farther away the star, the redder its photons. That's red-shift."

"Do atoms change?"



"No. Photons are redder because the universe is getting bigger. Galaxies are racing away from each other. The further away, the faster galaxies go and the redder their light."

Counting stars? Stars that come and go? A universe that is getting bigger? Light that changes? Atoms that don't? Vera had come for answers and was finding only more questions!

"Beep, beep, beep. Beep, beep, beep." It was time for Veed to work.

When she returned, she found an exhausted Vera curled up around her favorite dog, sound asleep. From under his tail, which you know was very pretty, Shu hummed his favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

SASHA



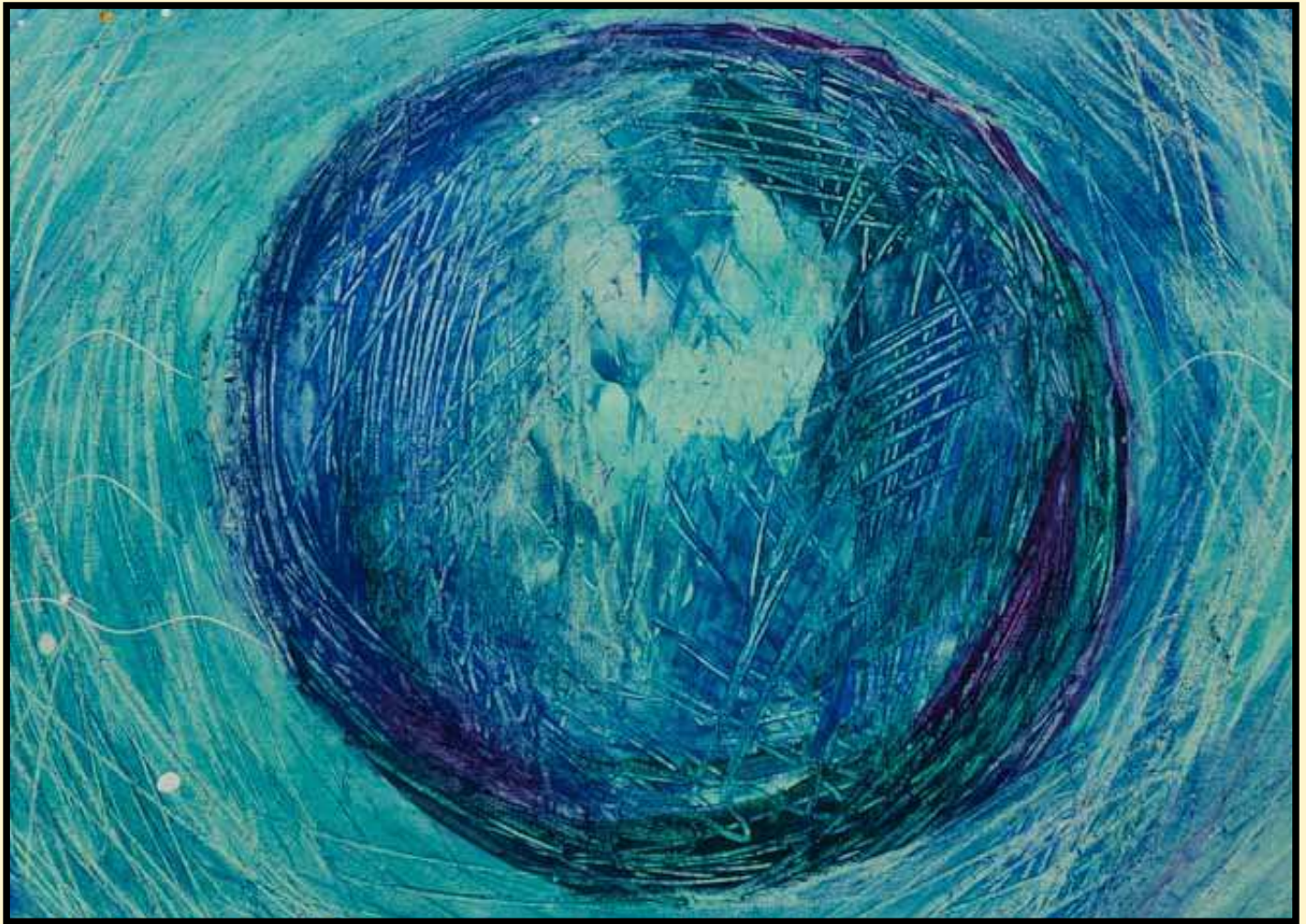
Vera tightly knotted her fingers in Shu's fur behind his ears and held on with all her might. Shu stretched out like a pancake, carefully tucked his tail, which you know was very pretty, and folded his ears sleekly back over Vera's hands. Together, their blue eyes flashed and off they rocketed into the sky!

