TELECOMMUNICATIONS HISTORY GROUP

CONNECTIONS news

www.telcomhistory.org 303-296-1221
Spring 2023, Vol. 30, no. 1 Dave Felice, editor

A Message from Our Director

In this newsletter you will learn of the wonderful things our Connections Museum in Seattle is working on and the celebration of the Panel Switch. They have acquired amazing artifacts to add to the story of switching. The work being done there is great.

At the THG Archives we continue to preserve the history of the telecom industry. Many folks are cleaning out their basements and sending us treasures. Our library has really become outstanding in its collection and Jack is working hard on the library database. Our archivist, Jody, is combining all our databases for easy searching. We are always doing requested research and loaning artifacts and information to local museums and schools. The Molly Brown House is doing a presentation on the Chicago World's Fair in 1893 and we are lending them some artifacts that we have from that era. One of our phone booths will also be traveling to the director of an academic theater. We so enjoy interacting with other museums and helping educators.

Our volunteers are so dedicated to the success of The Telecommunications History Group and I am astounded by their work and contribution that we could not succeed without.

THG also observes the founding of the National Geographic Society, 135 years ago. A diverse group of geographers, explorers, teachers, lawyers, and financiers met in Washington to establish the organization. Gardiner Greene Hubbard was the first president. He was also Alexander Graham Bell's father-in-law. Bell himself was a founding member and became society president in 1898.

Edison's Sound Machine will be vacationing at
The Molly Brown House in Denver!

Sincerely,

Renee Lang, Managing Director

Story of telecommunications preserved by THG

A collection needs to tell a story to be a museum, says the head of the Telecommunications History Group. In a Seattle newspaper feature story, THG Board President Peter Amstein says the story drives the museum's existence.

Collecting is only the beginning, writes Jerald Pierce, Arts and Culture Reporter for The Seattle Times. Pierce says museums have a powerful ability to preserve, but also give context.

"Probably the most important thing for someone creating a new museum is to think about the stories they want to tell," Amstein says in the article. "What do I want visitors to this museum to come away with? What do I want them to have learned or understood? And then, how do I structure my museum around that?"

The Telecommunications History Group operates the Connections Museum in Seattle's Georgetown neighborhood based on the story-telling principle.

Pierce writes that most museums face the challenge of maintaining the collection, deciding what should be kept and be displayed.

Pierce tells readers The Connections Museum "collects, maintains and displays various equipment from the history of telecommunications, exploring how that history has impacted our present day." A tour of the museum can take around two hours or more.

The THG president started as a visitor to the Connections Museum. According to Pierce, Amstein was fascinated by the stories behind the bygone technology and how they could inform how our society has developed over the years.

"People have to be able to come in here and not just hear but hear and see and feel and touch a story," Amstein adds. "That's what we try to do with each exhibit that we have. We say, 'OK, what is the story that we're going to tell?'"

Pierce tells how visitors usually get a knowledgeable docent to guide them through the museum. Herbert H. Warrick Jr., former director of network engineering for Pacific Northwest Bell Telephone started the museum in 1986. The phone company was throwing out obsolete equipment and Warrick wanted to preserve history. He convinced management to let him keep the equipment and start the museum that officially opened for tours in 1988.

"It was a labor of love," Amstein says, "mostly done by retired, or in some cases long-serving telephone company employees."

Pierce writes that the Connections Museum "is now on its second generation of volunteers, most from the local tech community with a willingness to learn how to be technicians. "

The article profiles numerous Seattle museums, including Curious Things, Pinball machines, NFT (Art), the Sea Mar Museum of Chicano/a Latino/a Culture, and national Nordic Museum.

Connections Museum is at 7000 East Marginal Way South, open 10 a.m. to 3 p.m. Sunday.
The multi-page Seattle Times feature article by Jerald Pierce is online at:
https://www.seattletimes.com/entertainment/visual-arts/what-turns-a-passion-or-collection-into-a-seattle-museum/.

Panel switching system lives on at Connections Museum

By Sarah Autumn

The panel switching machine at the Connections Museum was initially saved because Pacific Northwest Bell technicians were simply afraid to remove it. The No.1 Crossbar one floor above was still in service at the time the Parkway office's panel machine was decommissioned in 1974. Technicians worried that if they started cutting wires, they would inadvertently sever some cable that was important to the Crossbar, so they chose to just leave the panel equipment in place with the power off.

