# MAVERICK INVENTOR

## MY TURBULENT YEARS AT CBS

PETER C. GOLDMARK
with Lee Edson

*photo by CBS Laboratories*

$7.95

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with Lee Edson

The recording industry laughed when Peter Goldmark sat down and invented the long-playing record. But the record business had no idea of how much the tempestuous Hungarian electronics genius despised the interminable clicking of the old-fashioned record player, vintage 1945. In less than a year, Goldmark had invented the 33⅓ LP record, the same record design that has spread by the billions throughout the world today.

In *Maverick Inventor* Goldmark recounts his triumph over the recording industry, but as he points out, the invention of the long-playing record was simply one of literally hundreds of innovations and inventions made during his thirty-six-year career with the Columbia Broadcasting System, much of it as head of the prestigious CBS Labs.

The LP is a singular example of the Goldmarkian style. He would be offended by an existing product or system. He would apply his inventive mind to the prob-

*(Continued on back flap)*

*(Continued from front flap)*

lem and come up with a solution. Then he would do battle with the pencil pushers and accountants who controlled the purse strings. And finally, when the invention was brought to fruition, then the corporate wars began: either against General David Sarnoff and his troops at RCA or sometimes with the FCC.

In a jaunty style, Goldmark describes the inside story of his involvement with color television (he put together his first television set in 1926), automobile cassettes, EVR, plus his inventions during World War II.

If Goldmark had to do battle after his inventions were completed, his professional life was replete with interior struggles within the CBS corporate hierarchy. He recounts in detail his love/hate relationship with William S. Paley, the son of a Philadelphia cigar manufacturer who ran (and still runs) CBS with an iron glove.

But throughout *Maverick Inventor*, one theme is consistent: how the inventor's mind works and comes to grip with a problem, and then solves it. For the technically minded, as well as the reader who can barely cope with, say, the placing of an LP record on a spindle, *Maverick Inventor* is both a delight and a revelation.

ABOUT THE AUTHOR

Dr. Peter Goldmark today heads his own company, Goldmark Communications Corporation. Lee Edson is a free-lance science writer, with hundreds of magazine articles and two books to his credit.

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PETER C. GOLDMARK

WITH *Lee Edson*

*Saturday Review Press / E. P. Dutton & Co., Inc.*

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This book could not have happened without the many stimulating and searching sessions with Lee Edson. Lee managed to bring life to many of the critical turns in my career that otherwise would have remained buried in my subconscious. I am also grateful to Lee for helping me extract the important moments of the past as a guide to the future and thus enabling me to chart my new and exciting career after my retirement from CBS.

Many other people helped make this book. My special thanks to Leo Murray for advice and counsel during the lengthy sessions involved in putting all this together. And to his wife, Helen, who hardly saw her husband during the travail.

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# Maverick Inventor

# Prologue

ONE day in January, 1972, Max Buck, president of the International Radio and Television Society, was introducing me as the keynote speaker to an audience of broadcasters and their friends at the society's annual Newsmakers Luncheon at the Waldorf-Astoria. Among other things he said, much to my embarrassment, that the press had taken to describing me as a "Hungarian genius," a combination that is made to strike awe in the hearts of readers as they conjure up such names as John von Neumann, Edward Teller, and perhaps even Zsa Zsa Gabor. Then Mr. Buck went on to say that he'd also recently read in *The New York Times* that I had turned down almost a million dollars from my longtime employer, the Columbia Broadcasting System.

He paused, peered at his audience over his glasses, and guffawed, "Some genius!"

I don't suppose that in this materialistic world anyone can be considered bright, much less a genius, to turn down a near million dollars when he is not wealthy, when he's bumping into retirement, and when he's been offered the financial key to the effortless life after sixty-five. So why did I do it? And why do I think it is important enough to bring up at this time?

