



Commemoration of the 50th anniversary of TV broadcasting in Japan

The Dawn of TV Broadcasting in Japan

1. Kenjiro Takayanagi: The Father of Japanese Television

1.1 Kenjiro Takayanagi among the World's Premier Innovators

In Japan, Hamamatsu Industrial High School, Waseda University, and other institutions began studies on television at the end of the Taisho era (1912-1926). It is said that Kenjiro Takayanagi (1899-1990) became determined to work on television when he saw a picture in a French magazine illustrating a television of the future.

Dr. Takayanagi, who in the 1920's was a teacher at Hamamatsu Industrial High School, had already begun studies on a television set using an electric device for both imaging and image reception by 1925. Due to the technical and experimental restriction, Takayanagi eventually constructed a system that utilized a mechanical Nipkow disk and a photoelectric tube in the transmitting device, and an electric Braun tube in the receiving device. He succeeded in displaying a clear image of the character "イ" on a Braun tube on December 25, 1926 (on a mechanical and electrical system with 40 scanning lines). This was also the day when Emperor Taisho passed away; thus, TV in Japan began its historical journey with the start of the Showa era (1926-1989). Takayanagi's research progressed to the successful experimental TV transmission of an image of a person in 1928 (40 scanning lines, 14 frames/second).

1.2 All-electric TV System Completed

The site chosen for Nippon Hoso Kyokai's (NHK) Technical Research Laboratories (STRL) was Kinuta village in Setagaya, Tokyo. In June 1930, just five years after the start of radio broadcasting in Japan, STRL with a staff of 16, including Director-General Yoshihiko Takada (who served concurrently as the NHK Executive Director-General of Engineering) began research on television broadcasting.

Meanwhile, Takayanagi, who was at Hamamatsu High School, successfully conducted a TV experiment with a 100 scanning line, 20 frames per second system, and Tokyo Denki K.K. conducted an experiment using a 120 scanning line system employing a Farnsworth tube.

These efforts were followed by the invention of an image pickup tube, called the iconoscope, by Zworykin of the United States in 1931, a development which drew the world's attention. Immediately afterwards, Takayanagi's team test manufactured an iconoscope by themselves (220 scanning lines, 20 frames/second), and completed an all-electric TV system with 245 scanning lines, interlaced



Reproduction of character "イ" (NHK Broadcasting Museum)

scanning, and 30 frames per second transmission. Further improvements were made by Takayanagi's team, and in 1937, they fabricated a TV set with 441 scanning lines that operated at 30 frames per second. At the time, it was the world's best and is almost equivalent to the present TV system.

1.3 Resolution Focus of Global Competition in the 1930s

The 1930s saw preparations for implementing TV broadcasting in Europe. In Japan, the Television Research Committee adopted a provisional standard for a 441 scanning line, 25 frames per second, interlaced scanning system in 1938.

2. NHK STRL Established: Full-scale TV Research Commences

2.1 NHK Technical Research Laboratories Established: Television Research Commences

In 1937, it was decided to hold the Olympic Games in Tokyo in 1940, with NHK to do a TV relay broadcast of them. After a thorough examination of the systems that NHK had previously experimented with, including the Waseda University system and the Hamamatsu Industrial High School system, STRL decided to adopt Hamamatsu Industrial High School's electric TV system for the Olympic relay broadcast.

The first group from Hamamatsu Industrial High School joined STRL in September 1936, complementing the TV research engineering staff who helped to design and build the research facilities. In August 1937, Hamamatsu Industrial High School finished assembly of four "TV automobiles" (four vehicles were needed for imaging, video transmission, sound transmission, and image reception). More than ten new engineers came with the vehicle,

bringing the total number of STRL employees to 89 by the end of 1937. (STRL's reorganization in May 1937 established the three division, one section system, and Takayanagi was appointed Director of the Third Division, dealing with TV-related research.)

2.2 100-m Steel Antenna Tower

The TV research facilities in 1937 comprised TV building No. 1, a transformer room, a garage for the TV automobiles, and an air-conditioned studio facility. A full-scale research system for television was completed the following year (1938) with the completion of TV building No. 2 and a 100-m-high self-supporting triangular steel tower with a transmitting antenna. Thus, Kinuta became a base for TV research, with an experimental studio, the latest facilities, and an antenna tower capable of broadcasting all over Tokyo.

In such an environment, STRL developed a technology based on Hamamatsu Industrial High School's imaging tube research, and initiated the development of a prototype iconoscope in January 1938, with a standard prototype completed by June.