"Let's go look at that little green speck of a planet two freckles and a hair to the right of and a smidgen and a half below the red star Alpha Beta Gamma 4!" said Vera.

Shu doubled his speed and started singing his favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

Vera was curious, so she set her daddy's old watch. She didn't understand expanding universes, but thought that if the universe was getting bigger, it would take them longer to get back. She would measure it.



Vera watched the stars flash by. They were a bit bluer when Shu rushed towards them. Just as Veed had said they were a little redder as they raced away.

Vera saw a new star in a gas swirl that wasn't there before! Veed was right again. Vera decided that she wasn't going to count stars either.

"So what is the right question? What is the next step?"

Vera noted the time as they passed Alpha Beta Gamma 4.

Shu turned two freckles and a hair to the right and a smidgen and a half down, and headed for that little green speck of a planet.

Vera and Shu circled around this new world. It was a lot like earth, but the colors were a shade different and somehow it had a different "feeling". It looked uninhabited, but there were faint paths here and there.



Then they saw Sasha sitting under a tree watching them!

"I'm Vera and this is Shu."

Sasha's eyes gleamed in smile but the boy was silent. All the same Vera knew his name was Sasha.

Sasha shyly opened his notebook and began to draw. Soon the three of them were excitedly drawing and adding to each others drawings, laughing and smiling and laughing some more. They didn't have a single word in common, but they had understanding.

Sasha was a poet or a scientist or a philosopher or something like that. Sasha knew that Vera was something like that too.

Shu beamed. Even the tip of his tail, which you know was very pretty, twitched with happiness.



When their eyes said good by, they knew they would meet again.

Vera tightly knotted her fingers in Shu's fur behind his ears and held on with all her might. Shu stretched out like a pancake, carefully tucked his tail, which you know was very pretty, and folded his ears sleekly back over Vera's hands. Together, their blue eyes flashed and off they rocketed into the sky!

When Vera measured the time going back she knew she didn't understand the universe.

GLOOP



His mop of silver hair always covered both ears and often his right eye. His left eye squinted over the wire-rimmed glasses crookedly perched on his aristocratic nose.

Institute Professor Doctor Gloop Sir, as he insisted every student call him, had filled all the blackboards 6 times over in his frenzied style.

Vera wanted understanding, but this was painful! So awfully painful! But Gloop is the most brilliant physicist there is they say. Anyone who says so many things that so many people can't understand must be brilliant.

"In summary then, the General Theory of Relativity of Albert Einstein says that space and time are curved by matter.

"The Russian physicist Alexander Friedmann found beautiful solutions to these equations for the universe."

"All right!" thought Vera, "The universe!"



"Friedmann found that the universe is always changing. It began long ago with a giant explosion. But Friedmann found that two different things might happen.

"One is that the universe will expand for a while and then turn around and collapse. If that solution is right, the universe doesn't extend forever. You could count the stars.

"The other solution is that the universe will just go on expanding forever. It is infinite. The number of stars couldn't be counted.

"We know that the universe is expanding because astronomers see redder light from distant stars. Light gets redder as the universe expands."

"Light changes," reflected Vera, "What about atoms?" Her hand shot up to get Gloop's attention.

Most of the time Gloop's nose was plastered against the blackboard as he scribbled still more equations. Vera's hand was in another universe. Quietly, at first, and then louder, Vera called, "Sir!"



Whirling around Gloop searched for the source of interruption. He saw Vera's hand.

"My name is Institute Professor Doctor Gloop Sir, not merely Sir!"

