TELECOMMUNICATIONS HISTORY GROUP

CONNECTIONS news

www.telcomhistory.org **303-296-1221**
Summer 2020, Vol. 25, no. 2 **Jody Georgeson, editor**

A Message from Our Director

We hope you have all fared well during COVID-19 virus and the resulting stay-at-home orders. I have been reading old *Rocky Mountain News* articles and the closing down of Denver has happened before. In an October 1918 report, the "City to be shut three weeks to check epidemic" due to the Spanish Flu (incorrectly believed to have started in Spain). And in September 1946, schools and public buildings were closed due to the "Scourge" of Polio. I have a great respect for what our parents and grandparents lived through.

There has been a "Silver Lining" in all this. A lot has been accomplished on the home front. Yards are looking grand; houses have new paint; and I have met neighbors I never noticed before. Folks are out walking and visiting. There have been neighborhood front porch cocktail hours, and we are looking for smiles in the eyes of those in masks - and finding them.

Thanks to our generous donor for enabling us to offer a challenge grant again this year! See page 2 for details.

Stay safe and well,

Renee Lang

Acting Executive Director

THG's 2020 Challenge Grant

One year ago in July, we told you about THG's first-ever challenge grant. We did not know then how well it might work but as it happened, it was tremendously successful. We are honored that so many *Connections News* readers responded so generously.

THG is very much a volunteer-driven organization. And although most of our mission is accomplished by the efforts of volunteers, we do have essential expenses that must be paid. In addition to the routine things (like insurance, internet access and accounting), there are other expenses to protect our collections and upgrade our facilities that we have taken on in the first half of this year.

We have been able to pay for archival quality acid-free storage boxes for protecting our valuable collection of documents and for professional bookbinding services to protect more of our telephone directories. We also needed to upgrade the fluorescent lighting in our Seattle museum with modern energy-efficient LED tubes, because the 'ballast transformers' in the 60-year-old fixtures have been failing and are no longer considered repairable. The improved 'color rendering' of the new lighting also looks great and will really enhance future visitor's experience in the museum.

Your generous assistance last year made a tremendous difference and helped to underwrite these projects. Your kindness is greatly appreciated but there is more to do! The good news is that last year's challenge-grant donor has agreed to step up again and offer a new challenge grant with the same terms as before.

Here's how it works: every donation you make between now and August 15, 2020 will be matched one-for-one up to a total of $20,000. In addition, if you contribute at least $60, THG will count $35 of that as a renewal of your membership for 2021—and our challenge-grant donor will match your total contribution (including the amount applied to your renewal).

You may use the enclosed envelope to send a check, or you may make your donation online at http://www.telcomhistory.org/challenge/

The board of directors, the staff, and the volunteers at THG greatly appreciate your ongoing support!

National History Day is a social studies and literacy program that equips students in elementary, middle, and high school with the skills necessary to succeed in college and the real world. Students participate in a project-based learning curriculum that emphasizes critical reading and thinking, research, analysis, and the drawing of meaningful conclusions. Students can complete these projects in groups or as individuals in one of five categories: documentary, paper, exhibit, performance, or website.

In Colorado, the students compete in one of fifteen regions across the state in either the junior (middle school) or senior (high school) division, or in the elementary poster contest (4th and 5th graders). Regional winners compete at the State Contests in May on the University of Colorado Denver campus. First and second place state winners compete in Nationals at the University of Maryland, College Park in June. This year, all contests have been virtual, which made it even more difficult for our young scholars.

National History Day in Colorado reaches nearly 23,000 students across the state each year. They also provide teacher training, research field trips, supply grants, classroom resources, scholarship opportunities for students, and graduate and continuing professional education courses for teachers.

THG has been a proud sponsor of National History Day in Colorado for many years. In addition to our sponsorship, several of our volunteers are judges at the contest, and our organization presents a special monetary award for the best project about telecommunications. This year, the web site produced by April Tong and Sadie Korngold-Finkelstein was clearly the absolute best of several outstanding projects. You can see it for yourself at https://site.nhd.org/80859068/home. Congratulations, April and Sadie!

This year, I judged junior papers at the National competition. The winning paper from our group was about Lorena Weeks and her fight with Southern Bell for the right to apply for "non-traditional" jobs. I was so impressed by the amount of research and the quality of work that went into this project; I am hoping to get permission to include it in an issue of Connections News.

Mountain Bell to Qwest in 30 Years!