The answer to the first question is simple. At sixty-five, the mandatory retirement age at CBS (for everyone except the founder, Chairman William Paley), I felt healthier and more able than ever. My mind was literally bubbling with new ideas, both technological and social, and I had come to feel that the era of the seventies would offer a chance to apply them to the solutions of some of the major problems of society. To me, the answer to such problems always had boiled down to the common denominator of communications—not just radio, or television, or show business, but the deeper, richer, broader communications among people that lead to peace, harmony of races, and inspiration for progress. I felt I could help this process along through the proper and creative use of technology, some of which I myself had helped put together over the years.

On the other hand, CBS—one of the world's largest communications conglomerates, with a strong hand in everything from broadcasting to records to medical texts to toys—was not interested in communications as a tool of social engineering or of building a new society. Wrapped up as it was in show business, the company's primary attention was as always tuned to prime time, rate cards, audience reaction, minute breaks for commercials, and the other paraphernalia of the crazy-quilt world of television broadcasting. For the company the future was apparently limited to no more than thirteen weeks (the usual cycle of shows). A man who is voted from time to time the richest man in show business, Bill Paley has never publicly seen himself as a communications executive; he has seldom given a talk on communications or seemed fully to understand how communications technology was changing the modern world and what to do about it. A brilliant and creative marketing strategist in the early radio

days, his chief aim, as time wore on, was apparently not to rock the giant, aging boat of CBS, but to carry on the old Broadway success formula. His business life boiled down to three maxims: be quiet on how rich you are; find out what the public wants; and as an extra ingredient, battle the government when necessary either by lobby or by calling upon the First Amendment, or both.

In 1971 it seemed to me that the battle between CBS and myself—which had gone on for the major portion of three and a half turbulent decades—had reached a climactic moment. It was, I felt, my last hurrah. I had asked CBS for a chance to share in the future of communications as an active laboratory leader working with people who were devoted to innovation. The company had responded in the gracious way of corporation protocol—by offering me an inactive and powerless job with a lot of money. So I could do nothing but turn down the money and seek new support.

I am telling all this now because I think it is important for us to understand the nature of the communications world. We stand at a critical juncture in world affairs in which we are being inundated by the extraordinary outpourings of electronic communications devices and systems: cable TV, satellites, video cassettes, laser TV projectors, to name a few. At no time has communications technology been so fertile, so pervasive; the effect on us and on generations to come may be more profound than that of the printing press five hundred years ago. In my view we should not commit the errors of the past in the misuse of this technology, indeed of all technology, and suffer too much the slings of a Mumford or a McLuhan, but we should start using communications as the cutting edge for building a better society. That is why in the last year, among other professional interests, I've committed

myself to advancing the cause of a new balance of rural and urban population in America—which I call the New Rural Society—whose springboard lies in the innovative use of telecommunications in the life of the rural community.

There is another compelling reason for telling my story in the form of a book at this time. I have been often asked how an inventor invents, how I got to be an inventor, and whether it is worthwhile.

As I look back, I think my contributions were, somewhat ironically, not so much in the invention itself or in innovation (a word I prefer because it means putting an invention to work), but in its gadfly impact on industry. The development of the long-playing record impelled the recording industry including RCA, the giant of the communications business, to change for the better its historic pattern of record production. My work in color television resulted, I think, in bringing color to the public a decade faster than it might otherwise have come, though not exactly in the form I intended. Finally, electronic-video recording, though it ended up without the auspices of CBS, fired up the video-cassette business into the potential multimillion-dollar industry whose fruits we are beginning to enjoy today.

Despite my own experiences—which may seem to some like tours de force—I hope that readers may derive from this book some feeling for the life of the inventor, at least for his joys and sorrows, his frustrations and excitements from the moment of conception to the more difficult and often back-breaking team effort in carrying the concept to fruition.

Throughout the book I've tried to keep a light tone (Plato, I recall, once said unmitigated seriousness is out of place in human affairs), and to limit the technical information to the barest minimum, explaining the operation of only those

things everyone would be curious about. The book is autobiographical in form because I am convinced that this is a comfortable literary form in which I can readily share my ideas—and, for what it's worth, I can provide my own view of how things actually developed. I must emphasize they are my own views and bound therefore to suffer from all the defects of any personalized approach.

