

## Crocodile monologue

(Or invention of structure of atom)

I have come to know from horse's mouth that they have named me crocodile. Crocodile of all names! People really have outrageous ideas, ha, ha, ha. How on earth do I look like a crocodile? You must have seen my picture, if not the person- after all in books and journals my photos have come so many times. See here is one- does it look like a crocodile? Not at all. What do you say? Definitely not. Initially it may scare you; big, burly, the thick moustache. Many take me for a rustic ruffian. But crocodile is a sure no no. See, agreed I have a rustic look, but I have those cuffs in my shirt sleeve- like a polished gentleman of city. Yes I remember, this snap was taken in Canada. A man called Autohan was working with me at that time. You may have heard of Autohahn, one who won Nobel for first breaking the atom. Anyway, one day press-photographer reached our place to take a picture of mine. Very obediently I sat before the camera with a serious look. But the lens-man did not agree. This rustic look wouldn't do, he said. The readers would love to see me in the aristocratic look of a scientist. What to do then. Right then Autohahn found a way out. He took the cuffs off his shirt and put on mine. See here is the smart caption under the photo, Lord Rutherford of Nelson and so on-and my photo with those 'Huhn-cuffs', ha, ha, ha.

Anyway, what was I speaking about? Yes crocodile. Believe me it is a ridiculous christening. There must have been some mistake somewhere. May be they were meaning walrus. In Cam river there are neither crocodiles, nor walruses. So these superficial young scientists of Cambridge made a mix-up. Well, you cannot blame them really. In childhood, I too could not separate zebras from giraffes. Both were peculiar animals. And I just cannot convince myself that anyone of this young band would ever take the pains of visiting a zoo and know for sure which one is called crocodile and which one is walrus. Take this Kapitza (Capitza), who suddenly arrived one day from Russia. He is busy making a generator literally twenty-four-seven. He needs a big magnetic field for the purpose. If you ask him to go to zoo, he will think you are joking. But you cannot really say. Off their research, they would be doing things you just cannot imagine they could be doing if you had seen them at work. This well built guy from Denmark for example-yes Neils Bohr-I always see him busy with mathematics. But one day I saw him going to the field carrying a pair of football boots. Or this Gamov - another one from Russia - he too is busy with mathematics. One finds him alone in a corner engaged with some calculations. One day I saw him rowing in the river Cam. It is his hobby he says, one of many hobbies. Or for that matter, take the 'perfect gentleman' Cockcroft- Oh I tend to digress too often. I said that they made a mix-up of crocodile and walrus. I have seen myself in mirror. I resemble a walrus, not crocodile. I must add this resemblance did not strike me, a small girl discovered it seeing the picture of a walrus in a book. The book was Alice in Wonderland- what a book that is. My moustaches resemble the tusks of walrus.( To tell the truth, for me this resemblance is a bit too stretched, but as she said the creature looks like me right after seeing the picture, who am I to disagree?) Gradually I tried to convince myself what is wrong even if I do look like a walrus? You call me crocodile or walrus- to quote Shakespeare I will smell like Rutherford. And this similarity of the creature's tusks and my moustache is not entirely wrong either,( children generally have a correct perception of things). You said you have not seen a walrus? See a picture of it at least. Or see my picture. It will do, ha, ha, ha.

Oh, I again digressed. Well, what I mean to say is that leaving aside the 'facial' similarities, I am not surprised for nicknaming me walrus- it is a talkative creature, and I am notorious for being garrulous. You must be remembering the stories of Alice in Wonderland. There was one episode of Alice through the looking glass-

"The time has come", the walrus said,

"To talk of many things-  
Of shoes and ships and sealing wax,  
Of cabbages and kings"