By Renee Lang

We'd like to get to know each other; in following issues, we will be asking our volunteers and board members to tell their own stories. We're starting with Renee, our Acting Executive Director. If you have a story you'd like to tell, please send it to us at telcomhist@aol.com. We'd love to know your history!

In April 1974, I went to work for Mountain Bell as a Plant Reports Clerk at 930 15th Street in Denver. In 1977, I transferred into a non-traditional job and became an Installer. There were only a few women doing that job at the time. During my pole climbing test I fell twenty feet with my instructor, Jim Roller, on the pole next to me. I thought for sure that was it for this job, but he untangled me from the pole, pulled up my sleeves, noted I had no splinters, gave me a hug, and told me I had to get back on the horse. With shaky legs I went back up and came down in one piece. My adventures as an installer began.

I was assigned to the rehabilitation crew; we'd would drive around, fix drop wires, clean up wires on buildings, and look for pre-wire jobs on homes that were being renovated. About every three months we would spend a month doing regular installation to keep our skills up.

Renee & her truck

My area was Five Points and Capitol Hill. One of the first things my boss did was to drive me around and show me a building I was to go into only with a police escort and another building I was never to go into no matter what. It was a strange beginning.

I was not fond of climbing poles and would try anything to keep from climbing. One of my partners was Mary Novotny. One time we were in a junk yard and the phone line was attached to a 2x4 surrounded by old cars. Mary, who was very strong, held my ladder up straight while I climbed it and removed the phone wire. The owner had a couple of Saint Bernard guard dogs. We tried to get our equipment into the yard and be up our ladders before they found us. They were filthy messes but wanted to be petted. The owner got mad because if someone saw us playing with the dogs, they'd think they weren't the greatest watch dogs.

The guys in our garage gave us a bad time about not being able to do the job, but we always proved them wrong. We had the bucket truck one day when we got a call to help another installer downtown. He needed to get into a large B-box at the top of a pole and could tell there was a rat's nest in it. He wanted us to go up in the bucket and clean it out. When I got there, I could tell the nest was empty and instead of using the bucket I climbed his ladder, cleaned out the nest, climbed back down and left him standing there with a red face.

There were surprises around every corner. While installing phones for a guy in Capitol Hill, he got made rude suggestions and was flashing me in his bedroom. After I explained to him why we called our large screwdriver a "Dog Killer," he left me alone.

Renee & Mary Novotny

We installed a phone for a ninety-year-old woman who was in the hospital after a fall. She fell in her kitchen and couldn't reach the phone, so she spent the night on the floor until her granddaughter found her the next morning. We came in and installed the phone lower and were to add long cords for her. I came back the next day with the cords and she was home. She came to the door and had a disappointed look on her face. She said she had heard a couple of girls had installed her phone and she was hoping to see me decked out in installer duds. So, I went back to my truck and put on the tool belt and hard hat and came back in to put in the cords. We had a long conversation and she told me all about her family and that she had lived in the house for over 50 years. She still went up and down the long steep staircase every day - a very spunky senior.

Renee & crew member Tom Hoy

Back then we still provided the phones and had to do disconnects and phone retrieval for non-payment - not my favorite job. It was hard to knock on a door and say we were there to take their phone because the bill hadn't been paid. Some phones never made it farther than the dumpster, as they were full of cockroaches.

I look back at my years as an installer as my greatest years with the company. I really enjoyed working outside and all the wonderful people I met out there.

In 1978, I was married and became pregnant and the company didn't know what to do. I was the first installer they'd had in this condition. They used to joke about having to enlarge my tool and climbing belt. When I got so far along, they put me back into the job I had before I became an installer for the duration of my pregnancy. My pay was continued at the installer rate, which irritated a couple of union reps in the office. One day I got a call from a lawyer from California who was involved in other cases involving pay for women. We set a precedent that if an employee was forced into another job due to pregnancy, their pay could not be cut. You'd think the union would be happy about this, but they weren't.

After six months off with my baby, I went back to work as an installer. I stayed outside until 1980 when I transferred into Plant Line Assignments, where I stayed for 12 years. I then became a Central Office Technician in the Project Management group, where I managed 911 for Colorado and Wyoming. I really enjoyed this job. I was able to travel around a little and go to different 911 dispatch centers. After a couple of years doing this, the company decided that we had the wrong title for the job as we did not work in a Central Office. They wanted us to become managers, but I had too much time with the company by then to consider it. I had watched them herd managers into a conference room and fire them, so I didn't want anything to do with a management job.

