

Chapter Nine

WPC Thatcher finally tracked down Norman Clarke shortly before lunch. He was busily scribbling on a white board in the coffee lounge stopping occasionally for a mouthful of peanuts from a bag he held in one hand. The nuts did not help the policewoman dismiss her caricature of him as a rodent. When she interrupted his thoughts, he tossed the pen aside and collapsed onto a chair looking expectant.

“I’m afraid I’m going to have to pry into your affairs somewhat,” she tried to prepare him a little. She was also interested to see if he was expecting the conversation. He looked most surprised, so she continued. “I believe you were involved in a dispute with Andreas last week?” she pressed. He looked totally bemused then suddenly, the penny dropped.

“Oh goodness, about the citations?” the implications of her questions began to dawn on him and slightly panicked he continued, “But that was just a minor thing, robust defence of one’s work, nothing personal.” He looked a little pleadingly at her before deciding he was going to have to do better. “We had been discussing his latest paper and we talked about how my work overlapped. Then he didn’t reference me so I was irritated. But we thrashed it out and he was right that it was a little issue, not a thing of Nobel’s at all. Well we let it drop.” He seemed honest in his reaction but the WPC thought she might try to keep him on the back foot a little longer.

“It was an issue in an electroweak symmetry breaking model? That’s a Higgs model isn’t it?” She was pleased to see a look of utter surprise on the man’s face. “Can you give me a little detail?” she asked.

“Ah.. well..” flummoxed was a good word for it the WPC thought amused. “The problem with the Higgs is that quantum effects just keep on increasing its mass. Do you know that particles don’t obey everyday laws of physics because they can borrow a little energy for short periods of time in quantum theory?” he didn’t look convinced that she did, but she nodded as she vaguely remembered the Uncertainty Principle that he was referring to as one explanation of the weird behaviour of sub-atomic particles. In any case she was not about to give up her bluff now.

“Well the Higgs will borrow as much energy as is going and make itself very massive. It’s a problem because the Higgs then gives mass to everything else and if it’s too massive then everything else becomes so as well.” He was warming to his subject now. “So there must be some reason that it can’t borrow too much energy. Most likely that means that the theory must be changed into something different so that the computations stop the Higgs’ mass growth. It’s exciting because it means there must be lots of new particles to find in addition to the Higgs. There are lots of possibilities...” he paused as if contemplating listing the options.

“Anyway...” he had decided against and picked up a different line of thought, “the Hierarchy Problem is the problem that if you don’t have the new physics until very high energies then the only way for the Higgs to be much lighter than the new stuff is if there

are two bits of the computation which by chance cancel - very unnatural thing, not likely at all. The point is though it might happen a bit, I'd say. You know, it's a coincidence that the moon looks roughly the same size as the sun to us here on Earth so we get to see nice solar eclipses – that's two numbers accidentally turning out the same. So I commented years back that the extra particles beyond the Higgs might be a bit heavier than the Higgs, maybe ten times as heavy so two numbers around ten might cancel against each other to give one-ish. Well Andreas had a similar thing in a very different set up and I pointed out the link.. he said it was obvious.” Clarke shrugged and looked thoughtful.

The WPC reckoned that she had conquered understanding the e-mail but it seemed unlikely Clarke had been so overcome by rage on the issue that he had become a heavy metal poisoner! Well she'd bear the remote possibility in mind.

The accounts of the Winchester Historical Society were kept in bizarrely large tomes made of real vellum and encased in leather covers. Geoffrey Montford considered it excessively pompous and expensive. He said so.

The other man at the large baize-covered table looked up and regarded him uncomprehendingly through circular wire glasses.

“It's traditional, Geoffrey,” was his offered explanation. Montford suppressed his slight distaste for the small man across from him. In a voluntary society like this you had to work with whoever was willing. In any case, he wryly reflected, Cyril Hayhurst fitted the society's tone better than Geoffrey's more modern perspective on history. The oak panelled walls of this office with their adornments of nineteenth century oil landscapes, were a piece of pure Victoriana. Geoffrey still hoped to introduce the members to new tools of study from magnetic resonance to gas chromatography.

“So, Geoffrey, the police have failed to find this work by Newton?” Cyril asked with the usual slight whine in his voice.

“They don't think it exists. Andreas was forging documents – it looks like it was all a fake.” Montford had explained this before.

“No, I don't believe it. There was the bookmark.”

“We don't know that was authentic either.” There was a pause in which Cyril tapped five times at the base of a long column of numbers with his fore finger, before entering the total at the base. He was remarkably fast at addition.

“Well, I'll keep an eye on developments,” he concluded.

Montford just shrugged and returned to his work.

Carl had finally located a web page with a news item about the Phi that named Geoffrey Montford's wife. Georgina. Somehow the name seemed as alien as the morning's memories. Suddenly Carl became aware of someone at his office door and scuttled round quickly in his chair as if caught looking at something far more incriminating. Standing at the door was a gawky young man holding a coke can; Carl didn't recognise him from the staff.

