

**HERR PROFESSOR
DOCTOR GUSTAVE
M. SQUIRREL AND
HIS STUDENT
ALBERT**

BY

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German, not a tongue I had ever been fond of, perhaps too much television after the War. So as I sat there working the pots as usual, I was struck by the cackling above me as Antnee was trying out his German on his fellow squirrels. I had no idea

what he we counting but he did so in German, a strange thing for a squirrel who purportedly had Italian roots, as best as any grey squirrel could claim.

1 ANTNEE AND HIS CORN COB

I was trying to get the pots in order and I kept hearing the mumbling of the squirrels above my head. Then out of nowhere, I get struck upon the top of my head and the object bounces onto the ground before me. It was a fully eaten corncob, and it was totally bereft of any kernels of corn, chewed

down by that hungry collection of furry friends.

I looked up and shouted:

"Hey you guys, I am down here! Stop trashing the yard with your used food. Find some other place to drop them!"

Then a scurrying ruffle was heard through the branches, and just as he is always wont to do, good old Antnee jumped limb by limb, down to where I was. I looked at him and said:

"Was that your ear of corn?"

He smiled and said:

"Sir, no Sir, that was young Albert squirrel. He just eats the last of everything and then, whoosh, Sir, flips it over the side. I have spoken to his parents Sir, but the new generation,

you know Sir, they have no manners. They just let their children do whatever they wish Sir, truly like barbarians, Sir, so unlike us, indeed so unlike us Sir."

I briefly thought this here was my grey furry friend saying that he and I were of the same older generation and that these young ones were so uncontrolled. Imaging that, humans and squirrels with the same generational problems! I was amazed.

Antnee scrambled down, looked at me, and continued:

"Sir, you are unhurt Sir, I do hope, no wounds Sir, no wounds?"

I replied:

"No my good friend, a bit startled but other than that, woundless. But

perhaps you could tell me why the German lessons? Are you helping the young ones with their education as well?"

He scurried atop the bird feeder, or perhaps correctly called the squirrel feeder, and stretched out looking me in the eyes and I could see his rather corpulent buttocks billowing over the wooden plank which was the top of the feeder support. He then said:

"You see Sir; I have the responsibility to give them some culture. German is something which I believe Sir trains the mind. It is a structure language, one that many of the great minds of the past used. I believe Sir that the young should have some exposure to culture, difficult as it may be Sir."

Interesting but it made little sense to me at the time. Thus, I asked,

"But why German, what is so famous about German. It is not one of those languages that we speak today. Italian I can see, since many of you had come from Italy, a nice sweet language. French, now there is a structured tongue, sophisticated, complex, like the French mind."

I continued:

"Spanish, so many of the workers speak a dialect of it and it is truly a simple language. Of course, your lessons could be in Latin or Greek from your past tales. But why German?"

He placed his front paws under his chin and wrinkled up his nose before responding. Then, and now I could see I was in for another tale, he responded:

"You see Sir, I was also telling them about the story of Herr Professor Doctor Gustave M. Squirrel and his pupil Albert. Gustave, I use his given name Sir, to keep it simple, those German titles Sir, like Spanish names, Sir, so long, so important, but Sir, Gustave was Swiss, not German, but German Swiss, Sir, if you know what I mean."

I was a bit startled, a Professor, a Doctor, what kind of squirrel was this and who I wondered was this Albert that required educating the inhabitants of my trees in German. I asked, which by now I knew was the protocol with Antnee,

"Now just who is Albert and I guess Antnee you should tell me more of Gustave."

He smiled, and rolled around on his now rather comfortable belly and started what I knew was to be a long and intriguing tale.

2 GUSTAVE AND ALBERT

"You see Sir, Herr Professor Doctor Gustave M Squirrel was a brilliant Professor of Physics, world renowned Sir, in our world, Sir, a great and wonderful teacher Sir. He lived a hundred years ago or more in Bern, that Sir is in Switzerland. Just outside of the main down town area."

He was now on a roll. I knew where he was headed, and that it was a tale worth hearing and also worth getting a lawn chair for. I stopped Antnee and said:

"Antnee, just stay there I will get a chair. I have been potting all morning

and at my age the old back can take so much."