As an actor-writer once said, I believe that good stories should have a beginning, middle, and end—preferably in that order. So my story properly begins in Hungary.

# 1

# Bach, Bolshevism, Budapest

THE distance between No. 60 Aradi Street in Budapest, where I was born in 1906, and 485 Madison Avenue in New York, where I first embarked on my career with CBS, is exactly 4,373 miles as the satellite flies. It took me exactly thirty years to make the journey, and like others I often wondered if the odyssey was predestined.

The evidence, of course, is unclear. The highlights of one's early life as seen from the perspective and emotional overlay of half a century later are hardly reliable guides to the true forces that mold one's life. Psychologists in fact tell us bluntly that the most unreliable source of the history of behavior is the person's own memory. Nonetheless, certain things do stand out as important events in my life; they make up a kind of pattern, and for what that is worth, they do describe the genesis of the only inventor I've known intimately.

Among my memories are the several choices of career that seemed to arise when I was coming of age. My father, Alex-

ander, was a highly successful hatmaker in Budapest, and I am sure he would have thrown one of his hats into the air if I had announced that I would join him in the business. But he and my mother were divorced when I was eight, and his influence on me disappeared rather early.

My stepfather, who arrived on the scene a year or so later, was a banker, and I quickly decided that his career was not for me. Among other things I found little comfort in the thought of spending my life behind a wall of huge accounting books, even if some of the figures in them represented something that might accrue to me.

My mother was (and at ninety still is) a dedicated musician, and I grew up with the sound of music in my ears and in my blood. My Great-Uncle Karl, the son of a poor cantor, composed delightful melodies at an early age on a homemade flute and a cheap violin and then went on to become the greatest Hungarian composer after Lizst. He contributed to the burst of music that pervaded the gay Vienna of the nineteenth century, which was written by such luminaries as Strauss, Mahler, and Brahms, the last of whom, incidentally, was Uncle Karl's hiking friend.

Music in Austria-Hungary was not merely a charming atmospheric sidelight to living. It was like learning Latin, an exercise of intellectual development, and no cultured person could grow up without it. It is interesting to speculate that Austria-Hungary's distinction in, and love of, music might have provided the ordered, precise way of thinking that leads to technology. At any rate it is certainly a phenomenon that an agricultural, almost feudal, and very richly musical land could have fathered and nurtured some of the leading figures of twentieth-century technology, from Theodore von Kár-

mán, the inventor of supersonic aerodynamics, to John von Neumann, the inventor of the digital computer.

Under the circumstances it was no surprise that at an early age in my life—in fact I was six—my mother took me to a piano teacher, a gaunt, sharp-faced woman who loomed about eight feet tall in my youthful telescopic vision. Mrs. Halasz was an excellent pianist, as it turned out, but very rigorous and demanding, and somehow we never hit it off. My brother, John, on the other hand, got along well with Mrs. Halasz, and today he is an accomplished musician who heads the prestigious Mannes College of Music in New York. My antipathy for Mrs. Halasz may have accounted for my mother's turning me to the cello, which at that time was taught by an elderly, mild-mannered man. My relationship with the cello teacher must have been more successful because I play this instrument reasonably well today.

Great-Uncle Karl died in 1915. I was nine years old at the time, so I hardly remember him. But I do remember the passion with which my family and my family's friends carried on the tradition of music, mainly in weekly string quartets. A typical scene in the living room of our fourth-floor apartment consisted of my grandmother in bustles at the old upright piano, Mama in a stiff-backed chair playing the violin, and Father stooped over the viola, with me off to the side—a thin, quiet, nearsighted boy of nine—occasionally plucking the strings of the cello. Nothing was allowed to interrupt these happy musical labors.