"You, Carl Williams?" he asked, like he was a bored postman. When Carl nodded he thrust a battered piece of handwritten paper across the room, "I'm with the police computer team. We found this in the guy's waste bin. Louise," he paused, "WPC Thatcher said you were doing a code – this looks like it'll help."

"Right, thanks," Carl took the paper and the man slunk off taking a gulp from his can.

Georgina! Louise! Everyone was suddenly acquiring real names.

The writing on the piece of paper was clearly Andreas' and the page had been screwed up before being cast away. He smoothed it out a little. The police must have impounded Andreas' waste bin or this would have been long gone to the early morning cleaners. The top of the page was marked 3.3 and there were three handwritten five by five square grids of letters

A B C D E	U V W X Y	W X Y U V		
F G H I J	A B C D E	C D E A B		
K L M N O	->	F G H I J	->	H I J F G
P Q R S T	K L M N O	M N O K L		
U V W X Y	P Q R S T	R S T P Q		

Fascinating. A straight letter substitution from one block to the other Carl supposed. Z probably went along for the ride. Why does 3.3 mean shifting down by one row and then across by three? He couldn't see a link. A shift by five would leave the matrix the same, so it might be shift once down and eight across. Presumably the middle line was an intermediate working step and one just used the letters in the final block to represent the equivalent ones in the first. Well maybe. Of course he'd copied down the 2.2 blocks so he couldn't try it out. He'd need to see the 3.3 entries again to see if he could decipher those. Still, this was real progress. Today had thrown up all sorts of interesting successes.

WPC Thatcher, for completeness, had set herself the task of finding out what Born had been working on. Her quest had led her to talk to Paolo, the Italian postdoc, in the office next to the one Andreas had occupied. Paolo was wearing a black and white striped Juventus shirt. When she had entered he had been leaning out of the window smoking a cigarette. He didn't appear in the least bothered about being found so close to violating

the no smoking status of the Institute, and in fact, tossed the cigarette butt out of the window before closing it and turning to speak to her.

The WPC put her query to the Italian who started at once on a rambling discussion of a variant of the Higgs mechanism. She was distracted enough by the recurrence of the subject to interrupt her own line of thought.

“Why are you all so convinced that this Higgs is real? Surely there must be other possibilities?” she interjected. Paolo came to a halt and considered. He grinned and replied,

“No, no other possibility.” His pause seemed deliberately provocative, so she just shrugged and was about to try to find a new foothold in his previous discourse when he continued, “we’ve found three quarters of it already.”

“How can you find three quarters of a particle?” she wondered, perplexed.

“Not one, four. It feels the weak force so there are two weak charges,” he was going on but the WPC leapt in to try to keep a grip,

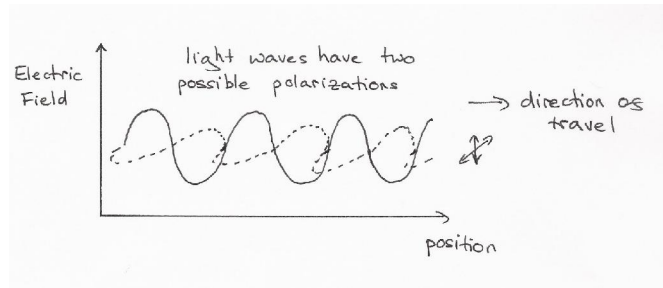
“You mean the two identical copies of the particle?”

“Uh huh,” the big Italian seemed willing to accept that. “Then there are their anti-particles too. Makes four.” Obviously, his expression added.

“And we’ve already found three of these?” the WPC couldn’t square this with the list of particles she’d met. Paolo frowned as if he didn’t really want to be going down this route.

“Do you know about the polarization of light?” he asked apparently at a tangent.

“Um, I think,” the WPC tried to drag up her old studies which seemed rather remote suddenly. “Light is a wave of electric field made by a charged particle oscillating? The wave can oscillate either up and down or side to side and those are the two polarizations.” Suddenly she remembered how this all connected to real life. “Oh yes, and light bouncing off water or a street or whatever tends to be polarized because the electrons in the material that emit the light naturally oscillate along the direction of the material’s surface. That’s why sunglasses are made to cut out one polarization to cut down the glare!” There’s something left in those old grey cells after all she thought. Paolo didn’t seem very impressed though.



“So why can’t it oscillate in the direction of motion of the light?” he asked smugly. She didn’t have an answer so he explained, “because light travels at the maximum speed possible so nothing in it can oscillate ahead of the light because it would have to go faster than light. A wave that travels slower always has the possibility of that extra oscillation” The WPC mouthed an ‘oh’.