When I returned he had remained in his comfortable nook and the shade was cool despite the warmth of the summer day. So here I was on my lawn chair, in my garden clothes, hat in hand, looking up at my friend who without a moment's hesitation restarted his tale.

"You see Sir, it was 1903, and Bern is the capital of the Swiss cantons. They have no true central Government Sir, not like yours, and the Swiss, well Sir, the Swiss are a bit different. They keep apart from the others, they have the mountains, and they have a mix of French, German, Italian and even a small tongue called Romansh, like a Latin tongue. Bern is on the Aar River, Sir, a beautiful site, mountains to the north and south, a high plain with

many trees, a fine place Sir for squirrels. Not that we do not enjoy New Jersey Sir, for indeed we do, you are all so friendly here."

I found that rather humorous, well New Jersey is not that bad, we have been here thirty years plus and after all I have Antnee and his friends, what more do you want.

Antnee then continued:

"Sir, Gustave had studied Physics in Berlin, a student of Planck, and he was a good friend of the great Professor. The two would talk a great deal about physics. Then he had to leave Berlin, family issues Sir, we squirrels you see Sir, we have them like you. His mother was in Bern, and he had a brother who had some problems, Sir, you know the type."

I sat there now totally bewildered. Now we have squirrels collaborating with the great minds that created quantum mechanics, Planck amongst them. I really wondered where this tale was going. And as usual Antnee was now totally engrossed in his story telling, I could see by the wiggling of his nose and the flittering of his whiskers. He was truly into the tale. As now so too was I.

I asked:

"So when this famous squirrel returns to Bern, then what did he do?"

Antnee replied:

"Good that you should inquire Sir, for he took care of his ailing mother, an aged old woman, but Gustave loved her dearly Sir, you know how mothers are Sir, for we all have them."

Here I am imagining squirrel mothers, and I wonder if there is a Freud for Squirrels as well, it is the old hand that rocks the cradle argument, or whatever it is for squirrels. The possibilities are spinning in my head!

Antnee rolled a bit on his belly, seeking a more comfortable perch, anticipating the long tale was just beginning. He then continued:

"Well Sir, it was one fine day in September I believe Sir, yes indeed it was September, in 1903, that Gustave was in the fine park in Bern, taking a Sunday walk, when he noticed below him on a park bench a young man who was so intense that he jumped down to the ground to observe him better. This young man has a mustache and a round head, a head of hair which was a bit wild and almost furry like. So

Gustave walked in front of this man, looked up at his face and he could see the level of intensity of thought that was quite high. He thought that perhaps he could assist this inquisitor into the laws of nature and thus Sir he spoke out."

Gustave then spoke to this intense young man:

"Sir, good Sir, may I perhaps be of some assistance, Sir, you appear so intense, so concerned, perhaps I may assist you in your quest?"

Antnee continued:

"The man was a bit startled, for he could hear Gustave and he heard the Berlin German, that high German tongue, which he had some familiarity with, but he saw no one in front of

him. He appeared even further confused. Then Gustave said:

"Down here Sir, at your feet."

The man looked down and to his abject surprise was Gustave, a grey squirrel with hair atop of his head all long and furry and curly, almost electrified, a bush like head of squirrel fur, and his whiskers looked like a moustache, a thick grey moustache. The man said to Gustave:

"And who or what are you. Squirrels are not supposed to speak my little friend. Do you have a name my small little creature?"

Antnee then became a bit agitated. He continued:

"Sir, you see Sir, Gustave came from the old German, if I may say Sir, the

Prussian way, and one did not talk to a Professor that way, especially one who has studied under Professor Planck in Berlin, one did not talk so freely Sir, you understand, so Sir, Gustave then spoke so as to inform this young man who he was. He said:"

"I am Herr Professor Doctor Gustave M Squirrel, late of Berlin, where I studied with Professor Planck. I am not, my young man, some plaything that you can address so casually. Now that you know me perhaps you will be so kind as to inform me as to who you are and why I should waste my time attempting to assist you in what appears to be a significant plight."

The young man was startled beyond belief. His first reply was:

"I apologize...did you say Professor Planck in Berlin....you know him?"