We were then living through an angry, violent period, marked by revolution throughout Europe, arising out of the ashes of World War I. In Hungary in 1919 the Communists, or Reds, led by Bela Kun, and the anti-Communists, or Whites, led by Admiral Horthy, were locked in battle for

control of the government. Occasionally Admiral Horthy's White airplane buzzed the houses in our neighborhood, and this became known to us as the Air Raid of Budapest. On the Danube a lone White Army gunboat, actually a converted excursion vessel with three sailors and a machine gun on deck, prowled the river nightly and occasionally fired a salvo over the heads of suspicious stragglers on the streets. This was the Hungarian Navy. Since our flat opened to the Danube, we had to keep the windows closed and the shades drawn so as not to attract attention; otherwise, a bullet might whiz inside and find its mark.

Although my parents must have felt the atmosphere of danger, it didn't affect the family's weekly musical soirees. In fact, the strongest evidence of how much music really meant to the family occurred one warm Sunday evening when we were gathered to play a Mozart quartet. About halfway through the performance we heard a great deal of noise and shouting in the street. Mother had left a window open to let in the cool air. Suddenly a clear voice rang out, "Turn out that light." Nobody made a move. The music absorbed us all. A few minutes later a warning bullet hurtled into the apartment and buried itself in the ceiling. Plaster fell on the floor, and a touch of dust flew up. Several of us quickly threw a panicky glance at Mother, but she refused to take her eyes from the score, and none of us dared move. Finally, when the last note vanished on the air, Mother calmly put down the violin, rose, closed the window, and pulled down the blinds.

In my school days I displayed a certain innovative spirit, which I may have inherited from Great-Uncle Josef, composer Karl's brother, who was a doctor and a revolutionist. After the Revolution of 1848, when Hungary gained her brief independence from Austria, Josef was accused of high trea-

son and sentenced to death. At the last moment he was saved by a colleague who helped him flee to America, where in keeping with the spirit of the time he joined the American Civil War and went on to discover red phosphorus, a substance now found in every match head.

My own youthful shows of derring-do were nothing so momentous, but they had a powerful impact; they usually resulted in my being kept after school for misbehavior. I remember once being involved with a bigger fellow in my class who, depending on the circumstance, was either my mortal enemy or a friendly conspirator. Somehow we managed to concoct a plot to get back at a geography teacher whom both of us disliked. The level of our hostility can be gauged from the fact that we thought of such dire things as stealing his briefcase and hiding it, or painting the chair before he sat in it. We had not learned the violent techniques of the English public schools.

"I know what," I said finally, after pondering several diabolic approaches. "Why not send the class home before the teacher comes? That'll upset him."

"How are you going to do it?"

"Never mind," I said, not knowing the answer.

He looked at me warily. "I'll bet you ten forints you can't get rid of the class before the bell."

"You're on," I said.

Now, of course, I had to do something. I have found myself best able to meet a challenge after it is offered. Then an idea struck me. I wrote a note, and while a friend of mine delayed the teacher on some pretext or other, I read the note to the class. It said that the teacher had come down with a terrible illness, and since he had no substitute, everyone was to go home immediately. There was a wild, noisy scramble, and in

a matter of seconds the classroom was empty. I looked at the product of my chicanery and realized with fright for the first time that one can be enormously effective by delivering with great enthusiasm a little lie that everyone wants to believe.

The next day, when the deception was exposed, I was propelled to the principal's office. I explained rather sheepishly that it was just a bet, but the principal took it very seriously. He called my father into his office and in his presence threatened me with expulsion unless I obeyed the rules. My father looked at me darkly and guaranteed my good behavior henceforth. He also contributed a bit of money to a new scholarship fund.

After a while word of my escapades got around, and it became common to blame Peter Goldmark for everything that went wrong in the class. Once a number of students held a tug of war with the classroom door: one group pushed in, the second group pushed out. Finally the door lost the battle and was unhinged. Everybody dashed off, but they were soon rounded up and made to face the defeated door. When a stern voice asked who was responsible, my good friends pointed to me. This led to another visit to the principal and another consoling contribution on the part of my father to the growing scholarship fund.

