Reminiscences of TAT-1

Jeremiah F. Hayes
Concordia University, Montreal

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I began working for the Bell Telephone Laboratories, shortly after I graduated for university in June 1956 and was immediately assigned to the submarine cable department. This was an auspicious time since the second half of the first transatlantic telephone cable, TAT-1, was laid that summer. The first half, carrying signals in the other direction had been laid the previous summer. The two cables stretched between Oban, Scotland and Clarenville, Newfoundland.

The inauguration of the new system was reported in the September 26 edition of the **New York Times** with the headline

> ## *First Call Made by Phone to Europe*
> *Line's Capacity is 3 Times as Great as Radiophone's*

Accompanying the text was a picture of the chairman of AT and T, Cleo F. Craige, George T. Montgomery, head of the FCC, and Frederick R. Kapple president of AT and T. Craige was reported to be on the phone to his counterpart in London.

1858

While the article occupied a prominent place at the bottom of page 1, it would elicit no more than mild interest from the general public. This stands in stark contrast to the widespread outpouring of joy that greeted the first transatlantic telegraph cable when it went into service nearly a century earlier. This is exemplified in a woodcut in the August 28, 1858 edition of Harper's weekly which shows huge bursts of fireworks over New York's city hall[1]. A later edition has a similar display in Union Square. The September 11 edition shows a great parade led by sailors carrying a model of the ship that laid the western half of the cable, USS Niagara. Songs were written to celebrate the great event. (Would you like to dance the Atlantic Cable Quadrille or the Atlantic Cable Polka?)[2]

Alas, the euphoria was short lived. The electrician in charge, a medical man named Edward Whitehouse knew little of the then existing theory. Misguided by meager 'experimental evidence', he damaged its insulation by zapping the cable with 4000 volts from an induction coil. Thereafter, the cable never worked very well. For example, it took sixteen and a half-hours to send Queen Victoria's message of congratulation to President Buchanan. The cable failed after a month of shaky operation.

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[1] This as well as other wonderful illustrations are reproduces in [1].

[2] Not everyone was an enthusiast. In Walden, published in 1854, Henry David Thoreau said " we are eager to tunnel under the Atlantic and bring the Old World to the new; but, the first news that we will hear is that Princess Adelaide has the whooping cough."

The ultimate triumph of transatlantic telegraphy is due to the determination and courage of one man, Cyrus Field. He had organized and raised the money for the attempts of 1857 and 1858. Incredibly, he repeated the effort for attempts in 1865 and 1866. With each failure valuable experience was gained and the latter succeeded. There was a double victory since, along with the successful 1866 operation, the end of the 1865 cable was retrieved and the circuit was completed.

At Last Some Excitement!

During my four-year sojourn in submarine cable, there was only one event, which drew wide interest. The week of February 22, 1957 started quietly enough. On page 33 of the **New York Times,** there was a brief paragraph announcing that the "Atlantic Cable is Silenced." Apparently, there was a break near the Newfoundland end of the cable. A repair ship was being dispatched and telephone service was being maintained by existing radio circuits. On Monday, February 23 it was reported that the radio circuits were hard pressed during the repair of the cable. Again, the item appeared on a back page.

Things changed. On page 1 of the February 27 edition of the Times, the up-most right column was headed

U.S Navy Boards a Soviet Trawler in North Atlantic

Action off Newfoundland Follows Breaks in Five Transoceanic Cables

There were pictures of the trawler and the US Radar picket ship Roy O. Hale. The story went on to say that all of the Soviet ship's papers were in order and that it did, indeed appear that the Russian seemed to be only engaged in fishing. With its usual broad coverage of a big story, the Times had several ancillary articles. For example, an 1894 law on submarine cables, to which Russia was a signatory, was cited.

For me the most memorable aspect of the coverage was a discussion of the reasons for cable breaks. It was stated that the most common cause was toredos, a kind of boring worm and sea mammals. Further, trawler damage was reported to be unusual. In the context of the Cold War, this misinformation had disturbing implications. The theory was that the Soviet Union would open an attack by cutting cables. The truth was that damage by fishermen had been the leading hazard from the earliest days of submarine cable. Legend has it that the first cable across the English cable was cut by a fisherman from Boulogne, who thought that he had pulled in a golden serpent. The cable companies routinely distributed calendars with girlie pictures urging fishermen not to cut cable that snagged on their gear. Subsequently, cables were buried in the ocean floor whenever it was feasible.

Fortunately, the controversy died away without serious consequences. There was a report on the boarding to the Soviet by the US, February 28. The Soviet protest laden with sarcasm was covered on February 28. Finally in conclusion, the March 2 edition reported that the cables had been repaired and service restored. Thereafter, telephone cable repair became routine, as had the repair of telegraph cable. I, myself, went to Clarenville a year later on a cable repairing expedition.

The Repeaters and a Mystery Solved

In terms of reliable operation, the most critical component of the system was the repeater. These devices, spaced at intervals of 37.5 nautical miles along the cable, compensated for loss. The repeaters were of a unique flexible design, which allowed them to be handled in the same manner as cable. Standard technology up to that point was a rigid repeater, which would require a new ship design for deep ocean laying. Estimates of traffic, which later proved to be far too conservative, could not justify to expenditure.

Within the repeater the key elements were its three vacuum tubes. It was unprecedented to place these components two and a half miles below the ocean's surface and expect them to operate without failure over a period of years. An idea of the fragility of vacuum tubes can be gained by recalling that many drug stores had a tube replacement center with a tube tester and a supply of the standard types. Normally, one would use the facility once or twice a year in order to repair a radio or TV. In contrast, I can't recall the last failure of a semiconductor component in any of the many gadgets in my home radios, TVs, computers, modems, watches, appliances…

Essentially, vacuum tubes operate by modulating a stream of electrons, which are boiled off its cathode. In terms of reliability, the toughest problem was balancing oxidation and reduction within the tube. The problem was to achieve a small controllable reaction between processes that were relatively large. The key was controlling the impurities in the material used to make the cathode. Since at that time, these impurities could not be accurately measured, trial and error was the approach. Batches of the purest material were ordered from suppliers, sample cathodes made and the best batch selected after careful life tests. In charge of the critical life testing was one Ed Veazie. He was a thin, taut, wiry man who radiated tension and smoked like a chimney. A fine conscientious person, he worried a lot. After the system was installed and operated successfully, his smoking virtually stopped. In fact, the vacuum tube of TAT-1 never failed in twenty years of continuous operation.

Somewhere in the search for the perfect cathode material, strange results cropped up. With the deductive skill, which was the hallmark of the Bell Labs of that era, someone discovered that technicians were using the oven meant for cathode fabrication to reheat pizza. There was mozzarella on the cathodes![3]

A Final Tale[4]

From the very first days of ocean cables, the cable is continuously monitored as the cable laying proceeds. Indeed, on the 1857-1866 operations, William Thompson, later made Lord Kelvin, checked for electrical continuity with the shore by means of his mirror galvanometer. My dear departed friend Bob Easton was the transmission engineer, performing the same task, on the cable lay of a system, subsequent to TAT-1, when an unusual signal came through.

Hoping to catch her husband before his departure, the Philadelphia housewife dialled the number hurriedly. "Is this Joe's barbershop?" The unexpected response was "Lady this is the Cable ship, LONG LINES, 300 miles off the coast of England." "Oh for Pete's sake, a wrong number is bad enough, but with my luck I end up with a drunk or a nut."

[3] For the detail on the vacuum tube, including the solution to the mystery, I am indebted to G.R. Leopold.
[4] Retold from [6]

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