

Prologue

The slow constant rattle of the dot-matrix printer, accompanied by the low hum of cooling fans of the observatory's equipment in a small bunker-like semi-underground room, filled out Maxwell French's ears. It had begun as annoying and even distracting a few weeks earlier, but now it seemed even soothing to him.

He had worked through the night. Again. The sun was about to rise above the horizon, illuminating the sky in pale yellows and pinks as he looked at the results of the dot-matrix printer. A cascade of zeros, ones, twos, and a few threes filled the page in a monotonous repetition, showing nothing new. He and his colleague had been looking for radio sources from outside the Milky Way galaxy for a few months now, cataloguing them if they found anything worth noting; the main purpose of the study was to find candidates for the theorised black holes.

"How's the alignment of the Ear, Max?" Asked Robert Howell. He was a fellow student of Max's during their studies at the university. Together, they had spent countless nights discussing the finer points in life with philosophy professors Jack Daniels and Jim Beam.

"Positive 5, 46, 47 right ascension, 0, 0, 50 declination. Hearing anything?" Max said while walking in the small room in the observatory's basement. He had been outside taking a manual reading of the alignment with a small optical telescope

fixed to the main mirror just for this reason. They had been scanning the sky for days, finding nothing interesting.

“It’s the M78 nebula, right? There’s something around there”. The Big Ear radio telescope was built in a way that made it impossible to pinpoint anything in the sky, only an area.

“Definitely something there. We’re getting to sixes and sevens on the printout, nothing yet in the alphabets”. Max said. Higher numbers meant stronger signals, and letters from A to Z meant stronger signals still. Every 10 seconds, a new line of alphanumeric got printed on the paper.

“Could you check the 1420?”

“*Nada.*” The hydrogen emission bandwidth of 1420 megahertz cut through the interstellar dust clouds and could reveal things not observable by optical telescopes.

“OK, let’s just leave it still for a while, and then go towards positive declination. Wanna cup of coffee?” Robert asked. It has been another long night for the duo. No matter how many nights they worked, staying awake was difficult.

“*Gracias.*”

“I really hate when you do that,” Robert laughed. “Your name is French, and yet you reply in Spanish. Have you tried ‘*merci beaucoup*’?”

“*Oui.* I didn’t like it.”

The dot matrix printer buzzed and clanked numbers on the continuous perforated paper fed to the machine from a box on the floor. It had been setup in a corner, next to a table with a pile of discarded Styrofoam take-away boxes, an old and stained Mr Coffee, and a pair of stereo speakers. Max had hooked them up to an oscilloscope, acting as a rudimentary audio monitor for the telescope. He had turned it off for the annoying sounds it makes.

“Oh, Orion, the Great Hunter, reveal thy secrets!” Robert trumpeted while carefully rotating a small knob that controlled the declination of the telescope.

“We really should ask for his help. We’ve been on the hunt for weeks without luck!” Max said.

“He’ll show us the way.” Robert confirmed, while turning the knob on the control panel on his desk. The controls resembled that of a ham radio, which it basically was only vastly larger in size and power. “If there’s anything in this constellation to be found, we’ll definitely be the first.”

As he turned the small, thimble sized knob, massive electric motors turned slowly, rotating the gears on the telescope’s main mirror, tilting it towards its intended target. The mirror was not a mirror for visible light but for radio waves, made of a mesh of steel truss beams instead of glass. The mesh reflected radio transmissions from space towards a curved secondary mesh mirror, which focused the radio waves on the actual observatory between the two mirrors.

The entire structure resembled a football field with 30 meters by 100 meters steel mesh ‘goals’ at the ends, similar in size to a 30-story building flipped on its side. As the primary mirror tilted by a just a few millimetres, several hundred new stars came into view; Matt noticed the ever slightly undulating line on the oscilloscope display jump and immediately go back to base level.

“Hey, go back just a little!” Max said.

“Did you see something?”

“Maybe, might have been a glitch.” Max turned on the speakers for the oscilloscope. There was the usual static, crackles, and beeps, but nothing out of the ordinary. “-Keep going, sweep the area you just passed.” Time passed, and they heard nothing special. Matt went to see the printer.

“The printout shows an 8BA9 around the time. There’s definitely something there.”

Suddenly the speakers made a loud noise resembling a boiling teakettle with a rusty old engine inside, and it stopped as suddenly as it started.

“There!” This time Robert could stop the main mirror exactly where the anomaly happened.

“Would you look at that! It’s a 1CA, the strongest signal in weeks.” Max said.

“I’ll keep the mirror pointed there, and I’ll rotate the observatory to counter-act the rotation of the earth.” Time stood still for the two young men for the next few minutes while the

telescope remained pointed towards the signal. Eventually, Earth's rotation would direct the telescope away from the signal, overcoming the small lateral rotation they could control; they'd have to wait until next night to see it again. The signal appeared once more after about three minutes, or three eternities for them. Somehow, the signal didn't seem natural.

