Tales of the Wireless Pioneers

By Henry W. Dickow

Book One
Part Four

Philo (Phil) T. Farnsworth, Inventor of Electronic Television

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The story of his great invention and its impact on society.
A personal friend of the author, his life story here is one
of the most interesting in the book.

Introduction

Success of electronic television is due primarily to two inventors, Philo T. Farnsworth of San Francisco and Vladimir Y. Zworykin of Camden, New Jersey. Little has been written about Farnsworth aside from the technical press, yet his contributions to television are of monumental importance. His electron dissector and multiplier tubes were two of the forerunners of numerous others which eventually brought television into the homes of millions.

Said his biographer George Everson, "The story of Philo Farnsworth who, through perseverance and unending research rose from an obscure farm boy with an idea to a famed inventor with a discovery that is enriching our living, contains all the elements of a Horatio Alger tale. But the story of Farnsworth is true. Moreover, it didn't take place in the days of Thomas Edison, Alexander Graham Bell, and other inventors—a period when America was "growing up" and when the vast field of science was first opening to historic discoveries. The story has occurred entirely during the twentieth century; it belongs to our generation. Farnsworth was a teen-aged youth when in 1922 he conceived his scientific idea for an all-electronic television system—the system that provided the basis for television in use today. At the age of fifteen he astounded his high-school science teacher by explaining in logical manner, with diagrams on the schoolroom blackboard, how he planned someday to transmit and receive images over distances of many miles. The fact that such a concept could be propounded by a high school freshman in a remote town in Idaho was amazing enough but is all the more astonishing when it is remembered that this youth had never been close to a research laboratory or a radio broadcasting station.

"Ironically, it may be that young Farnsworth's isolation from scientific centers and his lack of knowledge as to experiments then being conducted in television were a help rather than a hindrance to him."

Farnsworth was a product of the third era of wireless, or radio, following on the heels of Marconi and deForest. And because of him, the 1922-1940 years can rightfully be called the Farnsworth Years. Television did not originate with Farnsworth or Zworykin any more than wireless was the brainchild of Marconi. Nevertheless, the two inventors had the vision and the ability to make things work, to pull together the loose ends of earlier scientific discoveries and combine them into a practicable, workable pattern. Both succeeded in doing what others failed to do. Television, by means of a mechanical scanning disk and a photo-electric tube, had been tried and proved somewhat feasible in both the United States and in Europe, particularly in England. But being feasible is not to say that it was practical. It was a crude imitation of what was to follow. The "spinning wheel" or "windmill" of mechanical television had no possible chance of success, for it was not what the people wanted or desired.

Farnsworth removed the science of television from the mechanical into the electronic, and thereby gave the world a system of new and sensationally different form. It can almost be said that his discoveries were akin to those of deforest and his vacuum tube; deForest's invention spelled the doom of the crystal detector, Farnsworth's the doom of the mechanical wheel, for it would be difficult to imagine a modern home of today equipped with a huge revolving disk and a tiny aperture into which one could peer to watch his favorite movies or studio programs.

The story of Farnsworth is one of the strangest ever told. It required long years for him to secure recognition and an investment of more than $1 million went into his San Francisco laboratory before a truly successful electronic method of television evolved. Two men remained at his side through success and adversity, George Everson and Jess McCargar, the latter a California banker and friend of Everson, the man who discovered Farnsworth. Disappointments, successes, and problems came to Farnsworth in endless succession, yet his backers stayed with him for the two decades it required to bring the Farnsworth system to fruition. Only then were they rewarded for their patience and endurance. It was not an easy road to fame and fortune.

