CHAPTER 2

WHO INVENTED TELEVISION?

EVERY CHILD CAN associate the telephone with Alexander Graham Bell, the electric light with Thomas Edison, and the airplane with the Wright brothers. But who do we think of as the inventor of television? Some want to give that honor to Zworykin, whereas others feel that American-born Philo Farnsworth owns the title. You decide for yourself!

Actually, the development of television was simply too large an enterprise to have been the sole work of one gifted individual or even an inspired group. You might compare it to the construction of a large jet airplane, which we know would require the talents of a large number of skilled people whose identities and special abilities will forever remain unknown. In the case of television, however, there was a lengthy preamble of independent and uncoordinated effort undertaken by a great many dedicated scientists and engineers working privately all around the world.

The concept of a technology that would enable humans to communicate with each other through their two principal senses, sight and sound, undiminished by distance, was a popular Jules Verne-type fiction for many years. A number of visionary writers (skipping the cartoon book and fiction writers) projected their ideas of the effects that electric picture connections would have on everyday living. The best known of these early writers on the subject of "distant electric vision," and the most accurate predictor, was a prominent British electrical engineer, named A. A. Campbell Swinton, who proposed the idea of an entirely electronic video system in 1908. As desirable a prize as Swinton's system would have been, the staggering physical difficulties in-

Figure 2.1 A. A. Campbell Swinton.

volved in creating it forestalled any immediate attempt to bring it about.

By the last half of the nineteenth century, humans had compiled enough knowledge about the fine structure of matter as to be able to locate and process certain basic materials that had light-sensing and light-emitting properties. This encouraging work sparked the thought that Swinton's system might ultimately be possible, but the world would have to wait until a means of amplifying weak electric currents was invented before any real progress on television could be made. The vacuum tube was the first of these.

The scientists who were making the most important discoveries that led to the creation of our video system probably gave very little thought to the consequence of their inventions. Most of their work was done out of pure academic interest and a zeal for understanding more about the properties of nature's materials. Some were probably motivated by social pressure to distinguish themselves as the first to discover this or that, and to reap whatever rewards might ensue. Regardless of their motives, we owe an enormous debt to all of those wonderful people, too numerous to identify here, for the knowledge they compiled for us.

Television really began in 1884, when a 23-year-old German engineering student, Paul Nipkow, took the first practical step to-

Figure 2.2 Paul Nipkow.

ward actually setting up a video system. He described, but never really built, a mechanical image-scanning device that he imagined could transmit pictures over wires like a telegraph message. His image scanning concept introduced the idea of a point-by-point, sequential inspection of a scene, left to right and top to bottom, just as our eyes scan a printed page. The time-varying brightness encountered at each successive point, he thought, would generate a pulsating electric current that could be transmitted over telegraph lines to a remote viewing point. Nipkow's fundamental concept of the image scanning process is basic to the television system we use today.

Imagine a postage-stamp-size window in a black sheet. Immediately behind the window, place a one-foot-diameter disk punched near its edge with tiny holes spaced apart exactly the width of the window. A light source behind the disk would cause each hole to trace a visible line across the window as the disk rotates. If each hole were to be placed a little closer to the center than the one before it, a vertical component would be added to the sequence of lines seen in the window. The lighted patch would then take on the appearance of a luminous surface, or tiny viewing screen, as the disk continues to rotate.