"I'm very sorry sir. . .er Institute Professor Doctor Gloop Sir. But I was wondering, when the universe gets bigger do atoms get bigger?"

"Of course not!" replied Gloop and filled another blackboard with equations describing the size of atoms and how they emit light. "You see everything is constant!"

"But, do the constants change when the universe changes?" asked Vera in her naivety.

"Of course not! We wouldn't call them constants if they weren't constant!"

"Oh. Thank you, Institute Professor Doctor Gloop Sir."



Still squinting at Vera, Gloop saw a furry little ball on the floor under desk G13.

"You! Is that a dog?"

"My name is Vera, not merely You. Yes, it's my dog Shu. He is blind and I'm his seeing eye girl."

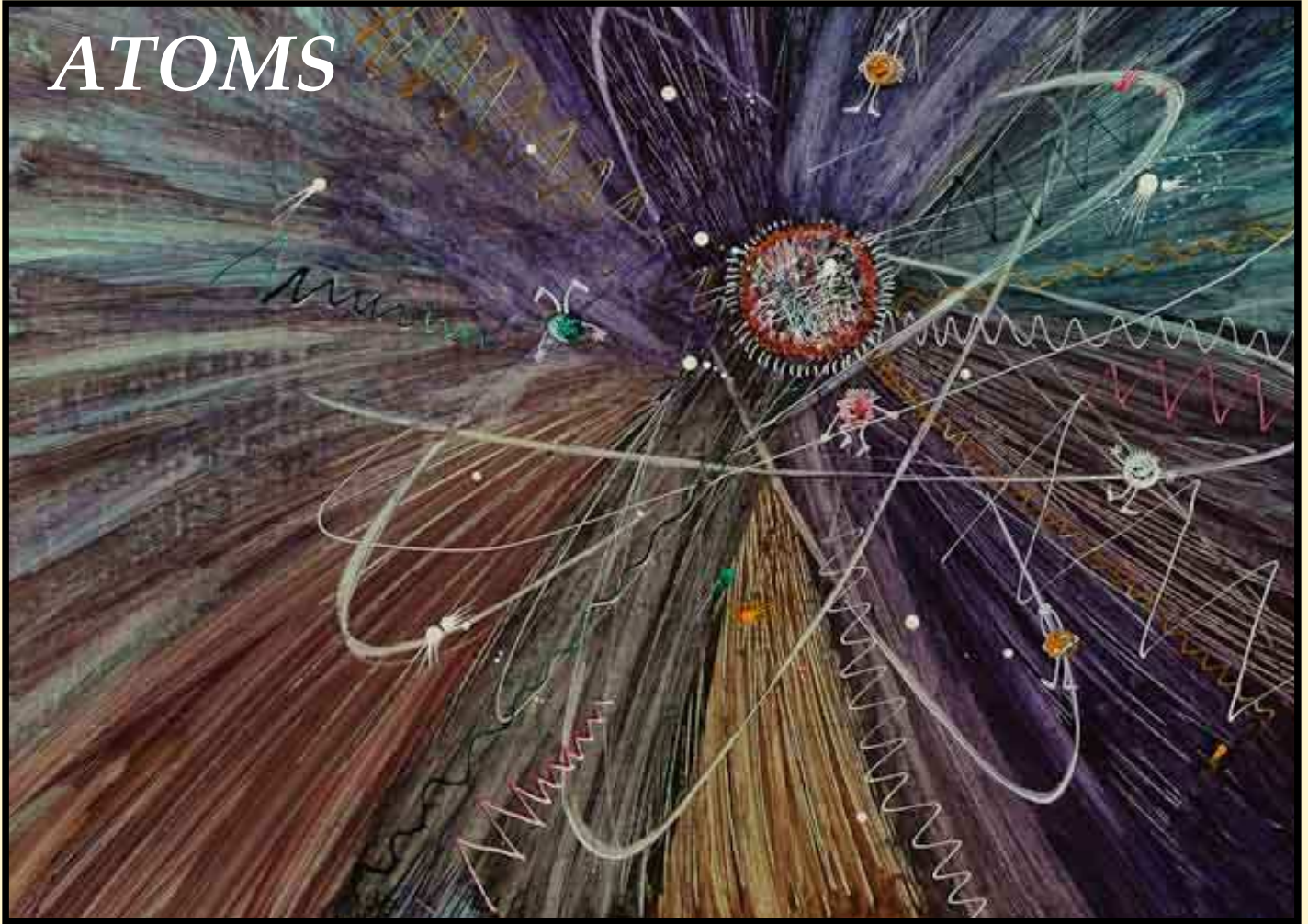
A confused Gloop wasn't sure if his strict rule against dogs in his class covered this case. But turning, he continued scribbling his lecture.