Ten years later, it was an obvious candidate for display in the newly established museum. Founder Herbert H. Warrick had worked in this switching office early in his career. And Herb's father, Herbert Sr., was a switch technician there on the day the panel system was placed into service in 1923, so Warrick had an extra interest in saving this particular machine.

In the simplest terms, a panel switch is designed around an early electromechanical computer which was officially called a "sender". The *sender* gathers up the digits from your phone as you dial them, and then once it knows the number you want to call it moves rods with metal *brushes* on them across large panels of electrical contacts to complete your connection. Those panels of contacts are where the whole system gets its name. This was an extremely innovative design for the 1920s, it was much more advanced than the previous (step-by-step) Strowger systems.

Subject matter expert (and panel switch caretaker) Sarah Autumn of THG's Connections Museum is shown working on a section of the switching system.

Rescuing the panel switch meant making a large hole in the outer brick wall of the Parkway building. The system was brought into the building as individual parts beginning in 1921 and assembled there over a period of two years. But it was not reasonable or even possible to fully disassemble it again before moving it to the museum, so they elected to open the wall and carry the frames out in their entirety with a crane. If you know where to look you can still see an outline today where they replaced the bricks after it was all done.

The full machine did not go to our museum, however. THG only has what might be described as a “minimum configuration”, enough of the machine was preserved to give visitors a good demonstration but not nearly enough to handle the volume of calls and subscribers that it was once capable of. Even then, when the machine was first reinstalled at the museum, it was put back into service only in a very limited way.

When I started volunteering at the museum in 2015, I embarked on a several year journey to restore and power up the rest of it, and to show visitors what it would have looked like 100 years ago. That involved things like cleaning, painting, mechanical work, and soldering thousands of connections by hand. Not to mention hundreds of hours of research in our archives and those of AT&T. Museum visitors can now experience the equipment much like it was back in 1923, including hearing the sounds and seeing the motions of the machine placing many calls concurrently.

Our panel switch was not a special one during its regular service life. Parkway was, in fact, quite a small and unremarkable central office when compared to the behemoths that served places like New York City. But it is really special to us now because it's the last working example of one anywhere in the world. Perhaps because Pacific Bell did not yet fully trust the new technology, they chose to install the first three of them in relatively sleepy suburban neighborhoods and gain some experience with them before trying panel switches in the large “Main” office downtown. Beside the one at Parkway (then called Rainier) there were sister machines put in at Melrose and West. Here are a few facts and figures:

Cut into service: Saturday, March 3, 1923, at midnight
Retired: December 1974
Moved to museum: 1987

Calls originated on first day in service: 36,199
Average normal daily calls (1923): 13,000
Approximate number of lines in service on first day: 4,000 (out of a theoretical maximum of 10,000)
Total cost of the first three panel offices installed in Seattle: $883,000 (1923)
Adjusted for inflation: $15,327,000 (2023)

Approximate Cost of the Rainier/Parkway system: $294,000 (1923)
Adjusted for inflation: $5,103,000 (2023)

"The most unusual aspect of our switch at the museum is that it is the only working example of a panel switch remaining anywhere on the planet. The Bell System (Western Electric) built and installed hundreds of these, but they have all gone to junk yards except for ours," says Peter Amstein, Board President of the Telecommunications History Group.

This machine probably has received more love and care in its lifetime than any other panel switch ever built. It was well maintained by the Bell System technicians when it was in service. But the amount of care and attention that it has received from me, and the museum volunteers before me, is itself remarkable. The story of the human connection to the machine is what's important here--in the way it served the human need to communicate, the ingenuity of the engineers that designed and manufactured it, and the love that has been bestowed on it in the last couple of decades. Museum volunteers have even traveled across the country several times since 2015 to find additional parts and pieces for it, in order to ensure we can keep it running long into the future.

As the panel switch celebrates its 100th birthday on March 3rd, 2023, I'd like to thank the folks who worked on it before me, and everyone who has helped in its continued restoration. Here's to another 100 years!

