

# **A Cooling Friendship**

*Asimov's Robots - 0*

**Greg Toland**

## ===== A Cooling Friendship =====

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Greg Powell paused as he left the Rapid Transit Station. The day looked like it was going to be good with a warm May sun glinting off the many skyscrapers of New York and taking the chill out of the air. He straightened his neck-tie and headed towards the head office of US Robots and Mechanical Men Inc in what he hoped was a confident stride. Today was THE interview day. He had successfully progressed through the earlier interview stages coming top in most of the categories. Today though he would be up against the top contenders from all of the other regions.

He paused again as he came to the flight of steps leading to the impressive entrance hall of the building. With a final check of his shoes, he always judged people by their tidiness of clothes and assumed that other people did the same, he strode up the steps to begin the next stage of his career ♦

Mike Donovan dashed out of the mainline station, his hair in disarray and looked around wildly. He was late for a very important interview and cursed himself for his late start for the day. He started to run down the block towards the nearest skyscraper, paused and then realised he didn't know where he was going. He stopped to open his briefcase to get the address details. Scrambling through the papers he found the interview instructions, glanced at them and stuffed them into his jacket pocket. A couple of papers blew out of his case in the light spring breeze. Chasing after them he eventually caught up with them and rammed them back in the case. He turned and started running in the opposite direction to the way he had started.

A few minutes later he arrived at the flight of steps leading to the impressive entrance hall of the building that was his destination.

Without pausing he started up the steps, two at a time, and breathlessly began the next stage of his career

As Powell entered the building he was met by the commissionaire who directed him to the seventh floor, where he was met out of the elevator by a very basic robot.

"Please accompany me to the West meeting room, Mr. Powell," it requested in a very mechanical voice. Powell followed dutifully thinking it was an old mechanical BT model, but there was something slightly different about it. The BTs were known as butlers and had been developed many years ago for basic house and function tasks.

He entered the meeting room behind the robot and looked around. Sat in the middle of the room was the only other occupant. Powell smiled briefly and walked forward to introduce himself.

"Hi, I'm Mike Powell from Oregon," he said trying to sound confident. "You are?"

"John Williams from California," he replied.

An awkward silence descended which was broken by the arrival of the BT robot followed rapidly by another three applicants. They too joined in the nervous introductions and Powell found out that they were a widely spread group of people with attendees from across the US and one from Europe. Isabelle Maudreau was from Paris, France and Peter Jones and Adrian Withers were relatively near neighbours being from Arizona and Texas.

A tall man entered the meeting room quietly and surveyed the scene. The applicants had not noticed him enter so he waited patiently assessing each person's behaviour in the conversations that were happening. Eventually Williams noticed him and turned to face him. The attention of the others was now drawn to the man.

◆ Good morning to you all. I◆m Peter Johnstone and I◆ll be your assessor for these three days of interviews and for the successful ones amongst you I will be your primary tutor and mentor. Would you all like to take a seat and we can begin.◆

Powell found a seat by the window and faced Johnstone.

Johnstone did not stand much on ceremony and launched straight into his prepared introduction, displaying the agenda on the computer projector screen at the front of the room. He had barely started when the door of the room was flung open and Donovan exploded into the room.

◆I◆m sorry I◆m late◆, he gasped. ◆I◆ve had a dreadful journey getting here, delay after delay and ◆◆, he paused as Johnstone regarded him with amusement.

◆ Good morning Mr. Donovan◆ he said unperturbed by the abruptness of Donovan◆s entry into the room. ◆Please take the spare seat and we will begin again◆

Powell mentally cursed as he saw that the only spare seat was next to him. He did not want to be paired with this lunatic on such a crucial day. Donovan flopped down in the seat next to him and pulled the screwed up pieces of paper from his pocket. He tried to straighten them out while hunting in his inside pocket for a pen. Johnstone waited patiently whilst all this was going on.

Once things had settled down and Donovan had himself as organized as he was going to be he continued.

◆As I was saying before Mr. Donovan joined us, here is the agenda for the next three days◆

The agenda showed that they would be having an intensive session of interviews, tests and evaluations. Next to each activity was a pair of colours. Each person glanced at their introductory papers, spotted

the coloured dot on their instructions and looked around to see who they were paired with for each activity.