Under his tail, which you know was very pretty, Shu burst out laughing. Gloop whirled around furious. "Who's laughing at me!"

"Excuse Shu, Institute Professor Doctor Gloop Sir. He is very sick. This will be his last day in your class."

It was. A very healthy Shu beamed in delight.

ATOMS



Vera gently petted Shu and looked at the Big Dipper and thought about atoms. Even in his sleep Shu made happy little sounds as Vera stroked his ears and scratched his back.

The occasional crackle of static in Shu's fur reminded Vera that it was electrical attraction between electrons and protons that held atoms together.

The moon was low on the eastern horizon, its crescent pointing precisely at the coming sun. It was another wonderful time to watch the earth turn. Vera was at peace this morning. She now had no doubts about the right question. "Do atoms change?" put fire in her belly.

Her next step? She knew she needed to know something about atoms. Once she asked "Do electrons go around protons like the moon goes around the earth?" She got the answer "Sort of, but not exactly," as near as she could decipher it.

The "sort of" came from Neils Bohr, who explained the hydrogen atom as an electron circling a proton, just like the moon does the earth, except the electron can only travel in special orbits.



The "not exactly" came from physicists who later explained that the electron isn't anywhere until you look for it. Then the electron is somewhere, but not exactly somewhere. They use statistical math and complicated philosophy which they claim to understand.

In each theory it is the glue of electrical attraction that holds the atom together. How strong is the glue and is it always the same? Vera had to know, but she didn't know how to know. For a start she decided to go look inside atoms on the way to Baboolya's.

"Get up, Shu, time to go. Shu! Shu! Wake up, Shu!"

"Maybe if I am very still," Shu thought, "Vera will let me sleep."

Vera and Shu played their Sunday morning game. Like always, the fear of cold water on his furry little head brought Shu to life.



Vera tightly knotted her fingers in Shu's fur behind his ears and held on with all her might. Shu stretched out like a pancake, carefully tucked his tail, which you know was very pretty, and folded his ears sleekly back over Vera's hands. Together, their blue eyes flashed and off they rocketed into the microscopic world of atoms!

"Look out, Shu!"

Tzzzzssssrrrrrruuuuuuuuuuuuuuuuuuuuuu!
Tzzzzssssrrrrrruuuuuuuuuuuuuuuuuuuuuu!

Things whizzed by!

Tzzzzssssrrrrrruuuuuuuuuuuuuuuuuuuuuu!

"Ohhhhhhhhhhhhhhhhh!" cried Vera as Shu desperately wheeled right.

Eeeennnnnnnnneeeeerrrrrrrrrruuuuuuuuuuuuuuuu!

Shu spun left!

Eeeennnnnnnnneeeeerrrrrrrrrruuuuuuuuuuuuuuuu!

And right! Again right!



Tzzzzssssrrrrrruuuuuuuuuuuuuuuuuuuu!

Eeeeeennnnnnnnneeeeerrrrrrrrrruuuuuuuuuuuuuuuu!

"Let's go home Shu!"

Eeeeeennnnnnnnnnneeeeerrrrrrrrrruuuuuuuuuuuuuuuu!