Studies on a receiving set began in 1937. Development proceeded on white phosphor, which was used in the set's fluorescent screen, and on enlarging the screen. This work led to the first 23-cm white fluorescent receiving tube in Japan.

3. Tokyo Olympic Games Cancelled

3.1 "Tokyo Olympic Games TV Relay Broadcasting Project"

NHK had decided to provide TV relay broadcasting of the Games, and Kenjiro Takayanagi and others participated in the project until its cancellation. NHK formulated a policy to work toward the implementation of full-scale TV broadcasting in May 1936. A national project that could have been called the "TV Relay Broadcasting Project for the



Vans for broadcasting from outdoors. Called "TV automobiles," they were (from left to right in the photo) the image receiving vehicle, sound transmitting vehicle, video transmitting vehicle, and imaging vehicle. (1937)

September 1940 Tokyo Olympics" was established at the Technical Research Laboratory, but so far, its researchers had fabricated only one image pickup tube and one receiving set.

Meanwhile, Takayanagi's TV had become virtually equivalent to the present TV set; It had 441 scanning lines and operated at 30 frames per second.

3.2 From the Laboratory to Implementation

However, these results were only in the laboratory; there were still an overwhelming number of problems to overcome before actual TV relay broadcasting could be provided to the public. These included the improvement of equipment's performance, the manufacture of various equipment, the construction of broadcasting stations for regular broadcasting, and the development of TV automobiles and mobile cameras for use outdoors. The staff was expanded in order to move TV from the laboratory into the real world. Many of the engineers who participated in the project came from radio equipment manufacturers. The budget for two years of research reached approximately 3 million yen. The Ministry of Telecommunications (presently the Ministry of Public Management, Home Affairs, Posts and Telecommunications) decided on the TV standard system and prepared a relay line between Tokyo and Osaka.

Although the Olympic Games were officially cancelled in July 1938, research on television continued, fueled by the zeal of those involved in the project.

4. Achieving the World Standard

4.1 Public TV Image Reception Experiments

Because of the Tokyo Olympic TV Relay Broadcasting Project, TV broadcasting in Japan achieved a practical implementation level within a short period.

The new Broadcasting Hall located in Uchisaiwai-cho, Tokyo was completed for radio broadcasting on May 13, 1939. To commemorate the completion, an experimental TV signal was transmitted from STRL to the hall (13 km away). This marked the first public television experiment using radio waves in Japan. It conformed to the TV standard in Japan; a 441-scanning line, 25 frames/second, 4.5-MHz video frequency, and 500-W output signal. Four TV sets installed in a backup broadcast equipment room on the 7th floor of the Broadcasting Hall displayed a test pattern, then the experimental image.

At the STRL TV studio, STRL employees appeared in front of two iconoscope cameras, taking turns saying: "Can you see me clearly? Can you see me clearly?" and announcing the station's call sign: "NHK Technical Research Laboratories experimental television station, J2PQ." Japanese television technology had caught up with the rest of the world. STRL staff reached 266 through successive



TV experiment at STRL (1940's). For shooting, the iconoscope was installed on a large caster.



Public TV experiment using a traveling TV car (1951)

expansions of the research project.

The first public television transmission experiment in 1939 was followed by another public experiment using two image receiving sets on August 19 and 29 at the "Koa Telecommunications Exhibition" held at the Mitsukoshi Department Store in Nihonbashi, Tokyo. Later, in March 1940, a number of TV experiments were performed, including one held during the "Splendid Technology Exhibition" at the Industrial Hall in Ueno, Tokyo.

4.2 Ground Work Laid for Post-war Electronics Industry

TV experiments proceeded with improvements to existing equipment and the fabrication of small lightweight cameras and lighting for capturing images while on the move. However, during the war, many of the TV industries were switched to munitions industries. Research on TV broadcasting was suspended in Japan. It was interrupted even in the United States.

5. Broadcast Law: Broadcasting for the Public

5.1 The Broadcast Laws

On August 15, 1945, Japan accepted the Potsdam Declaration. The Occupation Forces' General Headquarters (GHQ) issued instructions on freedom of speech and the press, as well as a press code and a radio code for Japan, emphasizing rules for newspapers and broadcasters, as well as their responsibility of providing broadcasting throughout Japan.

In April 1950, the Three Radio Laws, which included the Broadcast Law, were established. They replaced the pre-war Radio Telegraph Law, made Nippon Hoso Kyokai (NHK) into a special corporation, and established the Radio Regulatory Commission. The "Broadcast Law" led to a reorganization of NHK in which NHK was given the specific assignment of research on broadcasting.