"I don't think he'll amount to anything," my father was led to say to someone. "He's not serious enough."

At the age of ten I found myself attached to an "international crime syndicate" that had been operating clandestinely out of my home. My initiation happened quite innocently when my half brother Tommy's governess, a pretty brunette, invited me to join her whenever she took Tommy out in his baby carriage. She had a nice, disarming smile, and I felt warm in her presence, so I liked to go along. On these

trips I discovered that she was a lover of photography, a hobby she pursued diligently by stopping in camera stores along the walk and picking up various photographic materials, which she quickly slipped under the blanket in Tommy's carriage.

I once asked her outside of one of the shops whether she had paid for the merchandise. "I will pay later," she told me with a tinkling laugh and a squeeze of the hand.

After several weeks her hobby began to consume her. The supplies she picked up grew larger and larger until the baby almost suffocated under the heavy load in the carriage. I was still puzzled about the financial proceedings and asked her again whether she'd paid, as I knew my mother did on similar junkets to the stores. "Don't worry," she laughed. "It's all down in my notebook." She patted her pocketbook.

"I trust you," she added. "So don't tell your parents about this. Photography is very expensive. I don't want them to know how much money I owe."

"Oh, no, I won't tell," I said, glowing inwardly. It made me feel good to be her confidant. Besides, it all seemed reasonable—a slow-payment plan.

So it went for quite a while during the year. I began to enjoy sharing her secret, even to keeping an eye on the clerk and reporting his movements to the governess. But one day she didn't show up for our daily walk. I learned from my parents that she wasn't going to show up for a long time, if ever. She was in jail, my mother said in a hushed voice. It turned out she was a member of an international gang that stole and resold photographic materials. "It's strange you didn't notice what she was doing," my mother said to me later.

Looking back, I always have a clutch of fear in my heart over this incident. I really thought the governess would pay

for the materials because it seemed I wanted to think so. She was attractive. She said she'd pay, and that was enough for me. It never occurred to my ten-year-old mind that there was any permanence to her activity. It's frightening to think how easy it is to believe in something when you want to, even if you sense it's wrong, and to go off in the wrong direction in life through subsequent stubborn rationalization.

I've always wondered why I got interested around this time in making what proved to be my first technological contrivance, an event that foreshadowed my eventual choice of career. All I can remember is that my brother and I had become interested in motion pictures and slide projectors, because American movies and slides were very popular in Hungary. Every Saturday we went to the movies. Later we talked about what we had seen. We decided one day it might be fun to see whether we could duplicate movies and perhaps make money on them. But we didn't know how to start until one day we discovered Rauscher's shop.

Every boy should have a Rauscher's shop in his background. The store was no bigger than the inside of a Volkswagen bus, but it was packed from floor to ceiling with all the glories and wonders of a place like the Smithsonian Institution's attic. Rauscher, a small squirrel of a man (he had to be small to maneuver among the mounds of paraphernalia), had accumulated almost everything portable in his lifetime—pieces of American film, old storage batteries, wheels, drums, colored glass, halves of motors with wires sticking out, lenses, and contraptions of all sorts. It seemed to us that this gnome of a man was put on earth to satisfy the needs of imaginative youngsters because almost anything we asked for caused him to disappear and in a few moments pop up with the object triumphantly held in his hand.

From Rauscher's cornucopia I remember buying a flashlight that fascinated me, as did everything electrical. We discovered how a switch worked, using a flashlight and wires. We turned the light on and off by disconnecting and reconnecting both wires (it took us some time to learn that we could operate the switch with just one wire).

For our projector we bought a kerosene lamp, wire, bulbs, a piece of board, and other odds and ends. In those days movies used (and for that matter still use) carbon arc light to achieve the intensity needed to project the images. This was dangerous because the film was made of nitrate, which was highly flammable. If the film caught fire, the whole reel would go up in flame, possibly taking some furniture and our apartment with it.