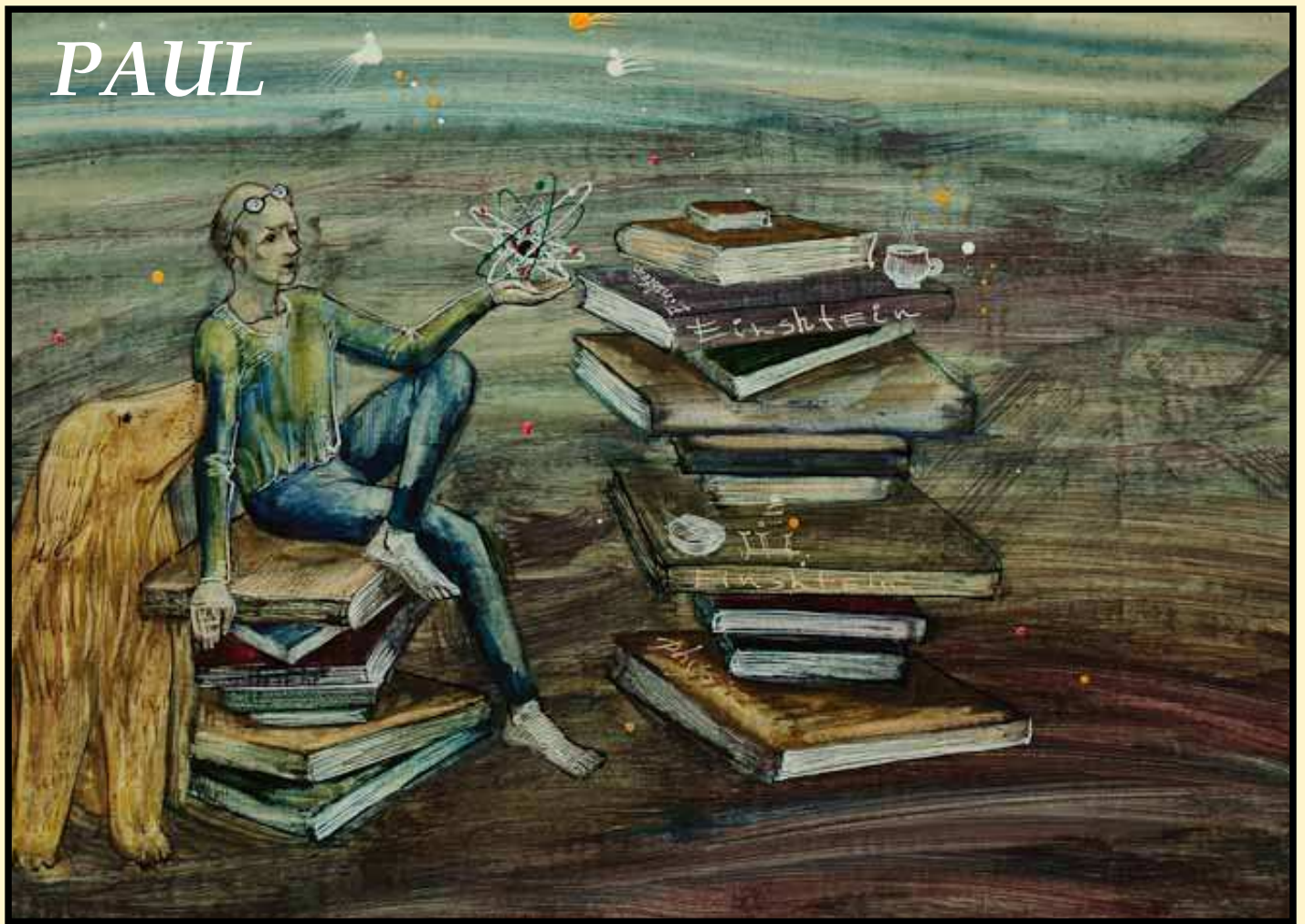
Tzzzzssssrrrrrruuuuuuuuuuuuuuuuuuuu!

Silence! It was over.

For hours Vera and Shu trembled under Vera's blankets. Never, never again would they venture into the atomic world. No. Never again.

Baboolya fried bacon and ham and potatoes and eggs and made pancakes. Shu slept under the wood stove with his long tail, which you know was very pretty, wrapped an extra time around his head. Vera carried food to Grandma's table.

Next steps are always possible. Vera's was to eat all day and sleep all night under 16 quilts of love.



Shu loved the winding, creaking stairs. When he was a puppy, each stair was a cliff to climb. Vera, who was hardly any bigger, pushed. It used to take them half an hour to get to Paul's little cubby hole.

Paul's mop of white hair now was mostly gone, but his blue eyes still danced in total delight when these two were with him.