Gustave replied:

"Know him, my young man, I not only know him but we worked together developing his theory of radiation from black bodies. I suggested some of the key elements; I ran tests on the infra red spectrum, why young man without my help the good Professor would still be working with those dumbkofts from Munich who act as lab assistants."

Gustave took a breath and then continued:

"So young man, who are you, what is your problem, and since you know who Professor Planck is tell me what interests you in physics."

The young man responded:

"My name is Albert Einstein; I work at the Patent Office here in Bern. I studied in Zurich at the Polytechnic, and I truly want to be a Physicist, I so envy you my furry friend, to have known the great Planck, for here I am a humble employee of the Patent Office."

Gustave replied:

"Pity is so unbecoming Sir, and self pity the worst. You are what you are and you will be what you make yourself to be. You seem bright Albert, if I may call you so, perhaps you may become my student, since I too find myself in Bern, and perhaps I can teach you so that we both may learn?"

Albert looked down at the wise squirrel and replied:

"Oh Herr Professor that would be kind. I have so many ideas in my head, I

have very few to talk about them with, so few."

Gustave replied:

"Albert, you have good fortune, for you can think without the burden of the Academy. The Academy as we all know it has far too many distractions, meetings, conferences, affairs of protocol, too much overhead as one can say. Here in Bern, at your quiet Patent Office, you can do your day work, and then we can meet at night and start our true work. Are we agreed Albert?"

He replied:

"Herr Professor, I look forward to this."

The Antnee looked at me and said:

"You see Sir; another case of squirrel leads man, Sir, and a most famous one indeed."

I then said:

"Well Antnee, what happened, don't tell me that Gustave invented relativity and the like!"

Antnee sprang upright in an almost scolding manner and replied:

"Sir, I am disappointed in you Sir deeply disappointed. You see Sir I am not finished with my tale, for there is much more to tell, you see Sir, Gustave helps young Albert, for indeed young Albert is quite smart, yet he is alone in Bern, despite having been recently married, he feels, shall we say, that at so young an age that all may be lost, and it is Gustave that makes him take hold of what he has and build upon it

Sir, not create it. For Gustave Sir was a great teacher, not one with the answers but one with the questions. You see Sir; it is having the right questions, the important questions, the properly phrased questions Sir that are as important as having the answers. Thus Albert had Gustave to help him with the right questions, and also to give young Albert a true sense of his own abilities."

I then asked:

"Well Antnee, then what happened? Did Gustave teach Albert?"

3 THE LESSONS

Antnee then spoke on:

"Then Sir, every week they would meet in the garden in Bern, summer or winter, Sir, cold, heat, sun or rain,

there they would meet and talk. You see Sir, Gustave was both a teacher and since the passing of Albert's father he became a father to Albert, the father Albert did not have in life, a wise squirrel Sir, a true teacher and soon to be true friend. Each week they met and talked, for Albert was given lessons to read, things to think about, many things. For it was at this time Sir that physics was changing. And it was Gustave who understood the change. Gustave's famous dictum to Albert Sir was always "The world is filled with uncertainty" and he insisted that Gustave learn to deal with it. For in Albert's world sir, a world of physics at the time, all was certain."

Antnee continued:

"Thus each week, Gustave would walk about the park, it was along the edge of the River Aare, and they would

walk, sit, talk. Gustave would tell Albert:"

"Albert, physics is about understanding the universe, big and small. There are so many things we yet understand. You can select whatever ones you want. Unlike at a University, you do not have a niche, a corner, you can look at many, some good, some you should abandon. And Albert, physics is understanding the phenomenon, explaining it, digesting it, so that it becomes part of you. You must learn to get the idea, have it digested in your brain, create thought experiments to test it, you do not need a great laboratory with many assistants, you just need your brain, and you have a very good one. And Albert, avoid the mathematics until the very end and keep it simple. One can always get lost in lots of equations, lost and forever trapped in the love of

manipulating them. I have seen many students Albert who believe that because they have equations they have discovered something. The discovery is in the mind not in the equations."

4 PHOTOELECTRIC EFFECT

Antnee rolled around a bit, and nibbled on a few sunflower seeds, I said to him:

"Antnee, perhaps you are eating a few too many seeds. You seem to be getting a bit plump."