I took a mind-numbing course in AC/DC electricity from a rocket scientist. It was six months of pure frustration, but I passed and transferred into a Central Office. I started out in the Capitol Hill Central Office where we rotated between it, East and Curtis Park. With little training it was a real challenge. I transferred to the Denver Main Central Office where the training was wonderful. We went to classes in Raleigh, North Carolina and Sacramento, California and learned from knowledgeable and patient techs in our office. I really loved this job and worked with a great bunch of people. I trained in all the Central Office jobs and I retired as a DMS Switch technician there in July 2004.

I had thirty wonderful years with the "phone company." I had some great jobs and made a lot of friends. The opportunity to try many different jobs was a company tradition, and in every job, co-workers became family. One of my best friends is someone I worked with on my first job and we have stayed close to this day. It was hard to retire.

The Touch-Tone™ Story from a THG Museum Perspective (part 1)

In the last issue of the Connections News, we told you about a project at THG's Seattle museum to restore our historic 3ESS system to full service. Because our access to the museum is severely limited due to COVID-19 restrictions, our volunteers have not made much progress there since early March. But we hope to get back to work on that just as soon as we regain regular access.

In the meantime, many THG volunteers have been working on projects at home. This includes researching new stories to share with museum visitors when we reopen. One topic visitors often ask about is the history of the Touch-Tone™ telephone—both how it was developed and how the service was implemented at central offices that served those fancy new "button" phones.

Coincidentally, there is a specific Seattle connection to this story because Touch-Tone™ service was introduced to the broad public in the AT&T pavilion at the Seattle World's fair in 1962. There is a wonderful scene in the film *Century 21 Calling* (which you can watch on the AT&T Tech Channel on YouTube) where two teenagers race to see who can complete a call more quickly—by pushing buttons or by spinning a dial. The button pusher won of course. The irony of AT&T's choice of venue for this introduction is that Seattle subscribers could not actually get Touch-Tone™ service until 1968, leading to some letters of complaint about the delay in the local newspaper.

Scene from the 1962 AT&T film *Century 21 Calling*

Signaling phone numbers over the line by way of musical tones did not begin with Touch-Tone™ service in the 1960s. There had long been efforts to enable operators to signal numbers over long distance trunk lines directly (rather than having them pass along the number verbally to the next operator down the line). An improved circuit for extending the range of pulse signaling was first added to a panel system in the Seattle area in 1925 and worked up to 160 miles (as described in *A History of Engineering and Science in the Bell System: Switching Technology 1925-1975*). Although this made operator-dialing for short-haul toll calls feasible, the equipment was removed again in 1926 due to reliability problems with the poor-quality open-wire circuits then in use. More experiments were carried out with a Step-by-Step office in Ohio in 1936, but not much progress was made with direct operator long-distance dialing until advances in vacuum tube electronics made MF (multifrequency) signaling possible.

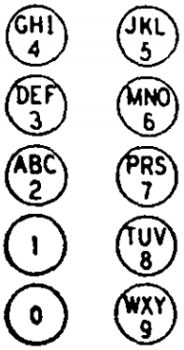
The idea behind MF was that with audible tones, it would be possible to send both supervisory and number signals over the same lines, and to the same distant locations, as voice signals. Initially, single tones were used. But after many experiments and field tests, a coded combination of two (out of a total of five) different audio frequencies was found to work best.

This research effort was taken into the development stage with a trial in Baltimore in 1940. There, operator keysets were connected to a set of multifrequency oscillators common to all switchboard positions. The corresponding tone decoders were provided in a local No. 1 Crossbar office, and so incoming toll calls to that office were established using multifrequency pulsing for the first time.

By 1950 the speed and efficiency of push-button calling had proved itself for operator switchboards. But the high cost and maintenance problems with vacuum tube electronics still made the idea unattractive for installation at the subscriber location. A large bank of hot (and rather delicate) tubes is required to produce and receive the multifrequency tones in our museum's No. 1 Crossbar system, and no subscriber would want (or want to pay for) such a rack of equipment at their office or home.

With the invention of the transistor at Bell Labs, a push button phone for subscribers became a practical luxury for customers despite its higher monthly cost. The system of tones developed for this was called DTMF, for Dual Tone Multi Frequency. DTMF was similar to the earlier multi-frequency system developed for long-distance operators, it sends two tones at once from a selection of eight possibilities. (Instead of the five possible tones used in the earlier MF system.) To avoid problems with the receiving equipment in central offices, the specific frequencies chosen for Touch-Tone™ calling are all different from those chosen for the original MF signaling system.