The swirl of the Institute had never engulfed Paul. He wasn't a brilliant physicist. Nearly everyone understood everything he said. For every plate of food on Baboolya's table there were 6 books and a journal on Paul's. He had only one blackboard and it usually was only half filled after hours of work. Paul's heart beat at a different pace.

Paul laughed with Shu and Vera at their harrowing account of travelling inside atoms. Paul loved problems that put a fire in his belly. It didn't matter whether it was physics or climbing another mountain or helping Vera learn to walk. Vera's problem "Do atoms change?" became Paul's too.

Vera and Paul decided to rocket into the universe of mathematics to look for an answer. For months they blended new guesses with careful deduction in their search.



Shu often watched them from his basket by the window and sang his favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."

Vera and Paul were lost. They fumbled and stumbled. They sat. They went for walks. They continued to search. They found a path.

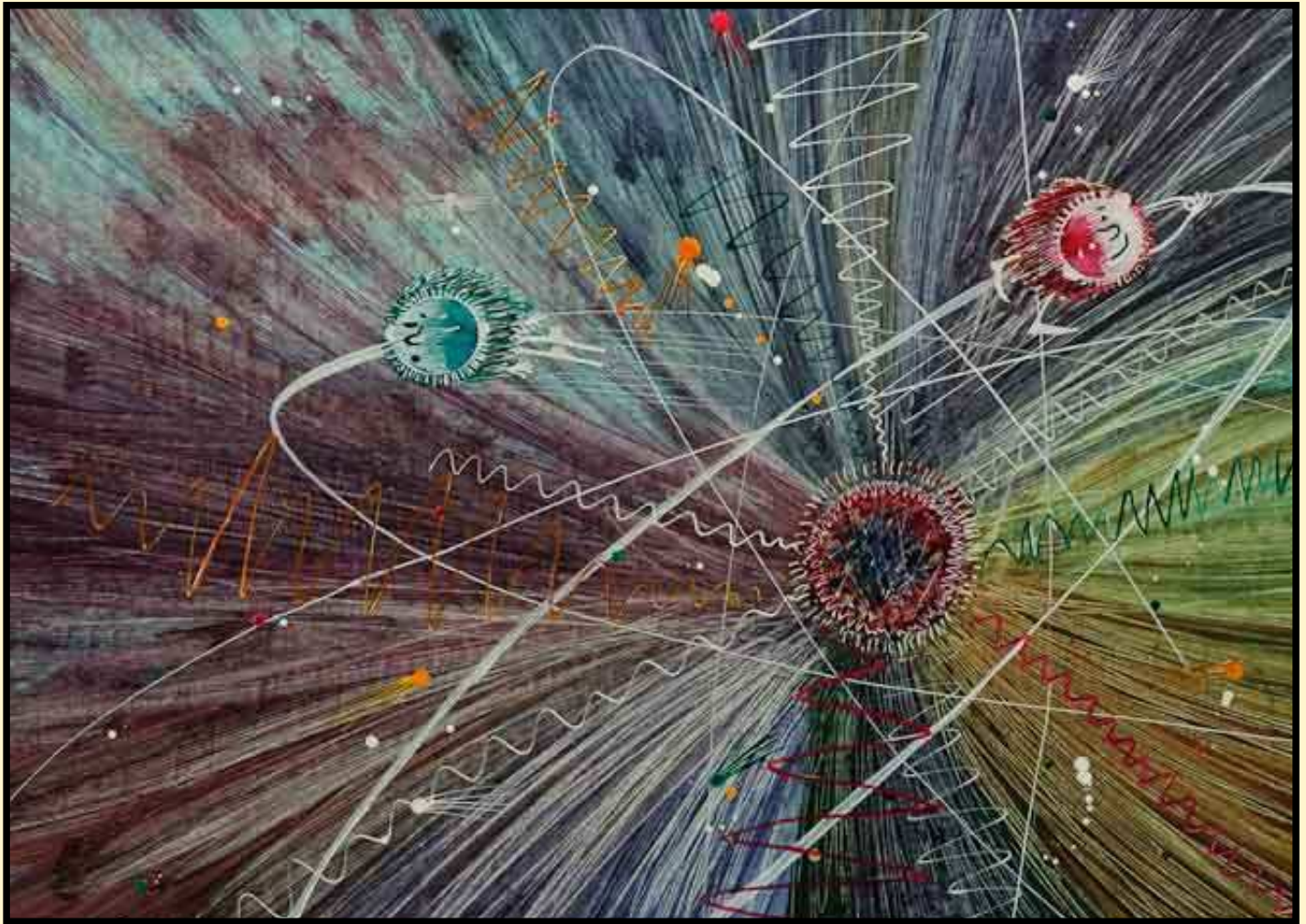
"If atoms change, electric fields inside must change. Right?"