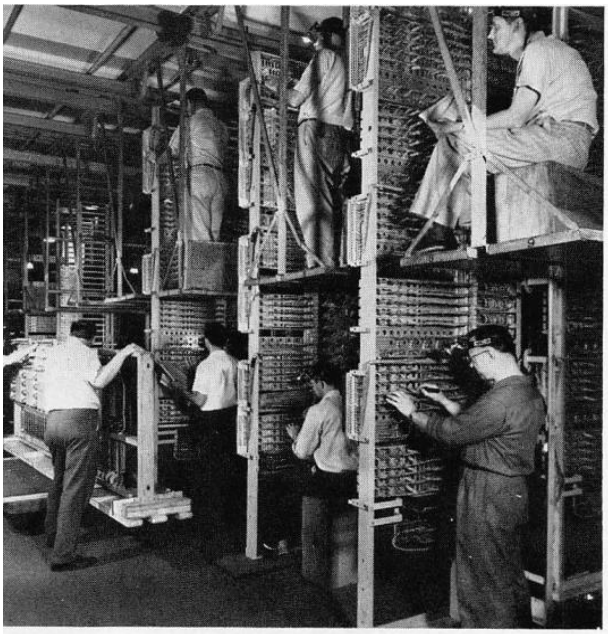
New York City gets Panel switch office in 1922

By Al Kovalick
Video Engineer and THG Member
Santa Clara, California

The Panel telephone Switch in THG's Seattle Connections Museum observes its 100th birthday in 2023. But New York City got its first Panel a year earlier, in 1922. These events were the first ripples in what would become a sea change in the way Bell System Central Office worked over the next 30-plus years.

In 1920 there were an estimated 128,000 Bell System operators, using switchboards to make connections for subscribers, according to the Boston Globe newspaper. At the same time there were some constrained dial-based automatic exchanges (no operator needed) installed in smaller cities. Engineers were eager for all customers to dial their own numbers without operator assistance, especially in large metro areas. With this goal, the Panel type telephone switch was developed by the Bell System. Even though there were various switching systems, the customers rarely knew what type of switch they were using.

On October 14, 1922, the first 7-digit Panel switch began serving subscribers in NYC. The exchange was located near New York's Penn Station so took on the name, "Pennsylvania Exchange." This reference led to the now famous phone number Pennsylvania-6-5000 (PE-6-5000), made popular by a Glenn Miller recording in 1940. The original phone number was PEN-5000 using the three-letter (PEN=736) plus four-digit (5000) format. But by 1940 most phone numbers were using the two-letter plus five-digit format, so PE-6-5000 was used. The PEN part is called an office code and each code supports about 10,000 lines.



Panel installations took as long as two years and a lot of manpower.

From 1892 until about 1912, many Step-by-Step and Rotary switching systems were installed worldwide. These systems had acceptable cost effectiveness in smaller cities. By 1912, the Western Electric Company proved that its Panel test system had great potential for serving metropolitan areas. So, all future switching development efforts were focused on Panel. However, efforts crawled partially due to economical operator-based switching and World War 1 slowdowns, as recounted by "Engineering and Science in the Bell System - The Early Years."

The first full, dial-based, electro-mechanical Panel office came alive December 10, 1921 in Omaha, Nebraska. This was a six-digit system. The first true seven-digit metropolitan area office was the NYC Pennsylvania Exchange. By 1930 every dial telephone in Manhattan connected to

one of many Panel offices. Several iterations of the Panel design were made over the years with final improvements into the 1960's, reported by Bell Laboratories in November 1963.

A seven-digit Panel installation took about two years with many installers. About 200 would do the iron work first. Then approximately six months later, 100 installers would do the assembly and wiring. So about 40 percent of the total installation effort was only for iron work! The first large scale exchanges were a hardy mix of electro-mechanical components and iron infrastructure.

Western Electric Magazine reported in 1983: "Growth of Panel continued at the rate of about 100,000 lines a year through 1926, after which it increased more rapidly, reaching a rate of nearly 400,000 lines a year by 1931, about 40 three-digit office codes each year."

There are many excellent references for understanding Panel System operations. In 1926, E.H. Goldsmith wrote the foundation booklet "Panel Type Machine Switching," published by New York Telephone. R.E. Hersey wrote "Panel Dial Systems" in 1929 for Bell Labs, (https://archive.org/details/a-132_panel-dial-systems).

The Connections Museum of Seattle and docents have published many fine articles/videos on system operations at https://en.wikipedia.org/wiki/Connections_Museum

As if to predict today's discussion of Artificial Intelligence, H.P. Charlesworth wrote in Bell System Technical Journal, October 1925: "I do not know of any mechanical device that reminds one so much of the functioning of the human brain as does this mechanism (Panel system) for completing calls following the dialing operation."