Powell was pleased to see that he was paired with Peter Jones for the first activity of the day. He thought that would give him an opportunity to get away from Donovan to make an appropriate impression.

Johnstone continued, "Before we get into the main activities, let's introduce ourselves informally and to make it interesting I would like you to include a lie about yourselves. Nothing too outrageous, I would like it to be believable but one that we might be able to guess."

Powell thought rapidly. He had prepared a bit to say about himself, but the lie had thrown him a little.

"Mr Donovan", said Johnstone. "As our last, and should I say late, arrival I think we'll have you start."

Donovan stood up and then sat down as Johnstone waved his hand.

"No need for formality. Just speak"

"Well", began Donovan. "My name is Greg Donovan and I come from Indiana where I used to live on a farm. I went to Harvard studying Artificial Intelligence and Robotics. I am here because I want to work on leading edge robots in the field not in the office."

Each person then took their turn to introduce themselves and Powell finished off the group.

"Hello. My name is Mike Powell and I am from Oregon where I had a rural existence catching fish in the local stream and hunting with my Dad. I went to College to study Robotics"

He tailed off and stopped as he tried to think of a reasonable lie to tell, but was saved by Johnstone.

◆ Thank you all very much for those introductions. Now by way of an experiment I would like to ask the other member of the support team here to comment. ◆

They all looked around but could not see anyone else.

Johnstone smiled and continued. ◆ You have all just learnt your first lesson. Bart, what do you think? ◆

The BT robot moved forward.

◆ Well Peter, ◆ it said. ◆ I think the following lies were told by the applicants ◆ ◆

It then listed all of their lies but stopped when it got to Powell.

◆ I ◆ m could not determine a lie from Mr. Powell but there was definitely something wrong with what he was saying about College and studying Robotics. ◆

Johnstone turned to Powell. ◆ I know that you went to Princeton to study where you gained First Class Honours in your Doctorate. Has Bart detected some modesty and hesitation rather than a lie? ◆

Powell flushed. ◆ I ◆ m sorry but ◆ ◆

◆ No apology is needed. You are the first person to confuse Bart in this way, so it was a good learning experience. ◆

◆ Now lady and gentlemen, there were two reasons I did that demonstration. One was to get you on your toes; the main reason though was to remind you that a robot is not a piece of the furniture.

It has abilities and capabilities that are similar, but different to our own. Never forget that. ❖

He turned to the BT robot.

❖ Thank you Bart. Please analyse your evaluation of Mr. Powell ❖s responses and determine an algorithm that will assist in the differentiation between modest hesitation and lying. ❖

He turned back to the group.

❖ And incidentally that will be the only use of Bart, or any other method, for lie detection. You are all here on merit and I am looking for all of you to succeed. ❖

The next three days consisted of group activities working on mini-projects that would test their basic understanding of robotics and its application in the field. As the theoretical leading lights in this field they all excelled in the tasks. Johnstone observed, along with other assessors both in the rooms and watching via video links, the presentations and workings of the teams and they began to form opinions of the strengths and weaknesses of the individuals and the pairings.

At the end of the three days Johnstone stood before the six slightly nervous potential field engineers.

❖ I ❖ll not keep you in any suspense. You have all passed every test and trial that we have put you through and I am pleased to say we would like you all, assuming you would like to, join US Robots and Mechanical Men Inc as field engineers class one. ❖

Powell smiled happily - Field Engineer Class One. The title stood out with capital letters in his mind. He looked around the room and saw the same pride and satisfaction on his colleague ❖s faces.

They all had a celebratory meal that evening. During this meal Donovan was surprised to find out that Powell was a first class juggler. Powell was not surprised to find out that Donovan was a raconteur par excellence and he kept the group amused for much of the evening with outrageous tales, most of which involved his general clumsiness and lack of planning!

The following day they started in their new careers. They continued to stay together as a group as their induction continued, but began to get linked into more fixed teams rather than rotated into different pairings.