“There! It's exactly at the hydrogen line.”

“Have you checked for any local phenomena, like a Russian spy satellite?” Max asked.

“If it were that, it would've moved away from the area already. “

“Oh yeah, true. But it was definitely a narrow-band signal, less than 10kHz bandwidth according to the print. Nature abhors narrow-band, right?” Max said. The printout had 50 columns, each corresponding to a 10kHz band that the Big Ear could detect. The signal showed up on only the leftmost of them.

“Pretty much, haven't heard of a natural narrow-band radio transmission before,” Robert said.

“So, um, what are we looki...”

Suddenly the speakers burst with sound, the single loudest they have heard. The sound didn't stop; it continued. And grew louder.

“What the hell is that thing?!” Robert asked.

After about a minute of ear-splitting noise from the speakers, the signal faded away. Max went to the printer and saw '6EQUJ5' just printed on the perforated paper.

"It went to Q and U level of strength!" Robert said looking at the printout.

"Wow!" Max said.

The signal had been going on and off for several days now. With the help of several radio telescopes around the world, they have been able to verify the signal as something real and not just a malfunction or glitch in their own system. The area of the signal stayed only a few hours in their view per day. Their peers from different time zones could keep track of it and fax in their findings.

"We've recorded about a dozen of these signals, all around the same strength, no noticeable pattern, no modulation, all at the 1420 line, all narrow-band..." Maxwell said aloud, more to himself than to Robert. "-Do you know of any theoretical object that would behave like this?"

"No, can't think of any. It's definitely not a star or a black hole, that's for sure."

"Yeah, those would be broadband and continuous signals." Max affirmed.

"Do we have enough to determine the distance?"

“No, not yet. Not accurately, anyway. But from the lack of redshift, it’s within our galaxy; more precisely, it seems to be moving towards us.” Max said.

Earlier in the century, Edwin Hubble had discovered that most galaxies were moving away not only from us, but from each other as well; This eventually gave birth to the idea of the Big Bang, the “everywhere explosion” of pure energy into matter that formed the universe. Hubble’s discovery relied on the physical phenomena of light and all electromagnetic radiation shifted towards longer wavelengths when moving away from the observer, and shifting towards shorter wavelengths when moving towards the observer; in visible light these correspond to red and blue colours respectively, giving the name “red shift”. A similar effect happens with sound waves in air when the “neeeee – oooooo” of a siren of a speeding ambulance seems higher in pitch when moving towards the listener, and lower in pitch after it has moved past.

“Moving towards us?!” Robert asked.

“It’s moving with the galactic flow. It’s millions of years from us at its current speed.”

Silence fell for a moment between the colleagues, broken only by the occasional beep of the IBM 1130 computer that was only the size of a typical office desk, tiny compared to the past electronic computers which took the space of a room or two.

“So, I’ve been reading this book. About extra-terrestrials contacting us...” Robert mused.

“I mean, it’s definitely extra-terrestrial.” Max said. “Extra means ‘beyond’ and terrestrial mean ‘earth’, so it means ‘outside of earth’.” he continued in his snarky adenoids.

“You know what I mean!”

“Ok, if it were that, what’s the purpose of the signal? Why transmit a single frequency to a random point in space?” Max asked.

“Could be a beacon. Like a lighthouse, it’s only pointed towards us occasionally?”

“But the signal hasn’t been regular.”

“Not that we see yet, anyway.”

Maxwell started looking at all the printouts and faxes from the other observatories. A small book’s worth of papers, all bearing a similar layout: several columns of numbers and letters, each corresponding to each telescope’s detection bandwidths. Some used the same system as the Big Ear, others numbers from 0 to 9, and some the 0 to F hexadecimal system. He only selected printouts that had time and date on the margin of the columns indicating the moment of detection, and then corrected the times to match the time zone of the Big Ear with a red Sharpie.

“Hey, do you have the scissors?” Max asked.

“No, they’re right there, behind you. What did you have in mind?”

“I’m just cleaning out the data.” Max said while cutting off all the excess noise from the papers. “Hey, could you draw a line on the blackboard with marks every inch or so?”

Robert realised what Max was doing and drew the line on the wall length black board. After a few tries he had marked out every four hours with a chalk making their original detection as time zero and started taping the thin slivers of paper each to their correct place in the timeline.

“See anything?” Robert asked?

“-*Nada.*”

A week more had passed since the original detection, with several more detections from around the globe, but not even one for the duo directly. They had been gathering the data along with a few groups in different observatories, but no one had yet seen any order in the chaos. They still worked during the night so they could be present when Big Ear pointed towards the signal origin.

Their timeline had swelled up to extend beyond the blackboard and they just ended up drawing a Sharpie line on the white painted concrete walls; it encompassed three of the four walls already of their underground room they called the office in the observatory. Several dozen slivers of paper littered the wall, and only sporadically any resemblance of pattern could be seen.