He smiled and responded:

"Ah yes Sir, but they are so good, my thanks to Lady Sara. She selects the best of foods. I especially liked those apples, and she cuts them into fine small pieces so I can take them home and eat them at night before I sleep."

I replied:

"Antnee that is not my point, you are getting fat; your butt hangs over the side of the feeder!"

Antnee smiled again and said:

"Ah Sir, the joys of the contemplative life. Why Sir, if there were no food here we would have never met. Besides we squirrels do not suffer as you humans do, I just save it all for winter."

I gave up. He was just plump and there was nothing I could do. He finished off a few dozen more sunflower seeds and then said:

"Now where were we Sir, ah yes, the first true discovery. Well Sir, it was in the fall of 1904 Sir, the leaves had dropped and Gustave and Albert were

on one of their walks, and when the wind blew down from the mountains, across the garden lawn, it created waves of leaves, mass waves, Sir, and Gustave was jumping in and out of the waves, when all of a sudden he was hit with a large magnolia leaf, slap, right in his frizzy haired head. Well Sir it knocked Gustave over and down. Then Sir, Albert walked over to see if Gustave was all right. Well Sir thankfully no harm was done."

I stopped him and asked:

"Well Antnee how does this lead to a great discovery?"

Antnee replied somewhat scolding manner:

"Sir you must have patience Sir, for discovery comes often from observing the most common things in an

uncommon manner, the prepared mind Sir, the prepared mind."

I said:

"Okay, okay Antnee, I will be patient."

Antnee continued:

"You see Sir, Gustave and Albert had been talking about Maxwell and his theory of waves, light waves and electromagnetic waves, you know Sir radio waves. So the two of them had been trying to understand the ether of Maxwell, when Gustave emerged from the pile of leaves and shouted to Albert:

"Albert, they just look like waves Albert, they just look like waves, they are really particles!"

Albert ran over to Gustave and said:

"Herr Professor, what do you mean?"

Albert responded:

"The leaves, Albert, they looked like waves but that was from afar and especially when you are big like you. But when you get down here, it is not the wave that hits you it is the leaf! It is the leaf, the particle. Maxwell is describing the average in the large, but on the small, like me Albert, it is a particle!"

Albert stepped back and like a flash of lightening, he suddenly saw:

"Then Herr Professor, say light shines on a metal, and then it emits electrons, then the light that hits the metal is really a, say we call it a light particle, it is that particle that breaks loose the electron!"

Gustave replied:

"Exactly Albert, it is a particle, yet in the large it is a wave. One and the same, Albert, one and the same. Now Albert, to work, I have some ideas which may help you, ones that Professor Planck and I had developed. To our study Albert, to our study!"

I was amazed. Here was Antnee telling me it was Gustave Squirrel who gave Einstein the idea for the photon and the photoelectric effect. It was that paper which won the Nobel Prize for Einstein more than a decade latter. Here I am being told that Professor Gustave discovered the effect by getting hit by a dead magnolia leaf in the garden in Bern! You cannot make this up!

Antnee could see my incredulity, and he said:

"Sir, perhaps this is a bit too much for you today?"

I replied:

"No, that is not the case; it is just that your tales of squirrels are such that we humans just kind of do what you squirrels tell us."

I heard snickering above my head and looked up. It was Maria Squirrel, she was listening intently. Then I looked around, the branches were filled with up to fifty squirrels, all intently listening to the tale, it was a scene from an Alfred Hitchcock movie but without the terror. It was as if Antnee was lecturing to a large classroom of his own students. I now also had an audience, since they were not only

listening to Antnee regale them of the wisdom of the squirrel, but they had been observing my own education at the feet of this master teacher, my friend Antnee.

I replied:

"Okay Antnee, then what happened, don't tell me Gustave wrote the famous paper!"

He replied:

"Oh no Sir, it was Albert, indeed it was Albert. Gustave just assisted him along the way, as we squirrels are wont to do."

He continued:

"May I continue Sir, may I continue?"

I smiled and answered:

"Antnee, of course, this is getting more interesting by the minute."