"Maybe."

"What changes when the universe changes?"

"Geometry. Let's think about electric fields in Friedmann geometry."

Vera and Paul studied Einstein's dance of geometry with electricity. They discovered that electric fields do change and that atoms grow precisely like the expanding universe.



"Do atoms change?" They do!

Euphoria turned to wonder when they found that atoms change twice as fast as photons.

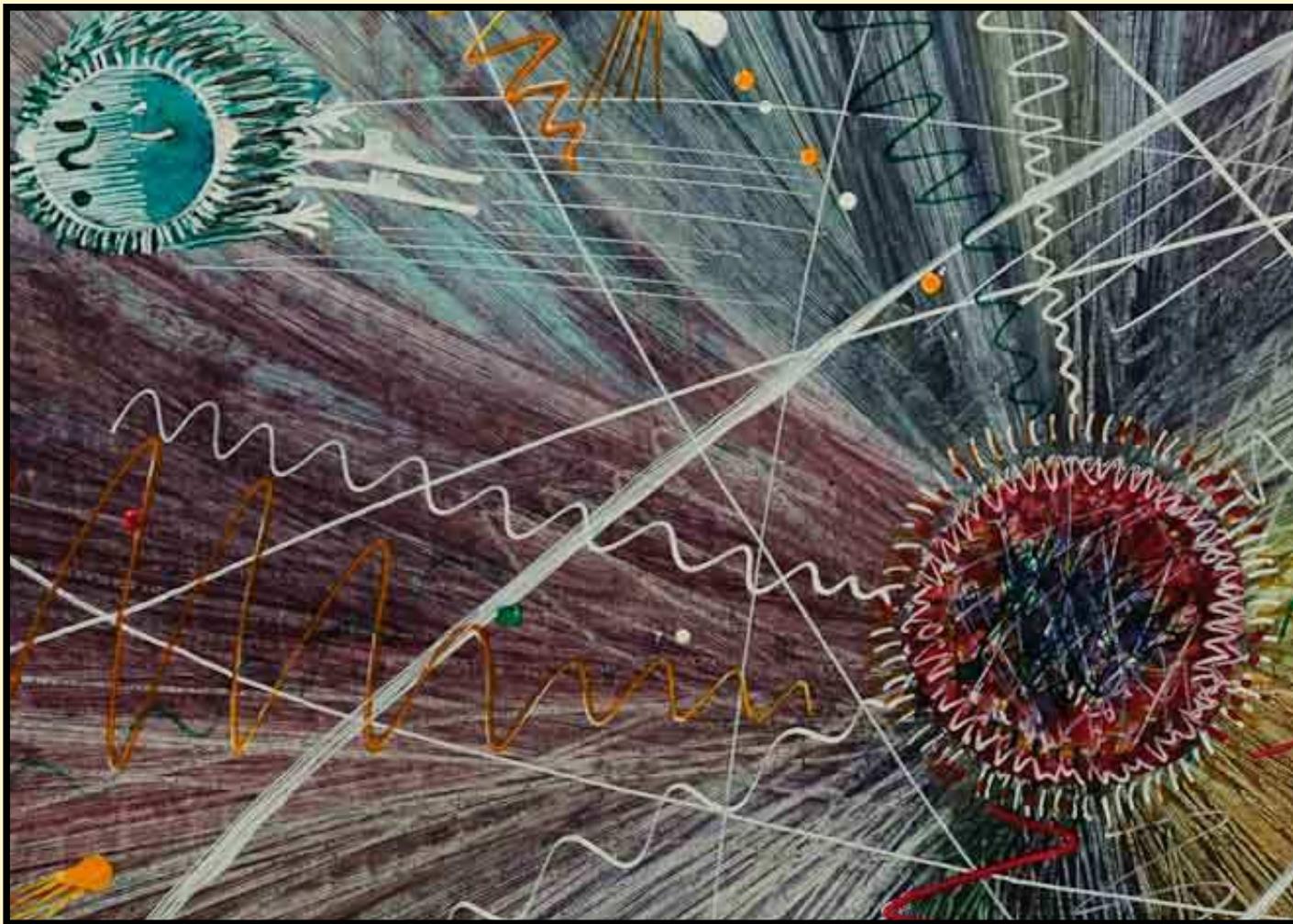
"Oh no, that means blue-shifts. Astronomers see red-shifts."