“Yeah, but what about this here? It has the same intervals as there.” Robert said, while pointing at two points in the timeline about three days apart.

“True, but what follows is different. There are larger gaps afterwards.”

“From the few days the Australian telescope was not gathering data!”

“Data...” Max said, more to himself. “-I think we’re missing something here. Did you throw away the papers?” He asked, referring to the pile of observational data sent to them from around the world.

“No, they’re still right here.” Robert handed the pile to Max.

“Look, I cut off only the strongest signals, but there are also these weaker signals we first thought only as noise, the ones that went to around strength A.” Max said.

“I get you” Robert picked up a pair of scissors and immediately got to work cutting the weaker signals to similar slivers of paper while Max was editing times and dates to correspond to their timeline

“Does it look like anything to you?” Max asked after taping on the last piece of the weaker signals.

“Kinda. Maybe.”

“Dashes and dots. Like Morse code?”

“Kidding me? Morse code from outer space?!”

“Looks like it, doesn’t it?” Max said.

The IBM computer beeped occasionally while the dot matrix printer buzzed numbers on the continuous paper. Occasionally, the oscilloscope moved a little, and a two or a three were printed out.

“Tell me, what is the simplest form of numbers?” Max asked after a moment of silence.

“Ones and zeroes; binary code, base two. What computers use, right?” Robert said.

“What if the stronger signals are ones and the weaker signals are zeroes?”

“Wouldn’t the empty space between the signals be zeroes?”

“Null’ is different from zero; no signal at all is different to a weak or a low signal.” Max said.

“So... We’re looking at binary numbers from outer space?”

“What else could it be? Natural phenomena would either be broadband, or clearly a repetitive signal with an obvious pattern; like night and day cycle, or the orbits around the planets and stars. It takes effort to send an alternating signal with data in it.” Max said.

“You’re jumping to conclusions!”

“Maybe, but do you have a better explanation?”

Another two weeks passed, and the data started piling up. Max and Robert were still the only ones who had all the data from all the observations around the world. They had compressed their timeline to just a straight line with a time marked as small ticks on one side, and ones and zeroes on the other side of line, they had gone away with the paper cut off altogether.

“Just look here, there it is again.” Max said. “Two ones followed by two zeroes followed again by a set of twelve signals, then another set of 1100 and a set of 12 different signals.”

“Yeah, but here’s a 1100 with only four signals afterwards. “

“Si. What numbers in decimal expression are those?”

“Well, 1100 is 12 in decimal. Could that tell that it’s followed by 12 numbers?” Robert asked.

“No, I don’t think so.” Max said. “That would be earth centric to think so. We use the decimal system because we have ten fingers. If it’s really an extra-terrestrial intelligence sending this, they most likely use a different base.” Max said. “-What if we do this?” He took a piece of paper and wrote down:

1100 000010100111

1100 001011101110

1100 0110

1100 000011101111

“In decimal expansion that would be 12 167, 12 750, 12 6, 12 239. Does that mean anything to you?”

“*Nada*. Absolutely *nada*.”

“Hexadecimals don’t really make sense either, nor do octal, or base six.” Robert said after crunching the numbers.

“Could the ones and zeroes mean something else? I mean, that they’re not numbers?” Max asked.

“Sure, power on / power off, yes / no, light / dark, good / evil, basically anything with a dualistic nature.”

“Yes. No. *Si*. *No*.” Max thought aloud. “Do you know how electronic computers actually work?”

“With ones and zeros, binary code.”

“Yes, yes, but their computing power comes from simple logic circuits.” Electronic computers had intrigued Max since he started working with them. He wanted to know how they operate on a basic level and had studied in on his own time.

“Logic?”

“You know, Vulcans and pointy ears and this:” Max said while holding out his hand with his index and middle finger

together and ring and little finger together. “Live long and prosper.” He said in his adenoids.

“You’re kidding me, right?”

“Well, logic in its very basic form. Look” Max rearranged the numbers into columns:

11

00

000

010

100

111

“Look, 1 is 1, true is true; 0 is 0, untrue is untrue. Untrue plus untrue is untrue. Untrue plus true is untrue, and so on. This is the truth table for a simple AND gate; both inputs have to be on for the output to be on.” Max said.

“And the other ones?”

“Just a moment.” Max said, while rearranging all the other numbers.

1 - 1	1 - 1	1 - 1	1 - 1
0 - 0	0 - 0	0 - 0	0 - 0
00 - 0	1 - 0	00 - 0	00 - 1
01 - 0	0 - 1	01 - 1	01 - 1
10 - 0		10 - 1	10 - 1
11 - 1		11 - 1	11 - 0

“The first 1100 is always just a header, tells the basic concept of Boolean logic, then it’s followed with the truth table for an AND gate, an inverter, an OR gate, and a NAND gate which is just inverted AND gate.” Max said.

“So, what you’re saying is... It’s an instruction to build an electronic computer.”

“From outer space.” Max said.