Despite such risks we confidently assembled our materials on a board. We built a housing out of wood and then lined it with felt for beauty's sake. All the wiring, I remember, was on the outside; codes were not yet discovered. Our biggest problem was to tie our makeshift line into the apartment-house power. We had to enlist the help of the superintendent to cut down on the house power while we made the attachment. Being an incurable romantic and a movie lover, he agreed to help us even though the other tenants complained of loss of power. We had to cut one wire at a time, splice and insulate it, and then attach it to an old-fashioned porcelain outlet. Once our apparatus was wired up, we filched a sheet from my mother's bedroom for the screen.

At first for subjects we drew pictures on glass in ink and paint, since we couldn't afford to buy new film. (Later Rauscher did scrounge up some old film for which we built a wooden reel.) At last we were ready for our premiere. We strung the film through the gate, switched off the lights, and

turned on the kerosene lamp. The exciting smell of nitrate filled the room. We sat in the darkened room adjusting our vision and waiting for the image to appear, like radiologists, and finally in a matter of minutes it did. We watched it, entranced, and then the inevitable happened, as I am sure it must to all amateurs. The lamp overheated. The film caught on fire, and we dashed about getting buckets of water, pillows, and clothing to snuff it out before it could spread. Eventually we managed to put out the blaze. Exhausted and shaky, we dismantled our first brilliant invention and discontinued the attempt to become the Thomas Edisons of Hungary. (Years later, during the development of our first TV films at CBS, I had a similar experience with fire for exactly the same reason, the use of nitrate films. This time I could do something about it. I quickly put in a rule that we were to use only acetate film.)

My parents were understandably upset over our misadventure. However, my father was not technical-minded and showed little interest in the cause of our disaster. Mother had mixed feelings. On the one hand, she complained that it was a waste of good linen. But looking on the brighter side, she pointed out that, after all, our operation was in the Goldmarkian tradition since Great-Uncle Josef, who discovered red phosphorus, a highly flammable form of the element, hadn't accomplished this feat without setting off a number of unexpected explosions.

The radio period of my life came in my early teens in Vienna, where we had moved to escape the bad conditions in Hungary after the Revolution. The Treaty of Versailles had chopped up the Austro-Hungarian Empire and scattered people across the face of Middle Europe. This brought long lines of refugees to Vienna. The schools were filled, and I

couldn't get in immediately. When I was able to enroll in a school on the outskirts of the city, it turned out to be a hotbed of prejudice against Hungarians. Being undersized and somewhat shy in the new surroundings, I found myself the butt of jokes and tittering, and was left out of many school functions.

I couldn't do anything about Hungary's poor image in the eyes of many Austrians, but I decided I could do something about my own intellectual development. So I bought radio materials and set about making a simple receiving set, following the directions in a do-it-yourself book. My brother didn't join me in this endeavor because his prime interest now lay in music. My goal was to tune in to the only German telegraph station operating at that time that could be heard in Austria. The name of the station was Koenigswusterhausen, a name that remained forever in my memory.

I carefully put the set together on battery and gingerly strung a wire out of the window of our apartment for an antenna. As I was manipulating it into position, a neighbor leaned out of her window and shouted it was against the law to hang laundry outside. I hastily told her that I was trying to communicate with Germany. She looked at me strangely, shook her head, and shut the window.

When I was ready, I invited my family to the debut—a magical Morse code broadcast from five hundred miles away, I told them. Even my banker father was intrigued enough to pause from his affairs and appear for the first solo demonstration of my mechanical and electrical prowess. I turned the homemade knob, and the loudspeaker emitted a loud, forceful, guttural crackle. Obvious static. My mother was delighted. "It sounds like Germany," she beamed, looking at me fondly.

I was disappointed, of course. Where was Koenigswusterhausen? I stayed up all night with the sick set. At one point I thought the culprit might be the antenna. So I decided to replace it. But the net result of my effort was only to tell me that the antenna was not at fault.