Farnsworth the Inventor

As a fifteen-year-old boy in 1922, he envisioned a system of television incorporating the photoelectric cell and the cathode ray tube. His high school tutor and chemistry teacher was the superintendent, Justin Tolman. At Rigby High School in Utah where the young Mormon boy was a student, he explained his ideas of an electronic television system after school hours to Tolman, who listened in fascinated awe. Farnsworth drew elaborate schematic wiring diagrams on the blackboard and pointedly went over the entire system with Tolman, who knew little or nothing of what the young genius was trying to convey. Farnsworth explained how he would focus an image to be transmitted on the photoelectric surface of the vacuum tube. If this were done under proper control, he contended, each point of the image would give off a flow of electrons representing the strength of the light focused on that spot. By this simple device, he reasoned that he could build up within the vacuum tube an electronic image which would correspond to the picture image focused on the surface. “It is true,” said Farnsworth, “that the electron image within the vacuum tube would be invisible, but nevertheless it would be an exact reproduction of all the lights and shades of the actual image in unseen electrical units.”

His knowledge of optics told him that light beams could be focused; therefore, why could he not provide a magnetic lens, or solenoid, to control the electrons and keep the unseen electron image sharply focused? This magnetic focusing was the second essential in the development of his television camera. In the transmission of pictures, Farnsworth knew that he must break up the image and transmit it a unit at a time. In other words, the image had to be scanned in much the same manner as the eye reads a page of print.

Farnsworth next considered the shape of the tube that would be needed to project the television picture. He concluded that the tube must be cylindrical in shape, with flat surfaces, closed at each end. The front of the tube would be coated with a photosensitive substance, and the impact of varying light intensities of the picture on this photoelectric surface would release an electron image. How well his theories were founded is seen from the type of cathode ray tube used for television today.

He told his tutor, Professor Tolman, that he would use magnetic scanning coils, which by attraction and repulsion would oscillate the electron image back and forth in an orderly fashion.

He further realized that two sets of coils would be necessary, one for scanning the image a line at a time with great rapidity in a horizontal direction, the other, moving slower, to deflect the image up by degrees as the lines were scanned. This then was Farnsworth's original conception of a television camera. In simple terms, a picture was translated from light values into a ribbon of electrical variations which could then be handled precisely as any other electrical current. Tolman now understood what Farnsworth was aiming at and gave him great encouragement to proceed with his experiments.

The problem of transmitting the television apparently solved, Farnsworth next gave consideration to the home receiver. It was, of course, essential that the received picture be transmitted through space the same as radio. Suitable amplifiers would be required to boost the signal strength for good picture reproduction on the face of the cathode ray tube.

Farnsworth's first receiving tube was a pear-shaped bulb with a slender stem. An invisible cathode beam would be formed by a current flowing through and heating the filament. He visualized a beam as flowing in a straight line to bombard the fluorescent surface of the cathode ray tube which was at the opposite end of the bulb, thus causing it to glow. Other technical considerations involving picture shades and tones are beyond the scope of this book, yet Farnsworth envisioned them all. The human mind can scarcely comprehend how a youth of Farnsworth's years and his limited technical knowledge, gained primarily from electrical magazines, could bring about the conception of an idea so complex as electronic television.

To help finance his project Farnsworth sought patents on three unrelated products, none of which brought him any financial gain, but only the usual fees paid out to patent lawyers and the like. At one time he was so depressed because of his financial condition that he considered selling his television idea to a scientific magazine, hopeful that he might receive remuneration in the sum of about $100 for his writings.

He was an accomplished musician, playing not by note but by ear. The violin and the piano were the two instruments he liked best, the latter played by the "pick and poke" system. Strangely enough, like other great men of science Farnsworth loved music; the two seemed

somehow compatible in many cases, even to the field of telegraphy, as was shown earlier in these pages.[1]

At one time young Farnsworth joined the Navy, intent on becoming a candidate for Annapolis. But military service was not for him. When his father died suddenly of pneumonia, Farnsworth elicited the aid of his Navy chaplain and secured his release from duty. He returned to his home in Utah to help support his family. It was here that fate intervened, when a stranger named George Everson came into his life. Everson had gone east on a fund-raising tour for the Community Chest, now the United Crusade. He was charged with establishing Chest units in many cities. He landed in Salt Lake City, Utah, where his car broke down with a burnt-out bearing. While it was being repaired, Everson began his search for manpower to conduct a direct-mail campaign in connection with his Chest drive. Farnsworth answered an advertisement for help wanted in the mailing department and was promptly hired by Everson.