5.2 TV Research at the Beginning of the Post-war Era

Research on TV in Japan, which had been banned by GHQ, resumed in 1946, beginning at STRL with the construction of a prototype image pickup tube and image receiving set and modifications to the 441-scanning line, 25 frames/second TV equipment of the TV cars that had been manufactured prior to the war. Dr. Takayanagi resigned from NHK that same year after he completed his job of launching television technology at NHK. He joined Nippon Victor Co., Ltd. (currently JVC) after leaving NHK. His accomplishments while he was at NHK contributed greatly to the development of Japanese TV technology.

Starting in 1949, STRL conducted public experiments at various locations. One of these experiments was held at the Mitsukoshi Department Store in Nihonbashi, Tokyo. In 1950, signals were transmitted, in an alternating manner, from transmitters at STRL and from the Broadcasting Hall to the Mitsukoshi Department Store in Nihonbashi, Tokyo. These broadcast signals were received on a receiving set in the department store and commemorated the 25th Anniversary of the start of NHK Radio Broadcasting. Additionally, scenes from the street outside Ginza Mitsukoshi were transmitted to the Hall using a 4-GHz transponder. This was the first microwave relay broadcast in Japan.

To inform residents outside the Tokyo, Nagoya and Osaka areas of the potentials of TV, public experiments and exhibitions were held on trains in 1950, and using TV cars during 1951-1952.

STRL fabricated its own image-orthicon camera in 1955 to replace RCA's image-orthicon cameras that had been employed up to that time.

6. TV Broadcasting Begins

6.1 TV standard

In June 1948, NHK conducted Japan's first post-war

public TV broadcasting experiment. In February 1950, it established an experimental TV station at STRL. Beginning in November, a regular 3 hour a day, once a week experimental radio transmission.

Examinations were also underway to determine which system should be selected as the standard TV system in Japan: the 6-MHz-band U.S. system or the Japanese 7-MHz-band system, which took into consideration possible upgrades that would allow for color broadcasting in the future. This "frequency debate" became heated in regard to preliminary radio license issues. The Radio Regulatory Commission, which was then in charge of administering radio, finally adopted the 6-MHz-band system (a black-and-white TV system with a bandwidth of 6 MHz per channel, transmitting 30 frames per second using 525 scanning lines), and promulgated it in 1952.

6.2 TV network between Tokyo and Osaka

NHK began using its downstream microwave network connecting Tokyo, Nagoya, and Osaka on January 11, 1953, aiming for eventual TV broadcasting in these major metropolitan areas. Since there was no initial plan for Nippon Denshin Denwa (the sole telephone and telegraph network company then, and later to be called NTT) to install a microwave network, NHK made the decision to construct an independent network using new technology, in order to introduce TV service as soon as possible. In August 1958, an upstream circuit was also completed, which made it possible for viewers in Tokyo and Nagoya to enjoy the heated competition at Koshien Baseball Stadium in Osaka. This meant Japan had been connected with a single network that would serve to expand the infrastructure that would make a simultaneous TV experience feasible for the entire nation. The network was later maintained by the Nippon Denshin Denwa corp., and all the major cities from Sapporo to Fukuoka were connected by 1956.

Regular TV broadcasting by NHK commenced on February 1, 1953. Although at the beginning there was

only one TV studio that could be exclusively used by NHK, all the broadcasting equipment, except the image-orthicon, were domestically manufactured according to STRL's designs.

6.3 TV broadcasting fosters a new culture and new technologies

Thus, TV broadcasting began, 23 years after NHK began its first television experiments and approximately 30 years after the start of Takayanagi's TV research.

Economic development and falling prices quickly made the television one of the three most treasured possessions in peoples' homes, along with the electric refrigerator and the electric washing machine. TV broadcasters began to create a variety of programs, from news and documentaries, to educational programs and dramas. TV was rapidly becoming popular. 1959 was the year of the Crown Prince's wedding. The number of black-and-white TV sets quickly exceeded two million, as people purchased them to watch the wedding on TV. This important event helped people to recognize the value of television, leading to a period of rapid diffusion of the new media.

Television technology has significantly evolved after its commencement 50 years ago. Japanese expertise in TV technology flowered first at the Tokyo Olympic Games in 1964 with live broadcasting sent to the US and with successful color broadcasting. These achievements were followed by HDTV, satellite broadcasting. The 21st century will no doubt see continued evolution of the medium.



Microwave relay station in Futagoyama (1953)



NHK Tokyo Television begins operation (1953)