He continued:

"Well Sir, they went back to Albert's small rooms, his wife was busy, she Sir for some reason did not like squirrels, not like Lady Sara Sir, but alas there are always a few Sir. There Gustave started the conversation. He said:"

"Albert, when I worked with Professor Planck we developed the expression for the emission from a black body radiator, that small black cylindrical hollow ball and we developed a formula assuming that energy was, let us say, quantized. Now Albert we can use that result to show the entropy of the radiator."

Then Albert replied:

"But we can also use the entropy equation to show its relationship to the volume."

Albert began sketching equations and the Gustave stopped him:

"Remember Albert, think this through, and then write the equations. Now think Albert, where does this lead?"

Albert thought and then smiled at Gustave and said:

"Why Professor, this means that if we have a single color of light then it consists of a whole bunch of particles of light, each having the same energy, like the leaves in the park!"

Gustave replied:

"Just exactly right. Now one more thing, and then you can write. There are many experiments with light. Remember when you shine light on copper, cesium potassium, and other materials, the light turns into electricity, namely it bangs off electrons, which if we place the material in an electric field we can get a current of electrons and control it with a battery. The flow of electrons is instantaneous. If the light were a wave it would take time to build up, like a wave on an ocean cliff, it does not collapse all at once, it erodes. But like a leaf hitting my head, the unit of quantized light energy hits an electron and then bang off it goes, to the other end, a current."

Albert said:

"Herr Professor, that is exactly what happens. May I write now?"

Gustave replied:

"Albert, now write."

Albert wrote all night, word after word. He did not sleep and in the morning, without waking his wife, he left for work. Gustave looked over the paper, moving page by page and he smiled and said to himself:

"Not bad for a young human, even if I say so myself!"

5 BROWNIAN MOTION

At this point I was near exhaustion. It was a tale from some thriller novel, trying to understand who did what to whom when. But I was amazed at how well Antnee told the tale. And of course the Professor Gustave, a rather interesting fellow, if indeed he ever

existed, but to Antnee and his students now lining the tree branches above my head, Professor Gustave was not only real but typical of the intellectual squirrel. I could see the muse theory, thus Shakespeare and Chaucer made sense, even Marcus Aurelius, but a scientist and Einstein of all of them, rather extreme indeed.

Antnee now reassembled himself and looked down and started anew:

"Now after a couple of months, spring came and Albert and Gustave sat aside a small pond. Albert had submitted the first paper and the two of them looked quietly at the water surface. There were skating spiders. Moving back and forth across the small waves on the pond. Albert remarked:

"Their movement, totally random, like the flies in the air above us, see Herr

Professor, they go one way, then change and fly another, no sense to their movement, both direction and distance being almost chosen at random."

Gustave replied:

"Albert, look also at the pollen from the pines, the air blows it in one direction but despite that the small pollen grains float in their own random paths. I had read a paper by a Professor Brown in England who described this motion for pollen in water; I can see it here at the edge of the pond, just bouncing about."

Then Albert replied:

"I think we should next try to explain this motion. It may be of use."

I stopped Antnee and said:

"Ah, now we are going to attribute the Brownian motion paper to Gustave as well. Did Einstein do anything?"

Antnee looked serious from up on the feeder perch and replied:

"Sir, you can see Sir that he did indeed do a great deal. You of all people should know what Einstein did on Brownian motion, for you Sir are an academic direct descendent of the famous Gauss, are you not Sir. And also Sir's book was not your first book on such a topic as was Einstein's work."

I replied:

"Yes indeed, but I did not get a Nobel Prize!"

Antnee replied:

"Ah correct Sir, but we had not met back then Sir, had we."

I paused for a moment and thought about what I had just been told. Antnee was starting to position himself as the lecturer and I was becoming the student, a rather strange thought. But oh well back to the tale. I replied:

"Okay Antnee back to Einstein!"

As I said this, I could see Maria Squirrel and all the rest above my head settle themselves in a resting position to listen to the now great story teller. As I saw this, I better understood the dynamic in this rather strange community.