In the very beginning, only a dozen or so scanning "lines" were crudely punched into a cardboard disk in order to create this

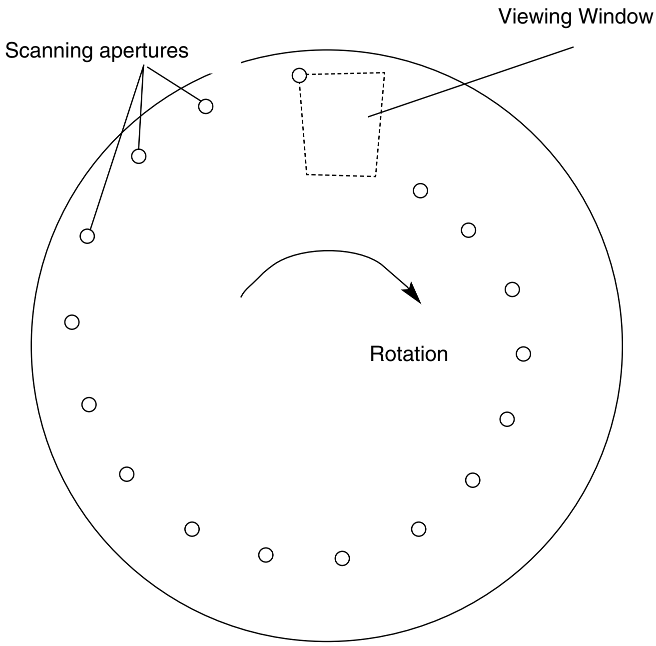

Figure 2.3 The principle of Paul Nipkow's scanning disk idea is seen here. As the disk rotates, the apertures trace over the image field a line at a time, either reading scene brightness information as a camera, or releasing light as a viewing screen.

effect, but as soon as little moving images could actually be seen, fascinated experimenters began raising the scanning-line numbers upward through 24, 30, 48, 60, and 120 to improve picture clarity. The ultimate promoter of this mechanical scanning idea was John Logie Baird of Great Britain, who went up to as high as 240 lines in the mid-1930s.

The scanning process served to convert light values into equivalent values of electricity that could be transmitted from point to point. For the *image* of a real object to appear on a screen like this, a duplicate scanning disk would have to exist at the remote location and run in exact synchronism with the viewing unit. The "camera disk," as it would be called, would have a lens in front of it to project an image of the scene onto the surface of the whirling disk. A photoelectric light sensor positioned behind the disk would pick up the varying light intensity coming through the moving holes in the disk, converting it into an electric current in

Figure 2.4 John Logie Baird.

proportion to the light intensity. Since no light sensor existed that could generate a large enough electric current to drive a lamp of any kind behind the remote viewing disk, an amplifier would have to be available to magnify that current. With this in place, the light intensity of the scene could thus be duplicated point by point in proper position at the viewing screen and would be recognized as a real image.

Early photoelectric cells, made by Elster and Geitel in Germany in 1892, could have served as the light converters, but before the invention of the vacuum tube amplifier by Dr. Lee De Forest in 1906, there was simply no way to strengthen their very weak currents. Television (and many other things) would have to wait for De Forest's invention.

Because the mechanical method of scanning and reproducing television pictures had gained such a considerable lead over the entirely esoteric idea of a completely electronic system, television developers were split into two camps well into the 1930s.

By 1928, Charles Francis Jenkins, for example, was regularly broadcasting mechanically scanned motion pictures late at night from a radio station in the Washington, DC area. As many as 2000 sets were said to be receiving his broadcasts at the time. In England, John Baird persuaded the BBC to start regular TV broadcasts

Figure 2.5 Charles Francis Jenkins.

in 1930. Those broadcasts continued well into the mid 1930s, but when fully electronic pictures finally became available and were found to be so much better, they put an end to mechanical television forever, destroying Baird in the process.

In an effort to build audiences for their broadcasts, Jenkins and several others began selling scanning disk kits that could be assembled by amateurs. Before the mid-1930s, however, excess inventories of these were being dumped on the market and one of my young friends was given one of them for Christmas. From Colorado, we searched many midnight hours looking for distant radio stations that might be sending out pictures. I can remember staring at the orange glow of the neon illuminator behind the scanning disk for hours, imagining that I could see some kind of a picture, but I can't honestly say that I ever did.