That evening, after the mailing had been completed, Everson, Farnsworth, and a group of others became engaged in a bull session, and Farnsworth offered to explain his ideas of a television system to the assembled group.

"What do you call it?" Everson asked.

"Television," Farnsworth replied.

"I have heard little if anything about such a thing. What does it do?"

"It sends pictures by radio, just as sound is sent today," said Farnsworth.

Everson passed it off as of no consequence, but Farnsworth renewed his discussion the following evening. His associate, Leslie Gorrell, advised Everson to give thought to what Farnsworth had related, and urged some financial assistance, the idea appealing to him as having unusual merit. Farnsworth then went into great detail to explain his system to the two men, answering all questions asked with surprising clarity in both technical and lay language. Everson was impressed. He offered to bring Farnsworth to San Francisco where he would introduce him to friends in the banking business.

[1] It's unclear what this refers to. Possibly Dickow had written "Tales of the Wireless Pioneers" chapters on DeForest or Fessenden that we have not yet uncovered in the Society of Wireless Pioneers archives. – Ed.

Said Everson to this writer, “We crossed Salt Lake and headed for home. I had many times wished that I had thrown him into the Lake instead of bringing him to San Francisco.” The reason for this remark was plain—the financial interests which gave backing to Farnsworth had by this time invested $1 million in his system and success was not yet within reach.

When Everson agreed to secure financial backing for Farnsworth the first contribution came out of his own pockets, $6,000, his life’s savings. When Everson agreed to part with his funds, he told Farnsworth “I have about six thousand dollars in a special account in San Francisco. I’ve accumulated it with the idea I’d take a long-shot chance on something, hoping to make a killing. This is about as wild a gamble as I can imagine. I’ll put that up to work this thing out. If I win, it will be fine, but if we lose, I won’t squawk.”

Later in the week, Everson, Gorrell, and Farnsworth wrote an agreement by which Farnsworth was to have one-half of the partnership. Gorrell and Everson each would get one-half of the remainder. Gorrell was a Stanford graduate in mining engineering and seemed to understand the basics of what Farnsworth had related technically, and it was on his advice that Everson entered into the partnership agreement. “Fundamentally,” said Everson, “it was faith in the ability of the boy inventor that brought about the partnership. Unquestionably his purposefulness and modest self-assurance added much to my confidence in him.”

When the party of three men and Farnsworth’s newly-acquired wife arrived in Los Angeles en route to San Francisco, they decided to set up shop in the southern city and build an experimental television tube. Finding a glassblower who could build a tube to Farnsworth’s exacting specifications was difficult, and a compromise was then arrived at. A tube was built, the inside of one end coated with a highly sensitive photoelectric material, and with a collector wire and lead out through the other end.

History was made on that sunny June day in Los Angeles. This was to be the first electronic television tube ever built. It was the first image dissector tube, the heart of the Farnsworth television camera. “Now we must get some copper wire for our deflecting coils,” said Farnsworth. We’ve also got to find some instrument for coil winding.”

By great good fortune the glassblower knew where to find them. Coil-winding operations began in the backyard of a nearby garage of an apartment which Farnsworth had

rented. The coil winder was Everson himself. A miniature research lab was set up in Farnsworth's dwelling, where experiments were conducted from May through the summer of 1926. This was the era of prohibition, and the strange goings-on in the Farnsworth apartment aroused the suspicions of his neighbors, who were of the opinion that a still had been put into operation by the young inventor. Arriving frequently with large and strange-looking bundles of materials, Everson and Gorrell were regarded with suspicion. In due time, there was a knock at both the front and rear doors. As they were opened, the occupants faced two policeman who demanded that they be permitted to search the house in quest of a still. When they found nothing of an alcoholic nature but saw the strange contraptions which Farnsworth had strewn about his quarters, the minions of the law were told that they were witnessing a television invention. Not knowing what television meant, they left, muttering to themselves that something far more sinister than bootlegging might be involved in this house.