You may already have heard about the history of the development of the button layout. It is only a small part of the Touch-Tone™ story but nonetheless an especially interesting one. Much experimental work was carried out, including the study of many different button arrangements.



Arrangement of letters and numbers on a toll operator's keyset.
Journal of Applied Psychology Vol. 39 No. 5, 1955

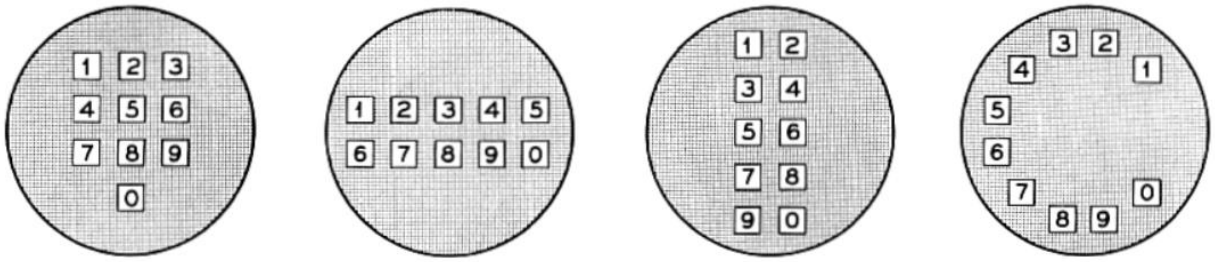
Toll operators used a keypad that was arranged in two vertical rows of five buttons, the numbering of which seems to have been arbitrarily chosen without much study. AT&T thought this arrangement might be contributing to misdialed numbers. Consequently, researchers at Bell Labs began formal study of the problem in 1955.

In a landmark and rather comprehensive study published in the Bell System Technical Journal in 1960, R. L. Deininger and his colleagues tested 16 different button arrangements with groups of Bell Labs employees. They also tested different button-top designs and the size and spacing of the buttons. And they tested to see what worked best in terms of the "feel" and how far the button traveled ("subjects preferred a smooth and quiet button with light touch and moderate travel").

They also tested whether it was better to let people hear the tones as they pressed the buttons (they found it didn't really matter). Lastly, they gave some thought to engineering and central office considerations, such as how long each tone would need to sound.

In summary, the test results indicated that "considerable latitude exists for key set design in terms of user performance" but some of the key set arrangements were subjectively much preferred by the testers over others.

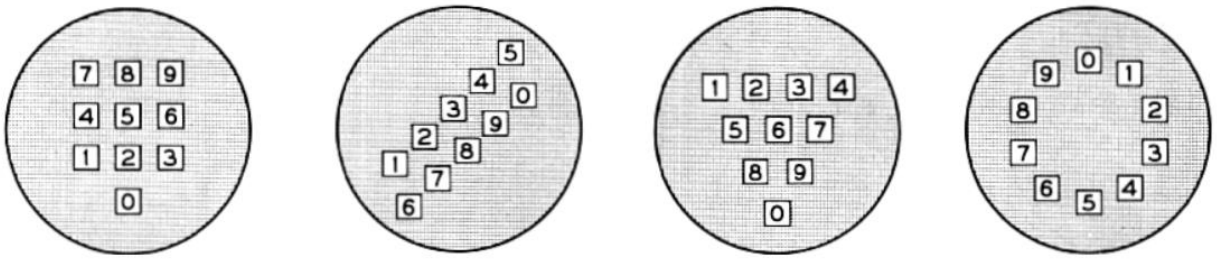
Four arrangements all did quite well, including the three-across and four-down matrix of buttons that we are all familiar with today. Also popular were the “telephone dial” layout (often found on novelty and reproduction telephones today) and a layout with two rows of five digits starting with 1 on the top left. In fact, that last arrangement was the most subjectively popular of all, by a small margin. Why AT&T ultimately chose the 3 x 4 rectangular layout from among these is not completely clear, but likely it had to do with simplicity of design for the mechanical parts and ease of manufacturing the keypads in large quantities. The 3 x 4 arrangement also fit well into the same space as the dial on the 500 set, leading directly to the Western Electric 1500 model push button telephone.