Blue-shifts? This was their reasoning. Veed measures old photons that are redder than when they started years ago. New photons from the same kind of atom today are twice as red. Comparing old red photons against today's even redder atoms, Veed would find photons have turned blue.

So where was their mistake? Vera and Paul looked and couldn't find one.

Then Vera understood why the return time from Alpha Beta Gamma 4 was shorter. The universe had gotten smaller in the time they were with Sasha.

In a flash, it was clear. Veed would see red-shifts if she compared blue-shifted photons against atoms that are twice as blue. The universe is contracting not expanding!



"We've had it backwards all these years."

They double-checked their physics. Each and every step had to be perfect. Each and every one was. The universe is collapsing.

They celebrated in their traditional way.

"Two large #10 pizzas with extra cheese, please."

LADY BUG



Shu and Vera loved spring.

Shu was stretched out flat soaking up the warmth of the sun, the air, and the earth. He was sound asleep.

Vera was stretched out flat too. She was watching a lady bug.

For hours this little red and black lady bug had been crawling up and down, left and right, out and back. It explored every blade of grass, every plant, every twig, every leaf. Now and again it paused and just sat.

"Is the lady bug sunning itself, resting, taking a little nap, or what?" wondered Vera. Then the lady bug continued its travels.

On one leaf the lady bug lifted the hard shells covering its wings and took off flying right at Shu. A puff of wind reversed its direction and it crash landed back to the left. With hardly a pause it began crawling again up and down, left and right, out and back, exploring every blade of grass, every plant, every twig, every leaf.

"How do lady bugs know what to do? Why did it fly right and not left? Do lady bugs think? Do they have fires in their bellies?"



Once in the fall Vera had seen hundreds of lady bugs sitting bunched together on a sunny rock poking through fresh snow on the summit of a mountain. What were they doing?

Yes, it was spring. Vera was filled with questions.

"Do atoms change?" had been the right question. The answer "They do!" and the remarkable conclusion that the universe is collapsing filled Vera with more questions.

"When will it end?" Probably in a few billion years, but Vera didn't know.

"What will happen after it ends?" Vera didn't know.

"Are our theories that describe our universe perfectly correct?" Vera didn't know.

Yes, it was spring.



Vera gently petted Shu. Even in his sleep Shu made happy little sounds as Vera stroked his ears and scratched his back.

"Get up, Shu, time to go. Shu! Shu! Wake up, Shu!"

"Maybe if I am very still," Shu thought, "Vera will let me sleep."

"Shuuu!" Nothing. Shu pretended to sleep.

"Shuuuuuuu!" Still nothing. Shu didn't move a hair.

But Vera knew his game and said with a twinkle in her voice, "Very well, I'm leaving without you. But first I am going to dump this glass of ice water on your furry little head!"

In a flash Shu was ready to go! He never knew if Vera was kidding, but he was deathly afraid to find out.



Vera tightly knotted her fingers in Shu's fur behind his ears and held on with all her might. Shu stretched out like a pancake, carefully tucked his tail, which you know was very pretty, and folded his ears sleekly back over Vera's hands. Together, their blue eyes flashed and off they rocketed into the sky!

Shu doubled his speed and sang his favorite song.

"Bu dittle, blu daddle. Su bittle, slu baddle.
Ku pittle, klu paddle. Gu tittle, glu taddle.
Dittle, dittle, tot, tot."



VERA

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