Patent applications were then drawn up by the firm of Lyon and Lyon in Los Angeles. Everson told Leonard Lyon of the Farnsworth plan. "If you have what you think you've got," said Lyon, "you have the world by the tail; but if you haven't got it, the sooner you find out the better, because you can waste a lot of money on a scheme of this kind. We have arrangements whereby we can call on the California Institute of Technology for technical advice and consultation. You bring your young genius in here and my brother Richard will bring in some qualified person from Cal Tech to join with him in passing judgement on the merits of what this young fellow has.

"The conference was arranged. Dr. Mott Smith of Cal Tech was present, as were Gorrell, Farnsworth, Leonard Lyon, Richard Lyon, and myself," said Everson. "During the conference Richard Lyon often got up from his chair and walked the floor, pounding his hands together behind his back and exclaiming, 'This is a monstrous idea—a monstrous idea!'

The conference carried on until six o'clock in the evening. Then it was concluded that Farnsworth's ideas were sound, and that there had been nothing of a similar nature on file in the patent offices to the knowledge of the attorneys. Dr. Smith approved the system.

"Is this thing feasible?" asked Everson.

"You will have great difficulty in doing it, but we see no insuperable obstacles at this time," said Richard Lyon.

Dr. Smith was then asked to name his fee for the consultation. It was a modest sum. But there was a consideration: "I'm afraid I'll have to add to that the amount of the parking fine, because I left my car on the street and came up here feeling sure that I could throw this scheme into the discard in a half-hour."

The next week was devoted to ways and means of financing the new invention, Farnsworth felt that a year's time and $12,000 in cash would do it. "Later developments proved Farnsworth to be the typical optimistic inventor, because it actually took more than $1 million in money and thirteen years of time before his invention was ready for commercialization. It is doubtful if either Farnsworth or I would have had the courage to undertake the venture had we known what was before us," said Everson. Everson then set out in search of financing. He had raised millions for charity and was one of the most successful fund raisers in the business. But in Southern California he was unable to raise a single penny for Farnsworth's gamble. Banker after banker turned him down. Both Everson and Farnsworth feared the worst. Many of those whom Everson approached from Santa Barbara to Los Angeles were his closest friends—men of great wealth, bankers, financiers, industrialists—yet none would venture a cent on a gamble like Farnsworth's.

Only once were they on the threshold of success, when a sum of $25,000 was proffered them on the assurance that color television might ultimately result from the Farnsworth invention. But Farnsworth and Everson were honorable men, and not only did they refuse to give such assurance, but they stated further that in their opinion it was probable that color television might never become a reality, or if so, it would come only in the not foreseeable future.

Abandoning hope of finances in Los Angeles, the trio ventured to San Francisco. There they met with success. And the approval for a $25,000 grant came from one of the shrewdest and most conservative of all the city's bankers, Mr. James J. Fagan of the Crocker Bank. It was the only time in the long history of the bank that finances were ever proffered for a speculative venture. And not only were the money matters arranged, but a loft in the building in which the

Crockers had an interest was further made available to the young genius. All at the bank took an immediate liking to Farnsworth. He was permitted to withdraw a sum of $200 monthly for his salary. The Farnsworth Television Laboratory at 202 Green Street, San Francisco, was in business.[2] He was in the height of his glory and the prime of his youth—20 years of age.

He began building his first transmitter tube, which he named the dissector. He knew nothing about glass blowing and there were no qualified glassblowers available in San Francisco. So he sent a wire to his brother-in-law, Cliff Gardner, to come to the city by the Golden Gate and serve as glassblower. Gardner had no knowledge whatsoever of this skill and he was to learn by "cut and try." Farnsworth was wary of allowing strangers access to his laboratory and his ideas, thus he called upon his family when manpower was needed.

Farnsworth had no trust in others. He knew that certain inventors in Europe were engaged in television experimenting, but he was certain that they had not yet stumbled upon the idea of a system of electronic scanning. When he was asked why he alone should have thought of this revolutionary idea, he replied: "That is a long story. Many tried to do something with it. They all attempted to break down the image for transmission by using mechanical devices. The first really half-way practical approach was in 1884, when a Russian named Nipkow, working in Berlin, took out a patent on the 'scanning disk'. In his apparatus he used a rapidly revolving disk with minute holes along the outer edge to accomplish the scanning. In 1889 an inventor by the name of Weiller used a wheel with convex mirrors of highly polished metal on the periphery for this purpose.