The button arrangements most preferred by volunteer test subjects

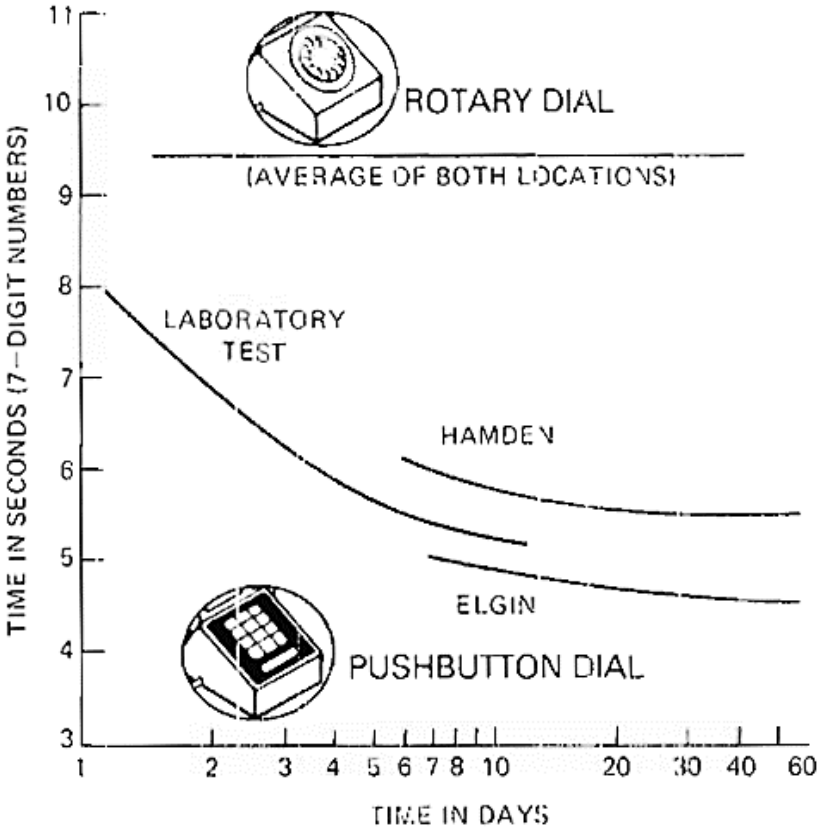
Interestingly, the British GPO produced their early type 726 push button telephone in 1967 with the two rows of five buttons arrangement, and it was also used for an experimental phone from Bell Labs that was tested in 1948 (but not found to work reliably at that time).

The fact that the number pad on the keyboard of your computer has ‘7’ on the top left instead of ‘1’ is attributable to the fact that the early PC keyboard designers at Apple and IBM chose to copy the layout of their calculators rather than that of their telephones. That layout dates from Sundstrand’s 1914 ten-key adding machine. Even though Deininger’s research at Bell Labs had shown that 7 8 9 on the top row was more error-prone, and putting 1 2 3 on the top row was preferred by most people, the adding-machine layout persists today for the same reason that computer keyboards are still laid out in the QWERTY typewriter arrangement invented by the Sholes and Glidden in 1873.



Some of the less successful button arrangements that were also tested

Technical trials of Touch-Tone™ service were held in a Step-by-Step office in Hamden, Connecticut and in a No. 5 Crossbar office in Elgin, Illinois in 1959. The figure below (from *A History of Science and Engineering in the Bell System: Switching Technology 1925-1975*) shows the improvement in dialing times over a period of 60 days as people learned to use the new "push button dials.”



The question of what to call the new arrangement must also have been debated. The fact that AT&T settled on the term “Push Button Dial” is a matter of consternation to some even today (since a dial is usually a disc or circle, and on a standard push button telephone there is just a rectangle). But the name obviously made sense to consumers, and that is undoubtedly what was important, as we are not now using something named the “Touch-Tone Signaler.”

By the early 1990s, Touch-Tone™ service was so common and popular that it was simply built into the base monthly rate at most telephone companies.

We hope you have enjoyed this brief dive into some of our recent research. We are all looking forward to sharing these stories with visitors when our museum opens to the public once again.

Please look for the next issue of *Connections News* as we continue the Touch-Tone™ story with a second installment discussing all the changes the Bell system had to make to Central Office equipment to provide this service.

Have a wonderful, safe, and healthy summer!

TELECOMMUNICATIONS
HISTORY GROUP