Antnee then continued the story:

"Well Sir, Gustave then met several times and spoke with Albert. They discussed many things, but Gustave helped clarify them. One afternoon, after many talks Gustave said to Albert:"

"Albert, the particle movement is like a butterfly trying to move in a swarm of mosquitoes. The mosquitoes are all flying around; they are small compared to the butterfly, but there are many of them, all flapping their wings. We know that the hotter it is the more they flap their wings and bang ever so slightly into the butterfly. Thus the butterfly is changing its direct every so often as it collides with the swarm, and its movement in many ways is akin to what we are discussing."

Then Albert replied:

"Ah, Herr Professor, then if we take that analogy and apply it to a mixture of say water and larger molecules, we see the same thing. The water is akin to the flies, their wings vibrating and like the water vibrating under higher and higher temperatures. The larger molecule, our butterfly moving about in the Brownian motion manner."

Then Gustave said:

"Yes Albert like motions we are all very familiar with!"

Albert replied:

"Ah I see Herr Professor, on one hand they move like lake particles in some form of osmosis and at the same time balance by diffusion. The pressure of the osmosis and then the removal of that by diffusing. Like crowds in a train station, they all come down the

stair rushing to catch a train, they cling by osmosis and they spread apart by diffusion and in the end, the two forces must balance. Yes Herr Professor, I did something like that for my doctoral thesis, let me show you."

Then the two of them worked through the details and in the end, just about three hours, they arrived at the constant term, which described diffusion. A very simple term. I showed how the rate of the diffusion, or the spreading out of the butterflies or people was dependent on a few simple variables, temperature being one. Then Albert said:

"Ah, Herr Professor we have a wonderful relationship, but how do we now relate this to the particles, there are so many?"

Gustave replied:

"Albert, like Boltzmann and Planck, we look at an average collection of the particles, because like the leaves in our analysis of light, sometimes one is enough but other times we need to collect them together. You can do this simply, we just calculate the probability of the number of particles as they depend on distance and time, the density of people in the train station as they pour down the stairs, rumble around, and flow onto trains! You saw that in Zurich all the time, remember the train station. People going everywhere, Berlin, Paris, Geneva, Bern, Basel. Everywhere, but they flowed."

Albert replied:

"People are like atoms and atoms like people, just a difference in size. Herr Professor, I know how to do this,

simply, we use the mathematics of simple diffusion again!"

Gustave said:

"Albert, brilliant, now write it down, use the constant we have and....and Albert!"

Albert replied:

"And Herr Professor here it is! We have solved it; we have a simple result, the function that Professor Gauss described, the answer for our diffusion."

Gustave smiled and patted Albert on the head with his paw and said:

"Ah fine work Albert fine work. Now just one more point. What is the average distance any one of these particles moves about and what is the

standard deviation of the movement, like asking what were the grades in class and then asking what the curve is to grade them on. Look Albert, it is in front of you!"

Albert scanned the few equations he had scratched down, and then smile and replied:

"Herr Professor, quite interesting. They move nowhere on average, they just wander about but on average go nowhere. Like the people in the train station, they just wander about but stay in the train station; in fact, they stay pretty much, where they started. But, Herr Professor, the movement is quite interesting if you look at the standard deviation, it grows not with time but only with the square root of time! A rather interesting process, a process which has strange growth!"

Gustave then turned to Albert and said:

"Now Albert, go and write this up, this is a fine result, I believe it will set many minds working."

Then Antnee turned to me and said:

"Sir, you I recall took this work and carried it even further some seventy years later, did you not Sir?"

I replied:

"You know me very well now Antnee, yes I did. I never understood how it all worked Antnee, when young I looked at equations and not at the world, you and Professor Gustave look at the world and then the equations. You have insight, it makes one think first and act second. I now appreciate that

much more. A fine tale Antnee, a fine tale."

I looked up and there were almost fifty smiling squirrels atop many branches looking down and listening. I was amazed as to their attention, for I had thought these furry friends all had attention deficit disorder since they were always jumping and flying about. Why I even saw three chipmunks and five rabbits listening as well. This was expanding!

6 RELATIVITY

Then Antnee turned and started to regale me again. He said:

"Sir, the final work and the final tale. This is the one which we all know Albert for. The first two were just a preparation for this third. This one Sir is the theory of Relativity!"