Over the subsequent days Powell learned to like and respect Donovan. The person he first saw as a totally disorganised fool, he began to recognise an intuitive and counter view of his own mind and ways of working. In a similar fashion, Donovan found that Powell was not the picky ultra control freak that he had first perceived. He began to see the logical, organised and knowledgeable person and they both found the classic opposites attract was really true. That was not to say that they didn't exasperate each other by their contrary behaviour, but that as a pair they formed a powerful team.

Johnstone recognised the potential of the Powell/Donovan team from an early stage and began to pair off the other members of the group and shaped each pair into a strong performing team. Each task and investigation built on the other until the group was beginning to work on new problems rather than solve, or rediscover, solutions that their predecessors had already dealt with.

Three months into the course Donovan and Powell were set what was to be their final problem before being formally released on the world to take on their field assignments. Johnstone outlined the problem.

"Gentlemen" he began, "What do you see here?" He placed a set of closely typed equations in front of Donovan and Powell that covered six sides of paper.

Powell took one glance at the list and replied, “Websters’ Conjecture that identifies the maximum density of a positronic brain before thermal breakdown due to conductive resistance of the basic substrata”

“Well done” said Johnstone, “nearly right”

Powell look crestfallen.

Donovan turned to the last two pages. “Modified by Johnstone’s inspirational work on high thermal conductive thread interleaving” he added with a hint of heavy irony.

“Excellent Mr. Donovan. Your perspicacity is awe inspiring in return”

It was Donovan’s turn to looked bemused. Powell leant across and in a stage whisper said “Observation you dimmock!”

“Thank you Mr. Powell. Now if we may continue...”

Donovan and Powell looked up with innocent faces.’

“Yes please”, they said sweetly in unison.

Johnstone continued with a smile. “As you know the key problem we have at the moment is the heat build up inside the positronic brain during heavy processing activity and the effect on the platinum infrastructure. It causes the resistance to rise and the effectivity of the brain falls off in a hyperbolic curve until it plateaus at 72% efficiency”.

He paused and looked at Donovan and Powell. He parodied a popular rerun of an old television series. “Your mission should you choose to accept is to find a way to maintain efficiency in excess of 84% without all of the bulky water circulation and other cooling methods identified to date”

“You can use of the Calvin Laboratory as your base for the time that you have for the work. Any problems just come and knock on my door.”

Donovan and Powell gathered up the papers and descended to the third floor and set themselves up in what was to be home for the next ten weeks.

Powell opened the door with almost reverence and stepped into the room. Dominating the front of the room was a larger than life size portrait of Susan Calvin. Donovan walked in, looked up, and then looked away. He always felt that her stare penetrated through to the back of his head.

He started to uncover the computer terminals and log them on.

“Greg, do you want to copy up the formulae on the whiteboards so that we can have them for reference.”

Powell started to write leaving plenty of space for comments and thoughts.

Five weeks later the laboratory looked like a true working environment. The once pristine formulae on the boards were covered with annotations and notes in red, green, blue and yellow. Each colour signified a version change in their thinking or design.

The workbenches had two prototype variants on cooling systems as well as the original water circulation system. A large sliding scale was on the wall opposite the formulae boards with two large markers. One was at 97% the maximum positronic brain efficiency achieved to date. The other was at 72% marking the old cooling effect efficiency before they started their project. The sliding pointer sat stubbornly at the 76% figure.

They had achieved that in the first week.

Powell was scanning a number of texts that he had researched and downloaded from Universities, periodicals and the Internet. He was trying to find information on cooling techniques and technologies that would further assist them in their task. Unfortunately since the advent of micro-cellular processors there was little need for cooling of computers and so the field was now a stagnant area. The move towards large city blocks and communal heating, cooling and other services also meant that the size of the plants to perform these tasks was not a problem.

Powell stopped and sat back in his seat and scratched his ear. Donovan looked up hopefully at this. He had learned that this was a sign of an idea, but that it was not practical and so he would not talk about it.

◆Come on Greg, spill the beans. What◆s the idea?◆

Powell stretched and rose to his feet.

◆Well we could try using the Peltier effect ◆◆, his words trailed away as he was deep in thought.