Table I—Number of central office codes

Dec. 31	Manual	Panel	S × S	X-Bar	ESS	Total*
1950	3,257	502	4,107	604		8,470
1955	1,991	512	6,087	1,161		9,751
1960	715	494	7,511	2,258		10,978
1965	94	528	8,212	4,281	1	13,121
1970	11	451	8,393	5,637	264	14,756
1975	1	144	7,911	6,549	2,183	16,788
1977	1	68	7,223	6,537	3,477	17,306

* Some buildings are multi-entity facilities containing more than one central office code. Therefore, the number of Bell System central offices exceeds the actual number of central office buildings.

Panel installations peaked with 528 central office codes in 1965, then started to decline with Crossbar switching (X-Bar) and Electronic Switching System (ESS) replacing Panel. Step-by-Step (SxS) was typically, but not always, reserved for smaller cities and towns. Each central office code supports approximately 10,000 subscriber lines.

The terms Central Office (CO), Office, and Exchange can have different meanings in the context of telephone switching. First, any of these can refer to the building that houses switching equipment. For example, "The Crossbar Central Office and Panel Central Office are 10 miles apart." Second, these terms can also refer just to the equipment associated with a single "office code". For example, the PENnsylvania and GARfield office equipment can share the same CO (or Exchange) building. Alexander Graham Bell first coined the term Central Office.

As the Panel switch enabled subscribers to make their own calls, the Bell System conducted extensive instructional programs, showing people how to dial. Instructions were provided an many formats to ease the transition.

Biographical information about the author is at: https://www.theavitbook.com/about-the-author

Working TV first shown in Britain

Like many other Scottish inventors, John Logie Baird plays an important, but perhaps less heralded, role in the advancement of telecommunications. In January 1926, Baird publicly demonstrated the first working television system showing true images. The Times newspaper reported on the demonstration, at Selfridge's Department Store, with a story which included a grainy photograph.

Baird went on to use telephone lines for the first Trans-Atlantic TV broadcast in 1928 and develop the first electronic color TV.

Baird studied electrical engineering at Glasgow's Royal Technical College but did not graduate. Because of poor health, he moved to Hastings, on England's southeast coast after World War I. He tinkered with TV ideas patented as early as 1884 by German inventor Paul Nipkow. Using household items such as scissors and darning needles, Baird concocted a method of rotating mechanical disks to transfer moving images into electronic impulses. Baird's process was the first to display low resolution, but visible images.

The first known photo of a moving image. From Baird's "televisor," January 1926. Subject is Baird's business [artner, Pliver Hutchinson. (Wikipedia)

By 1927, Baird was able to transmit an image 438 miles between London and Glasgow, in apparent response to AT&T's experimental long distance telecasts between Washington and New York. Bell Labs used a similar device shining light through a rotating screen.

Advancements came quickly. Baird set up the Baird Television Development Co. Ltd. By 1929, the British Broadcasting Corporation started regular telecasts using the 30-line scanning system developed by Baird. The mechanical system, with an increasing scan rate up to 240 lines was soon replaced by an all-electronic 405-line process from Marconi Electric and Musical Industries (EMI). BBC adopted the Marconi method exclusively in 1937.

Baird continued experimentation, concentrating on color TV. But his post-war proposal for a 1000-line high-definition system got lost in a bureaucratic shuffle. Consistent color broadcasts didn't arrive in Britain until 1967 with the PAL (Phase Alternating Line) method. Most of Europe and Africa had PAL, while North America used the NTSC (National Television Standards Committee) scan refresh system.

Baird also tinkered with video recording, fiber optics, infrared night vision, and a type of RADAR. These experiments did not produce any commercial results.

The National Library of Scotland lists Baird in its Hall of Fame, describing him as one of Scotland's ten greatest scientists. In 1914, the Society of Motion Picture and Television Engineers (SMPTE) posthumously listed Baird in its Honor Roll. In 2021, the Royal Mint issued a limited edition 50-pence coin to recognize Baird's inventions.

In the U.S., a home television receiver was introduced in January 1928, in Schenectady, New York. There were occasional TV broadcasts in the area on equipment made by General Electric.

Radio Corporation of America introduced a cathode ray tube in 1932 to improve the display. Russian-born physicist Vladimir Zworykin developed an iconoscope tube for better cameras.

Regular TV service in the U.S. started in 1939. Color transmission began in 1954.