The canard about me is that whenever I see a pair of ears in front, my mouth opens and I decide that the time has come to talk of the world around, of radioactive atoms, of matter particles, about the simplicities of the laws of Nature, of playing golf- yes I remember one good thing, golf. It is a good day today. Let atoms and molecules be in cold storage for now, get the clubs out and go to the links (there goes our caddy; he is already on the way to the golf-links). Yesterday I had a lot of difficulty in the hole five, but today I would not spare him! So I am out to the golf-link. May be all alone. It is futile to expect someone now to leave his work and join me for golf. That Kapitsa there is holding on to his demon like a mad man.(Yesterday there was a short circuit, he was looking for a bigger magnetic field, the entire building shook like in an earthquake, our bones too shook. He is out for an encore it looks- no no, I will not remain here to see all those things, I rushed to the golf-link). Here is our footballer Neils Bohr, what sum he may be busy with- yeah, here I remember, I have an Integral, just complete it, I will be back after an hour of golf. You do not seem to be in a mood for that, ha, ha, no problem, I am just joking, you remain busy with your quantum and all that, only do not forget my Integral. If you cannot, then it will be difficult to call you a maths-wizard, is not it Neils-(You know, the difficulty with these maths-wallahs is that whenever I give them a mathematical problem, they do not show any interest, they think I am joking. They just cannot get out of the fact that I have always got an 'A' in mathematics. What they do not understand is that I simply do not enjoy being in the middle of these chaotic mathematical jumbles. I am a laboratory scientist . Even if I have the energy to make these subtle calculations, I simply have no interest in these.) Anyway, it is good that Neils was assigned that meddlesome thing. He was dithering at my face, but I know for sure that once I am out of sight, he will pounce on the Integral like a tiger. Fine, now who do I take with me for golf? It is of no use trying to look for someone in the lab. Everyone would be busy in work leaving aside everything else. To think of taking someone for golf will be like crying in the wilderness. Oh here is our Russian chap Gamov. What mathematical mystery is he going to solve in this lovely morning? He is more of a character than Neils Bohr. He does not believe in anything solid and real that you can hear and touch. Everything in this universe for him only consists of waves and starts making calculations. It is so complex; his mathematical analyses simply make my head reel. I am an experimental scientist, I believe in things I can touch and see and smell. I am not one to spend days on analyzing imaginary waves that you do not see or hear. For Gamov, electron is a wave while I am working on it accepting it as a material particle- which has weight and existence. Surprisingly, my conclusions are proved to be correct and Gamov's too are not proved wrong,(Rather they are found to be correct). But you I know, I believe things are not as subtle and complex as they make them to be, those must be much more simple and straight-forward than they think. When strangers meet me in science seminars, they are at their wit's end thinking what this clumsy rustic character could be doing here. I cannot help laughing. Because you cannot really blame them.( When I said I won the Nobel in Chemistry and that I find mention in books on Physics one was simply not ready to believe, ultimately he was ready for a bet!) After all, given my loud and boisterous movements, it is normal for anyone to take me as rowdy from the countryside. I simply have no polish and I prefer plain speak. And you know, the laws of Nature too are quite plain- the sun rises in the east and sets in the west, ha, ha, ha- and all major original theories have pretty simple interpretations. Very easy. And I believe, when we will gather more wholesome knowledge about Nature, say what are the facts about atoms and molecules, then we will arrive at the conclusion that things are not at all complex, very simple, very straight. Anyway, let Gamov remain with his mathematics in all happiness now but I am out to play; who will remain indoors in such weather? Don't you find in the Bible - "See, the winter is gone, rains ceased, flowers blossomed all around, now is the time for the birds to warble and doves have

started crooning in our land." Add to that sound of golf clubs hitting the ball was heard in our golf-links, ha, ha, ha.

You know there is a romance in perfectly hitting the ball into a hole, it is no less a thrill than hitting an atom with an electron or alpha particle. May be a bit more thrilling rather. Because in a substance there are thousands of atoms, there is every possibility of hitting one, but in golf you can aim one hole at a time. Of course the hole is bigger than an atom, but so is the ball compared to an electron or alpha particle. Both are plain games, easy and simple. The electron or the golf ball is a pebble, and the atom or the hole is the target. The rules too, are simple. You throw the stone, either it will hit the target, or miss it or its speed will get reduced. Just see what happens. In boyhood I was chided on many occasions for breaking glasses by throwing stones. But this habit of throwing just did not leave me, ha, ha, ha, I throw alpha atoms in lab and golf balls outside. May be because the rules are so simple. You know I am a straightforward soul. For example I have no patience to study the chess board pawns and make one move in one hour. My policy is, come straight to the battle-field, and throw whatever you find-stones, bricks, balls, electrons, alpha particles. You must be knowing, physicists have done this throwing before me also. J. J. Thomson threw electrons to substances, and Lenard too. But I was not satisfied with electrons- it is a sort of very thin pebble, you cannot throw it too fast, nor can it tear through objects and gets obstructed, at times even comes back after the collision. I prefer mortar like strong, heavy objects, which does not come back after tearing through the object; not catapults. So I chose to throw alpha particles, I mean nucleus of helium. It has two unit positive charges, and it is eight thousand times heavier than electron, a real heavy stuff. You must accept it now that my whims worked, ha, ha, ha- my throwing have convincingly proved how an atom is formed. Till then there were some presumptions only. We knew that atoms have electrons with negative charge and a particle with positive charge (which we named proton), but we did not have clear idea about the formation. Some like Kelvin with the ideas of a mechanical system thought these protons and electrons are a chaotic mesh with some springs and levers. Some others propounded that these are all glutted like potatoes in a bag. Another set talked of waves, energy and were happy to create atoms and molecules with a maze of mathematical signs. I thought enough is enough. Something has to be done. The walrus blabbered that now is time to throw and throw a lot, ha, ha, ha. This idea of mechanical atom is one mess, so is the atom of those mathematical signs. Laws of nature just cannot be so lemon- squeezing. You just make some throws and see the result; at least you can glean some characters of the atoms. You have predecessors in J. J. Thomson and Lenard. I came straight to the battle- field, I mean the laboratory and without wasting a single more, started throwing the alpha molecules at everything-gold, platinum, silver, copper and what have you.