I now was truly amazed. I asked Antnee:

"Now Antnee, you are now telling me that Gustave invented the theory of relativity as well? Let's see, first the photoelectric effect which gets a Nobel Prize, then Brownian motion which led to my early work, and finally Relativity. Frankly, I tried to study that when I was young, no good references, and I remember a lecture or two at MIT, but engineers did not really get into relativity. So you are now going to tell me how Gustave did this too?"

Antnee replied:

"No Sir, Gustave just helped focus, but he did assist on some key points. You see sir, the photoelectric effect led to photons and photons go at the speed of light and they have energy but they

have no mass at slow speeds. This got Gustave and Albert thinking. For you see Sir, Albert had been examining this problem for many years until Gustave came along. Now the two of them were ready."

Antnee continued:

"Well Sir, one day, in the park, I believe it was the middle of 1905, possibly earlier Sir, Albert and Gustave were discussing motion, movement Sir, in two different frames of reference. Let me explain Sir how Gustave introduced this. He said:"

"Albert, I have been thinking of the problem you mentioned on the movement on a train versus the movement on the sidewalk. I can think of a similar example but from a squirrel perspective. You know we have the hawk as an enemy. Many

times the hawk sees us and then attack from above. This often happens when we are jumping from one branch to another. Thus we have two frames of reference. In the tree to tree frame I have to consider how fast and what angle to make my jump so that I can reach the opposite branch and in far enough so I do not fall. Every squirrel knows that. Then there is the second problem, the second frame of reference, for when I am jumping there may all of a sudden appear a hawk, and I must calculate my relationship to the hawk, so as to avoid becoming his dinner. In the tree cases I am jumping to the branch and in the hawk case I have to avoid the hawk. I must calculate my jumps and my rolls to as to achieve both goals and do so in two frames of reference!"

He continued:

"But curiously Albert two different things happen. When the hawk dives it screeches, which for me it's good because I can hear his screech and determine from the pitch how fast he is approaching. Sound travels faster when he approaches. However when I look at him, his color remains the same, namely light travels the same whether I am watching him from below or if I am flying away from him amongst the trees at a great speed. My senses, squirrel sense are very accurate for color and sound so we can see what you humans cannot,."

Now Albert one final point, I was reading and we spoke about the Michelson and Morley experiment in the United States, The tried to see if there was an ether, which we showed was not the case with our paper on the photoelectric effect. But in so doing the two men showed also that as I

suspected light travels at the same speed no matter what frame of reference we have, light speed is the thing that remains constant not distance or even time, they are relative, relative to the frame of reference!"

Albert replied:

"Herr Professor, as I also have been saying, but perhaps not as well, for I have studied the work of Professor Lorentz, and he developed a method to deal with this. He allows us to calculate what distance and time would be if we kept the speed of light the same for every frame of reference, it is a simple calculation. Here let me show you."

Antnee continued:

"Sir, and this was the crucial moment Sir, the moment which capped off all

that Albert became truly known for Sir, the moment in which relativity was created, relativist of distance and time, and the constancy of the speed of light, a brilliant idea Sir, the two men working so closely."

Antnee continued:

"You see Sir, the two of them suddenly had all the pieces in front of them. Albert continued:"

"Herr Professor, now let me summarize. First, all the laws of physics must be the same for any frame of reference, you and the hawk and you and the tree."

Gustave replied:

"Albert, that is correct."

Albert went on:

"Herr Professor, light speed is the same for any frame of reference, your hawk or your tree. Indeed if your hawk was going near the speed of light, the speed of light in the hawk-squirrel frame of reference would be the same as that for the tree-squirrel frame of reference, correct Herr Professor."

Gustave replied:

"Yes Albert well phrased, and you have yet to swell the idea with a mass of equations. In addition you know that fact one must apply perforce of the laws of nature and fact two must apply because of Michelson and Morley's experiment. Keep going Albert, now where does this lead to?"

Albert stopped for a moment, looked out across the river Aare and turned to Gustave and replied:

"Herr Professor, it is simple, now distance is relative, time is relative, and mass is relative! Namely the faster you go the shorter the time, the closer the distance and the more the mass, and we just use the simple relationship of Professor Lorentz!"