◆OK, genius◆, said Donovan. ◆I give up. What◆s the Peltier effect?◆

◆Oh sorry. It◆s a late 20th century discovery of the cooling effect that can be achieved by passing an electrical current through an array of Bismuth Telluride semiconductor pellets that have been 'doped' so that one type of charge carrier—either positive or negative—carries the majority of current. When DC voltage is applied to the module, the positive and negative charge carriers in the pellet array absorb heat energy from one substrate surface and release it to the substrate at the opposite side. The surface where heat energy is absorbed becomes cold without moving parts, compressors, or gases. The trouble is that it is as impractical as the cooling techniques that we have tried as you need to dissipate the heat and that would add so much bulk.◆

◆ Unless you were able to have a suitable large surface area of a metal body to use ◆ smiled Donovan.

◆ Of course! ◆, exclaimed Powell. ◆ The solution ◆s been staring me in the face. I was thinking of the positronic brain in isolation, not as part of the whole robot. ◆

It was now Donovan ◆s turn to sink into deep thought.

◆ Greg, I would estimate that we would have to dissipate 1800 Joules of heat energy to get efficiency up to 84%. Would that be possible and what would it mean to the body temperature of the robot? ◆

Powell went over to the white board and began to write up some new formulae and alter some of the old ones.

◆ I estimate that dissipating that amount of energy would raise the robot body by about 10 ◆ Celsius ◆, he concluded.

◆ So ◆, went on Donovan. ◆ If we were to dissipate even more energy and provide some means of thermostatic regulation we could maintain the body of a robot at normal human body temperature. ◆

Powell turned to look at Donovan.

◆ Do you realize that if this works we will have solved two of the key issues in developing fully mobile and human-like robots? ◆

Donovan smiled back at him.

◆ Hmm, the thought had crossed my mind! ◆

They set to with renewed vigour and started to design the Peltier cooling system.

One week later the laboratory looked very different. Adjacent to the Positronic brain on the workbench there was a robot body shell connected by a large heat bus. Donovan was bent over, his upper body inside the robot shell doing some last minute adjustments when the door opened and Johnstone entered.

Donovan straightened up, hit his head and cursed at the interruption.

◆And good afternoon to you too Mr Donovan◆, said Johnstone with a laugh.

◆Oh sorry, I didn◆t realise it was you ◆◆, apologised Donovan.

◆◆ or you might have said something worse!◆, finished off Johnstone.

◆I thought I◆d come in and see what your requisitioning of some very unusual items was for.◆

Powell started to prevaricate.

◆Well we don◆t know that this will work and we haven◆t really been able to do any testing ◆◆

◆Mr Powell◆, interrupted Johnstone. ◆I will be pleased to be the first person to see the trial a success.◆

Donovan happily took his position at the console and initialised the Positronic brain and other peripheral equipment in preparation for the test.

◆Have faith Greg. I know this will work.◆

He turned to the wall scale. The efficiency pointer rapidly rose to 94% and then started to fall. They watched it drop below 80% and then Powell switched on the Peltier pump. The pointer continued to fall then stabilised at 76%.

Donovan looked crestfallen and began to check connections.

◆Don◆t be impatient Mike. You know that there will be a lag before the Peltier effect kicks in.◆

They all looked back to the wall scale. The pointer began to move back up. It passed the 80% mark and Powell permitted himself a small smile. As it passed the 84% mark Donovan let out a loud whoop of joy.

◆We◆ve done it!◆ he shouted.

Johnstone continued to watch the pointer. It rose to 89% before stabilising.

Donovan checked the thermometer on the robot shell.

◆It◆s reading 35◆ Celsius so that means that we could up the efficiency of the pump by a couple of degrees which will give at least one more percentage efficiency point.◆

Johnstone turned to the two smiling engineers.

◆Gentlemen. It has been a privilege to see the first demonstration of the Powell/Donovan cooling system. Congratulations. I look forward to hearing more of you two in the future within US Robots and Mechanical Men Inc.◆

Powell and Donovan turned to each other and shook hands. Their partnership had produced the first of many successes.

Johnstone turned to leave them to take their detailed measurements and prepare their research paper. As he was closing the door he overhead voices being raised.

◆Hey Greg, why isn◆t it the Donovan/Powell cooling system?◆

Yes he thought to himself. This partnership will go far ♠

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