Anyway, this exercise of projectiles bore fruit. Thus we came to know what constitutes an atom. Now –a-days, in further studies of atoms and molecules, everyone does the scattering experiment. In place of particles many use rays also, it is so popular. So I originated a good trend, is not it? Ha, ha, ha. Anyway that is how I understood the formation of atoms. In the mean time I learnt many other things; for example, this 'crocodile' name of mine is one. It must be Gamov's contribution. While boating in the river Cam he must have thought of crocodiles and thus it came. He also has a story of a tourist in Africa. It is an interesting one. While roaming through a dense forest in the continent a crocodile devoured a hand of his in a river. The poor tourist somehow saved himself. With the hand, his wrist-watch too entered the crocodile's stomach. The tourist had to spend quite a few days in that region and the crocodile also made attempts to eat him in full. But his wrist-watch made the tick-tick sound inside the belly and thus the tourist knew that the crocodile was lurking around at a good five miles' distance. So his wrist watch saved his life and he reached his home without further damage. Lately I have come to know that when I would not be present in the laboratory, the staffs bunk work- someone would be doing cross-word, another one would read a detective novel, or newspaper, a bunch would

gossip while munching sandwiches- but whenever they hear a guffaw in the corridor or loud singing of "Onward Christian soldiers, marching as to war", those thrillers, papers and sandwiches would be hastily concealed and everyone appeared busy and obedient workers, no time even to raise their heads. My loud laugh was like the wrist watch in the crocodile tummy. So I had no scope of reprimanding anyone for callousness; the boys have made a real fool of me all these days, ha, ha, ha.

Ok, so I am no more the garrulous walrus, I am a simple crocodile only. Fine, very fine, I am a game for that. But what was I talking about? Oh yes, about atom's formation. You have not got it yet? It is very simple. See, my pebbles or alpha particles have hit at some objects and dug in. Some others bounced back in different directions. The heavy, speedy stones cannot be obstructed by thin objects. So certainly the thin electrons have not obstructed their course. And those that bounced back have hit at strong objects. And these must be the protons with positive charge. How? Because, alpha particles are also positives and a positive particle pushes back another positive particle which is called repulsion ( On the other hand positive and negative pull one into another which is called attraction). Let me admit I have done some mathematics in this aspect. Anyway, what have we learned from this? Suppose, we threw some stones at a wall of a house, some have gone through to the other side and some others have bounced back. We will conclude that the wall must be having a window or at least some holes, through which the pebbles have crossed and the others have been repelled by something. For us the element causing this repulsion is positive charge, because a positive charge only repels another positive, the alpha pebbles. To sum up- there is a heavy positive charge in the centre which we have named nucleus, outside it are the negative charges, the electrons. Positive and negative charges are in equal measure because atom, as a whole, is charge-less, neutral. The window or the passage that the stones made way is a big one, in other words, the nucleus in the centre and outside it the electrons, much smaller compared to the volume of the nucleus. But they cannot remain like that, here comes mechanics. The electrons are moving around the nucleus like the planets orbiting the sun. So, the small and heavy nucleus with a positive charge in the centre, a big vacant area around it and outside that area the electrons with negative charge of exactly equal measure merrily orbiting around it. Now- a-days, it is found that there are many other charge-less particles in this nucleus with positive charge, which are referred to as neutral particles. By the way, this simplistic 'solar system' model of mine has undergone many changes, some additions and deletions, but its framework remains the same. That is the basic structure of an atom. Not clear yet? It will be clear to you. Very simple, just try to think how the planets move around the sun. Look at the face of that one in the third row, he has got it clear, ha, ha, ha. It is really funny that when someone after a long confusion, suddenly comes to understand somethings, a look at his face will tell you that he got it crystal clear. Hey hold your laughter, hearing the noise here; they have started a roar in the next room also. Surprising, this laughter is such an infectious thing, it is high time we reduce it, ha, ha, ha, ha.