“Anyway, the energy in light in a quantum theory comes in lumps, particles called photons, although you should really be talking about two different sorts of photon, lumps of energy associated with each polarization.” He didn’t appear very happy with the discussion. The WPC presumed he was desperate to write down an equation since he kept glancing at the ones spread out on the desk. “So, back to the weak force. It has three particles like the photon called the W plus, W minus and Z zero. They get a mass from the symmetry breaking.” His explanation was speeding up again but the WPC thought she was just about still holding on. The whole point of filling the vacuum with this Higgs had been to give weak charged particles masses she recalled.

“The massive W and Z particles don’t travel at the speed of light,” Paolo continued, “so can have three directions of oscillation. That means there’s effectively an extra particle because you can put energy into that polarization rather than just the two polarizations of a massless photon. So finding the three particles, W plus, W minus and Z zero with mass means each has an extra particle. Those are three of the four bits of the Higgs, yes?”

“Really?”

“Yes, yes, it’s very clever. So having found three parts with all the right properties to be the Higgs, there really has to be a fourth particle. It might have extra friends or decay so fast you can’t really see it but something like it must be there.” Paolo suddenly looked to the door as if relief forces had arrived. Carl was leaning in looking to interrupt.

“She’s all yours Carl,” Paolo said rather quickly, “I need coffee.” And he rapidly slipped past them both and headed off down the hall. The WPC was clearly going to have to find another source to discover what Andreas had been doing.

“Are you terrorizing Paolo?” asked Carl amused at the hasty departure.

“I’d thought he was terrorizing me!” muttered the WPC. “You were looking for me?”

“Yes, but why are you so interested in physics and the Phi? Isn’t Andreas’ private life a more likely source for a murderer?” Carl’s day had bred enough confidence to start questioning the police methods. The WPC returned a slightly patronising look,

“I’m not the only one investigating this case you know. I just got you lot as the short straw. My colleagues are having all the fun of breaking the news to Andreas’ battalion of women friends.” Yes, Carl should have realised that, he thought. He wondered if they had got to Georgina yet. “So what did you want?” the WPC prompted him.

“I think I’ve made progress on Andreas’ diary code.” Carl announced. The WPC’s face suddenly looked more interested,

“Well, that’s good – what does it say?”

He started briefing her on the whole 3.3 versus 2.2 saga but rapidly switched to the statement that he needed to see the full book again when he saw she had little patience for the details. The WPC looked at her watch – it was twenty past four – and screwed up her face.

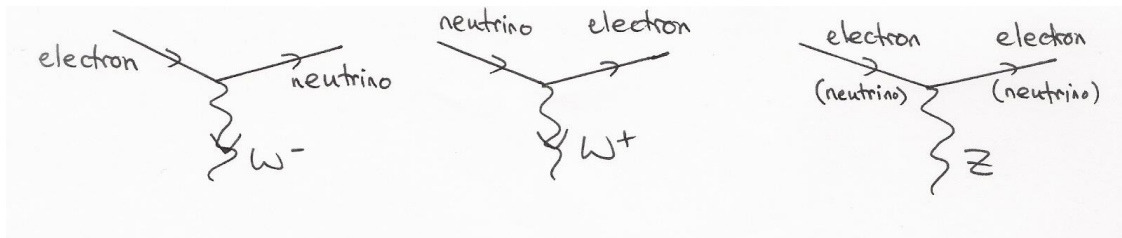
“Damn, I have to go and pick up my kid from nursery at five; I can’t take you down there now. Then this evening’s not possible either,” the WPC observed the surprised look on Carl’s face, “Police officers have real lives too, you know.” Carl was still adding up, Louise, child, presumably married. The WPC continued, “And I can’t get to the flat tomorrow morning – the whole investigative team is meeting first thing. Can we meet there at noon?” Carl mentally checked his diary before shaking his head,

“We’ve got a seminar speaker tomorrow – we go for lunch and then there’s the talk. Eleven thirty til three is bad.” The seminar series was the centre point of the Phi week so it didn’t cross Carl’s mind that it might not have priority. The WPC looked pensive,

“It would be good to know what’s in there for the meeting,” she was eyeing brownie points from her superiors. “I could lend you the flat key? You’d have to promise not to touch anything but the diary.” Carl was keen to do the decoding too, so readily agreed. The WPC handed him a card with her mobile number and a large iron key. “Phone me tomorrow morning by half nine whether you make progress or not,” she made him promise.

“Oh, and before we go... why are there three particles like the photon for the weak force when there’s only one in electric and magnetic theory?” her subconscious was still trying to digest Paolo’s explanations.

“Remember, we said that the weak force probes particle types by interchanging them? Well you need one type of force field that switches electrons to neutrinos and another that takes a neutrino to an electron – those are the two W particles. Then there’s the photon’s direct equivalent that doesn’t change the particle type



and that's the Z particle." Carl explained.

"OK, time to switch to thinking about finger painting and Teletubbies," she concluded heading for home.