Contemporary world built by Scots

Being Scottish is more than just nationality origin or clan or even culture. It is also a state of mind, a way of viewing the world and our place in it. – Arthur Herman

Scots or Scottish descendants have been at the center of every major social and geopolitical event of the last 500 years, says American historian Arthur Herman. He validates that heritage in his book, How the Scots Invented the Modern World.

Scotland's Highlands, now sparsely populated, are north and west of Glasgow. There are major universities in Edinburgh, Aberdeen, Glasgow, Dundee (near St. Andrew), and Inverness (known as the Capitol of the Highlands).

Herman's book, subtitled "The True Story of How Western Europe's Poorest Nation Created Our World and Everything In It," is essentially a history through the lens of Scots who invented, implemented, and improved elements of present-day life.

According to Herman, Alexander Graham Bell was following tradition by inventing and patenting a working telephone and other engineering endeavors. Antonio Meucci of Italy and Elisha Gray of Ohio were working on telephony at the same time, but Herman says Bell applied typical Scottish thinking to make the telephone practical.

In February 1876, Bell got his first patent. He set up his highly successful National Bell Telephone Co. the next year, and became wealthy in the process. "Bell had become one of the new breed of American businessmen: the industrial magnate," writes Herman.

Bell also became president of the National Geographic Society and a regent at the Smithsonian Institution. He spent heavily on research to help the deaf. He also experimented with aeronautics, medical technology, and sound reproduction.

Perhaps the most notable of Bell's subsequent projects was his collaboration with fellow Scots, Joseph Henry and Samuel Langley, on designs for manned aircraft. The Smithsonian Institution's original display for the first airplane featured Bell and Langley's prototype instead of the craft flown by Wilbur and Orville Wright.

Another Scot, Samuel Finley Breese Morse, set the stage in the middle 1800s. After studying experiments in Europe, Morse developed and implemented a practical method for telegraph messaging. Again, a Scotsman applied what Herman calls the transformative ideas of organization.

The first telegraph message, "What hath God wrought," in 1844, seems more prophetic than anyone thought at the time, according to Herman. He says the message expresses "astonishment, almost foreboding, at how the world would change...thanks to technology and the industrial age."

The Western Union Co. became a virtual monopoly in telegraphy. The telephone challenged that enterprise. A court case was settled when both sides agreed to provide specific services. The Bell company kept "telegraph" in its name, but essentially was confined to telephony.

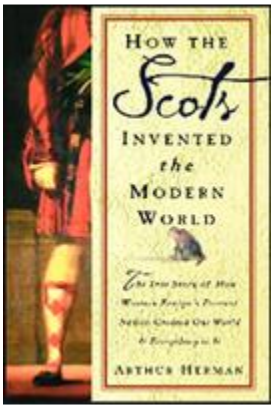
Herman says another Scot provided the transformation to a system based on meeting demands of consumers and suppliers. The author describes Andrew Carnegie as "creator of modern corporate enterprise and the most self-made man of all."

Carnegie emigrated with his family to the Pittsburgh area, and saw his success based on education. He started in a telegraph office, moved into railroad management, and invested in Pullman coaches. Carnegie turned to steel production, using Englishman Henry Bessemer's relatively new process. The Bessemer system significantly reduced the cost of steel production by reducing impurities in molten iron.

Carnegie didn't really invent anything; he worked on the process, improving production while constantly increasing efficiency. According to Herman, Carnegie's approach typifies fellow Scotsman Adam Smith's capitalism "on a huge scale."

After selling U.S. Steel to financier J.P. Morgan for over $300 million, Carnegie began a massive philanthropy campaign. Most notably, he financed the establishment of over 3,000 libraries around the world between 1883 and 1929.

"Obviously, the Scots did not do everything by themselves," Herman writes. "But it is the Scots who drew up the blueprints and taught us how to judge the final product." As an immigrant group, Herman says the Scots were not held back by religious or cultural discrimination.



Throughout the book, Herman provides a thorough catalog of notable Scots. Up to 21 members of the Constitutional Convention were Scottish. Presidents James Madison, James Monroe, John Calhoun, Andrew Jackson, James Polk, Rutherford B. Hayes, and Woodrow Wilson had Scots ancestry. Alexander Hamilton, Aaron Burr, Patrick Henry, and John Paul Jones were Scottish immigrants.

Lawyer James Wilson helped James Madison reconcile the concept of a strong national government with the revolutionary notion of popular sovereignty. Wilson also set the foundation for the Supreme Court.