"Since the turn of the century the Nipkow and Weiller devices have formed the basis of practically all television experiments. Jenkins of England had succeeded in transmitting a fairly recognizable crude image with a scanning disk. All of them are trying the impossible. It can't be done by mechanical means. I propose to do it by wholly electrical means by manipulating the speed of electrons." And he did.

When he built his first successful experimental transmitting tube, the first image to be televised was the dollar sign, in good humor. It is difficult to describe the thrills and cheers that emanated from the small group in the laboratory when the first electronic system of television

[2] A plaque commemorating this site, California Historical Landmark #941, can still be found at that address. – Ed.

proved successful. Next to be televised was a triangle. Then smoke emanating from a lighted cigarette was seen to flow across the face of the receiving tube. Step by step, improvements were made, and interest at the laboratory was at fever pitch. In due time, motion pictures were televised. This was accomplished in 1926, long years before television came into the home as a means of entertainment.

From the knowledge first gained in the design and manufacture of pilot transmitting tubes, it had been relatively simple to make a tube for the receiving end, but only after a number of unusually difficult hurdles had first been cleared. When news of Farnsworth's success leaked into the brokerage offices of the Financial District, there was a rush to buy stock, but because it was closely held by four men, only these few holders were in a position to sell. Gorrell took advantage of the situation and sold a small block of his holdings for $5000. Farnsworth shrewdly sold a few shares here and there to friends at high prices, and with the proceeds he purchased a beautiful home in the famed San Francisco Marina District. The stock ran the gamut of prices from a low of $25 per share to more than $1000, then fell off again to a disappointingly low value. Those who sold at the opportune time reaped handsome rewards. The gyrations were due in part to adverse publicity given the Farnsworth invention in the scientific journals, particularly those house organs which were controlled by the large corporations whose own mechanical scanning systems were vastly inferior to the electronic method of Farnsworth. High praise was paid Jenkins of Baltimore and Baird of London, both of whom were hurriedly putting out a scant few television receivers based on the scanning disk principle, if only to discredit Farnsworth. The high praise given these already-obsolete systems rankled Phil Farnsworth to no end.

In due course he received and entertained a distinguished visitor, Dr. Vladimir Zworykin, who had just recently been transferred from the Westinghouse Laboratories to those of RCA at Camden. Zworykin, the inventor of the Orthicon or Iconoscope camera tube, was delighted when he first saw the Farnsworth Dissector tube. Holding it in his hand he remarked, "This is a beautiful instrument. I wish that I might have invented it." The glassblowing skills of Gardner astonished him.

At first it had been the intention of the Farnsworth group to deny Dr. Zworykin access to any of the secret developments in the Green Street laboratory, but when it was deemed essential for the ultimate success of television generally that only the world's largest corporations could adequately finance and produce this new miracle Farnsworth agreed to tell all to Zworykin.

Phil Farnsworth's first patent application was filed on January 7, 1927. Then there were long stretches of uneasiness when interferences might develop through others claiming prior conception of the same ideas. Such interferences always present dangerous financial problems, particularly for a fledgling company with limited assets. The first major interference came from RCA, claiming that the Farnsworth dissector tube interfered with Radio Corporation patents. This suit cost the Farnsworth interests $30,000 to combat. Farnsworth won. In two other patent suits, one covering the "blacker than black" synchronizing pulse and the other covering the "saw-tooth" wave scanning a prolonged and costly struggle ensued. The proceedings dragged out over many years, but in the long run it was Farnsworth who prevailed.

Searching for broader horizons, Farnsworth came under the wing of Philco of Philadelphia, and the San Francisco laboratory was moved to the eastern city, much to Farnsworth's chagrin. He relinquished his beautiful San Francisco home and forsook the cool climate of the Bay City for the summer heat of a cramped penthouse laboratory atop one of the Philco buildings. Farnsworth ventured to England and Germany where he made arrangements with television interests of both countries for licensing agreements. Even Baird of London, with its former scanning disk method, signed with Farnsworth, but the system did not take to the air by reason of a disastrous fire which consumed the studios and all of the Farnsworth equipment. In Germany, World War II and the Nazis doomed the Farnsworth system.