Early television engineers at GE and later at RCA had only the mechanical scanner to produce the steady, day-long video test signals needed in their lab, and that was a problem. No human or other life form could possibly face the strong lighting required to obtain a steady video signal from that type of very crude "camera" until Felix the (now famous) papier-mâché cat came along to stand on a rotary table for them. Figure 2.7 shows how he developed over the years.

Figure 2.6 Scanner.

J. J. Thomson's discovery of the electron in 1897 led to a wave of interest in electronic effects of all kinds, particularly electrons released from heated emitters. Use of the fast electrons to do what had never before been possible with heavy mechanical devices began immediately. Both television and oscillography were the first applications to benefit from the properties of the electron.

Well before the electron was defined, however, the first sign of anything that could make a luminous mark on an evacuated

1929/60 lines 1934/343 lines 1937/441 lines

Figure 2.7 Felix the cat.

Figure 2.8 J. J. Thompson.

glass enclosure was described in 1878 by Sir William Crooke. He showed what he called "cathode rays" making a visible bluish fluorescence form on the walls of an evacuated vessel. The "rays" could be drawn from a cold metal surface by a high-voltage electric field (thousands of volts). No one then knew that this was actually the flow of electrons moving freely in an evacuated vessel.

Figure 2.9 William Crooke.

In 1897, Professor Karl Ferdinand Braun succeeded in getting one of Crooke's tubes to produce a small focused spot on a fluorescent screen. The spot could be moved by placing a magnet near it or by making the "ray beam" pass between electrically charged metal plates. In so doing, visible line traces could be made on the face of the tube. Here was the beginning of a simple means for forming an electronic "screen" or scanning raster for a television display.

Ten years later in Germany, Professor Max Dieckmann built the very first real cathode ray tube using a heated cathode as the source of electrons. He also made a TV-type scanning raster and showed moving patterns on it by allowing electrical contact points to brush a rotating commutator running in synchronism with the scan. This was just a stunt to show a crude image on his tube and did not involve a photo-pickup camera.

In 1911, the Russian physicist, Boris L'Vovich Rozing, at the St. Petersburg Institute of Technology, set up a similar Braun tube scanned in step with a mechanical camera to pick up and display real optical images. We assume that a vacuum tube amplifier was available for use in that experiment. The image he obtained was said to be dim and not well focused but it was probably the first *live image* ever displayed on an electronic screen.

A student at the Institute at that time, and a favorite laboratory assistant to Dr. Rozing, was Vladimir K. Zworykin who was

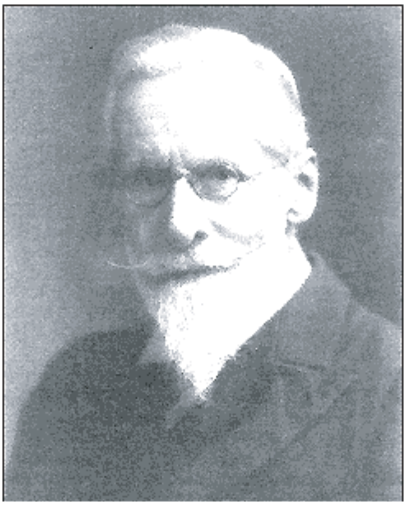

Figure 2.10 Karl Ferdinand Braun.

Figure 2.11 Max Dieckman.

postured by those events to carry on and greatly expand Rozing's work, which he had so intimately witnessed. Zworykin remained at the core of electronic television development from that time all the way to his retirement from RCA in 1958. Since he added so many important improvements to Dieckmann's original tube and to Rozing's early experiments, Zworykin is generally seen as the

Figure 2.12 Boris L'Vovich Rozing.

Figure 2.13 Zworykin with his iconoscope, the tube that brought us into the age of electronic television.

central figure in the development of the cathode ray tube and its application to television. It was my good fortune to spend a summer evening on the porch of his vacation home at Taunton Lakes, New Jersey in 1948 as he reminisced about his life and told about those first experiments with television.