Gustave replied:

"Exactly Albert, you are brilliant. Now what else can we determine, what about the energy, the kinetic energy?"

Again Albert got up and walked to the edge of the Aare, he walked back and forth, which Gustave found some fresh acorns and was munching. He had gotten a bit paunchy as a result of these lessons, the food was excellent along the river bank. Then Albert turned and said:

"The kinetic energy Herr Professor is different, because now it has a rest value, and at the rest value, let me write this Herr Professor, at the rest value we have...."

And Albert wrote on the pad of paper on the bench along the Aare the formula:

$$"E=mc^2"$$

Gustave looked up at Albert and there was a great smile on his furry face. He said:

"Albert, my fine young man, this is amazing, do you know what this means, it means that there is inherently tremendous energy in all mass, the rest energy. I truly wonder how many people will ever understand this, I truly do?"

Albert responded:

"Herr Professor, this also explains another fact. The element in the photoelectric effect, we called it a photon, it has zero rest mass and all of its energy is what it has going at the speed of light! Why that explains everything Herr Professor, that explains everything!"

Gustave replied:

"Indeed it does Albert, indeed it does. Now go off and write it up. You can use the equations now, and make sure you are clear on the one with E you wrote down, many people may remember that one, indeed many people."

Albert replied:

"And many squirrels Professor, many squirrels!"

7 ZURICH, PRAGUE, RETURN, OFF TO GERMANY, AND FAREWELL

Antnee was now winding down. There were some loose ends but he wanted to close the story. At this point the audience above my head and at my feet was wandering away, I had guessed that the best parts were over. But Antnee was always wont to finish in his own way.

Antnee then summarized what happened after. He said:

"Well, Sir, Gustave and Albert finished the papers and they were sent in and published. Imagine Sir, an unknown Swiss Patent clerk, sending in these three great ideas, and getting them published. His style, Sir, not quite that

of Planck or those in Berlin, but the ideas, Sir, he presented ideas, with equations backing up the ideas, not the other way around Sir. A brilliant move. Each was short, simple, focused, and new Sir. Albert learned a great deal about style from Gustave, they made a great team Sir.."

"They continued for a few more years and then Albert got a Professorship in Zurich. He convinced Gustave to move with him, and he did. Albert was there for a short while when he got a position in Prague. Albert's wife was a Slav Sir, and he felt that this might help his marriage. Unfortunately, it did not Sir. You see Prague, and you know it well Sir, was and is a strange city. At that time, it was German and Slav, and separate Sir, a great distance between the two. You had told me so yourself even now Sir. Thus Albert returned again to Zurich."

"Finally Albert was offered a prestigious Professorship in Berlin. Gustave was now quite old. He could not go Sir, and they both knew that this was to be a final farewell. Their parting was somewhat sorrowful, like two friends, an old one in Gustave, and the young Albert, now getting the recognition he deserved. Gustave Sir was so proud. His best student, his lessons learned, and now he was to be off on his own in the biggest University for Physics, Berlin. Yet Sir, Gustave knew Germans, Sir, this was over a hundred years ago, even then Sir, they were always ready to turn, to be elite to themselves and brutal to outsiders. Gustave wished to let Albert get the best but he did want to warn him of the den he was entering."

"Thus Sir, the day came to bid farewell. Albert and Gustave went to the train

station. Albert's wife stayed behind. So Gustave was the only one to bid him farewell, a good thing Sir."

Albert looked about the train station, smiled at Gustave, and said:

"The train station Herr Professor, our Brownian motion paper, we are a great pair the two of us Herr Professor."

Then Gustave said:

"Farewell Albert, you have been a good student, in fact my best. There will be great things for you in Berlin. But a word of warning. The Germans are not like the Swiss, you should know that, and some Germans are shall we say less than accepting. So beware and be careful. Remember you always have a home in Switzerland. For you are Swiss now. So farewell Albert."

Gustave jumped up on Albert's shoulder and gave him a hug, a very un-Germanic gesture.

Albert walked towards the trains and said:

"Good bye Gus!"

Gustave, his full head of grey fuzzy hair blowing in the wind, smiled and waved goodbye, Albert was now on his own.