Foreign Dignitaries

One of the amusing incidents in the history of the development of the Farnsworth system was the desire of many of the world's leading scientists to meet the inventor and discuss television problems with him. Obviously only a scant few such requests could be granted. The Chief Engineer of the Federal Communications Commission called from

Washington to inform Farnsworth that a representative of the French government was on the train from Washington to Philadelphia and requested that someone meet him at the station upon his arrival. The Frenchman had met none of the Farnsworth people and they in turn had not met him, so the question of identification presented an awkward situation. A Farnsworth representative went to the station and had no trouble spotting the visiting official. He was the only one who got off the train wearing a frock coat and striped trousers.

In San Francisco a representative of the powerful Mitsui Company called Everson on the phone. He informed him in clipped English that an eminent scientist from the Japanese Imperial University had arrived with letters to him asking that he arrange for the learned doctor to visit the Farnsworth laboratories. Said Everson, "The Japanese scientist proved to be a toothy myopic fellow with little knowledge of English. He made it plain to us that he was prepared to spend several days at our laboratory if we would grant him the privilege. Since we had little hopes of successfully exploiting our inventions in Japan, we could see no harm in letting him do as he wished.

"On the second or third day after the visitor had seen the television transmitter and receiver and had spent some time in technical discussion, our engineers inquired of the Japanese regarding the progress of television in his country. He replied, 'We already make your receiver set. When I go home we make your transmitter.'"

Everson stated that he was not a bit disturbed by this surprising confession but was a bit startled by his frankness in stating his intentions.

Bartholomew Molinari

While Phil Farnsworth was devoting his efforts to the Philco Laboratory of Television in Philadelphia, the original San Francisco laboratory continued to operate under the direction of Bartholomew Molinari, one of San Francisco's earliest wireless pioneers and an ardent believer in Farnsworth's system. "Bart" as he is known to all in the radio fraternity, was the designer and builder of the portable equipment used throughout the nation for demonstrating the Farnsworth system. He journeyed with this apparatus from city to city, giving lectures and demonstrating wherever he went. He also is an internationally known radio amateur, with the

call letters W6AWT, and the 1927 winner of the Hoover cup for the most outstanding amateur achievements of that year.[3]

His six years of service with Farnsworth brought him no remuneration in cash, for he agreed to accept stock in the company instead. Had he sold his holdings at the opportune time when the market was at its peak level he could have profited substantially. But he was not to be so fortunate. He sold his entire holdings for a mere $16,000, bringing him a net salary return of only $2666 per year.

Farnsworth the Man

Phil Farnsworth was a generous and kind-hearted man. His Mormon upbringing caused him to share his newly acquired wealth with relatives and friends in need. Two sons were born to him. Philo Jr. was born in San Francisco in September, 1929. In 1931, just before moving to Philadelphia their second child, Kenneth, was born. Shortly after arriving there Kenneth contracted a streptococcus infection of the throat and died after an unsuccessful emergency operation. A broken man, Phil Farnsworth took up the study of medicine as an avocation. He diagnosed his own ailments.

"I have sometimes wondered if this self-diagnosis has not been somewhat harmful in the several sieges of illness that he has endured," said Everson. And in Philadelphia the health of the famous inventor eventually broke.

Philo eventually worked a patent-exchange arrangement with RCA and the Farnsworth share of this deal has been rumored to be as high as $5 million, with no denials. The name of Phil Farnsworth then disappeared from the television scene until the Farnsworth factory for building radio and television receivers was opened in Fort Wayne, Indiana immediately following the end of World War II.

Mr. Farnsworth is in poor health, yet still living, at last report.[4]

[3] Molinari was also the first amateur to QSO Japan from the continental US, which he did from his home in San Francisco in February of 1925.

[4] Dickow's article probably dates from about 1970. Philo Taylor Farnsworth died on March 11, 1971.