By 1760, there were so many Scots in North Carolina that the area was known as Little Scotland. The feuds of the Hatfields and McCoys we continuation of fighting between the Campbells and MacDonalds.

James Watt changed the world by perfecting the steam engine. Architect Robert Adam provided the neo-Italianate template for civic buildings in the U.S. and Britain. In the middle 1700s, Glasgow printers Robert and Andrew Foulis pioneered long-lasting standards for graphic design. Thomas Telford was world famous for massive engineering projects such as canals and bridges which are still in use. Telford also designed and supervised construction of nearly 1,000 miles of new roads in Northern Scotland.

John Loudon McAdam devised a new, simple system of road construction that is now known worldwide as asphalt. His name carries on in the word "tarmac."

Robert Fulton, of Scottish descent, made the steamboat functional in the United States. Scot George Stephenson adapted steam power for railway use. Archibald Buchanan built the first integrated cotton mill. James Nielson developed the modern blast furnace. In the 1840s, James Young found out how to extract kerosene from oil shale, setting the stage for the petroleum industry. Charles Macintosh discovered the process of vulcanizing rubber. John Findlay Wallace, of Scottish descent, was Chief Engineer of the Panama Canal.

At the turn of the 20th Century, Scotsman David Dunbar Buick invented a process for bonding porcelain to steel for modern plumbing devices. With Walter Marr, Buick invented the overhead valve (valve-in-head) gasoline engine, still used today, and founded the company that would become

General Motors.

Frontier pioneers Jim Bowie and Daniel Boone were Scots. Robert Stuart pioneered the Oregon Trail. James Watson Marshall discovered gold at Sutter's Mill, California. Many of the Latter Day Saints (Mormon) missionaries who explored and settled the western states were converted Scottish Presbyterians.

Scottish explorer Thomas Cook sailed around the world three times, opening the South Pacific. Alexander McKenzie crossed Canada in 1793, ten years before the Lewis and Clark expedition. An American of Scottish descent, Henry Stanley, set out to find another Scot, missionary explorer David Livingstone, who lost contact on his third expedition across Africa.

Prime Minister John McDonald led a campaign for Canadian confederation. Scottish Governor-General Lord Elgin introduced reforms leading to Canadian independence. Sanford Fleming, Chief Engineer of the Canadian Pacific Railroad, devised standard times zones for the entire world. Scottish immigrants had a major role in development of Ontario, New Brunswick, and Nova Scotia (New Scotland), where they displaced French settlers.

In 1809, Scotsman Lachlan McQuarie became governor of the penal colony of Australia and organized society around keeping order and humane treatment. Around the same time, Scottish businessmen set up communities and government in New Zealand. By 1861, one-third of New Zealand's population were Scots.

Scottish military forces helped Britain win the Opium Wars with China in the mid-19th Century. Scots developed Hong Kong as a major Asian trade center. Scots were deeply involved in British politics and "pretty much ran the empire," according to Herman. He says Scotsmen such as Arthur James Lord Balfour and Prime Minister William Gladstone were admired for their integrity and ambition.

Prominent Scottish writers include Robert Burns, Walter Scott, Robert Lewis Stevenson, David Hume, James Boswell, Arthur Conan Doyle, and Ian Fleming. James Bond was Scottish, played by famed Scots actor Sean Connery.

John Walker and Tommy Dewar developed ways of blending Scotch whisky to make it more palatable in where consumers preferred a "smoother" taste than traditional Scottish single malt ("uisge beatha").

From 1707 to the present, Scots took full advantage of the Treaty of Union with Britain. Glasgow has been a prominent Atlantic trade port with North America. Originally, the principal product was tobacco and wealthy traders were known as "Tobacco Lords." Later, Glasgow became a center of shipbuilding for the world.

The Scots Gaelic language is in a Renaissance, now spoken throughout the country along with British English. After a 1997 referendum, Scotland had its Parliament restored. Scottish voters narrowly turned down an independence referendum but voted to stay in the European Union (Brexit). Another independence vote is under consideration.

How the Scots Invented the Modern World was printed in 2001 by Crown Publishing. At the time of publication, author Arthur Herman was Coordinator of the Western Civilization Program at the Smithsonian Institution in Washington.

The writer of this original story, Dave Felice, has traveled widely in Scotland on several driving and ferry trips. National Records of Scotland has an extensive list of famous Scots at https://www.nrscotland.gov.uk/research/learning/hall-of-fame/hall-of-fame-a-z.