I thought for one despairing moment that I just didn't have the skill to understand technical things and there was no point continuing. But luckily I was able to consult an older technical friend of the family, and he found the cause of the trouble. The instruction book had omitted a vital condenser in the circuit diagram. When I added the part, the set worked. The German broadcast came in loud and clear.

This was a turning point in my education. For one thing it made me thorough. Since then I have always checked out anything from a book or paper. More importantly, I discovered that it isn't always necessary to understand fully the theory behind what you are doing. It is often important just to move ahead by trial and error. It was not until I entered college that I figured out how a radio really worked, though by then I had put several sets together. Today when I make a shortcut in engineering, I always hear in my head the message of Koenigswusterhausen: be as thorough as possible, and always move ahead.

My initial feeling about college was one of intense disappointment. I had determined to enroll in a science or engineering course by the time I was sixteen. I wanted to attend Vienna Technical College, which had a good reputation, but the college's Hungarian quota was filled, and I was not admitted. I felt morose and desperate. Fortunately my cousin, an ex-army officer, arranged to get me into Berlin Technische Hochschule, at Charlottenburg, which was a reasonable substitute for my first choice, even though it was about 350 miles

from home. However, the first year was not devoted to electrical engineering as I had hoped, but to drawing and design. I am the worst draftsman in the world and got through the exams with great labor. The teachers, in typical Germanic fashion, were forbidding and unapproachable. Each day I prayed for someone stimulating to come into my life.

My prayer was answered one day when I became the assistant of Dennis Gabor, a man who won the Nobel Prize in Physics in 1971 for his discovery of holography, a form of lensless photography so mysterious to laymen that a member of my staff was inspired to write, "What's it for, Dr. Gabor?"

Even as a young man Dennis was a man of wit and old-world charm who kept me entertained with his aphorisms and anecdotes. He was also an athlete, who owned a racing scull in which he practiced rowing each weekend on the Weser outside Berlin. During the week he would repair to his room at lunchtime and exercise with dumbbells, quoting from the Greek poets while munching a salami sandwich. On these occasions I often sat in a corner watching him in awe.

In the evening I served as Dennis's part-time laboratory assistant and had a chance to observe him in the throes of earning his Ph.D. Dennis had a knack for picking a tough, complex problem involving complex solutions worked in complex ways. His thesis was to study certain electrical phenomena on high-voltage transmission lines. He had to build all his own instruments, including an oscillograph, which was then commercially unavailable. Some of his equipment stretched from floor to ceiling and took weeks to build. To record one wave shape he had to build an enormous power plant. Today an instrument that performs the same function can be put in a briefcase.

Dennis helped make my first year tolerable. The next term

I was accepted by the Physical Institute at Vienna and started on my own project for a degree. I worked with a Professor Heinrich Mache, an important nuclear physicist of his day, on a technical phenomenon called "ion mobility." The problem was not only important in nuclear physics but had the major distinction of having puzzled some leading physicists, including Lord Rutherford of Cambridge. That was enough for me. I had to solve it. When I presented my paper to Professor Mache, he was so impressed that he read it to the Academy of Sciences, since I as an undergraduate was not permitted to address this august body. I think it may have been the only undergraduate paper so honored. When I hit on a good thing, I stay with it, and subsequently I found enough depth in the problem of ion mobility to pursue it for my Ph.D. Professor Mache again happily read my paper to the academy.

But physics was not the whole of my existence. After the austerity of Germany life in Vienna was free and ebullient, full of music, spirits, and girls. I worked in a tiny basement room with a high barred window, which became irresistible when I learned that the great German pianist-composer Johannes Brahms had lived there. Here was the very room that must have echoed with the sound of his intermezzi and waltzes. How many of his vibrant ballades or moving concerti had the papered walls absorbed? On what fine golden morning did Brahms—his head filled with the splendor of unwritten music—meet with my great-uncle for those hauntingly lovely walks in the Austrian Alps?

It was strange that during this period of the twenties, while Vienna was vibrant with Brahms's music, the social critics of the day were predicting the death of the piano, the symbol of bourgeois culture for over 150 years. They declared that in

another twenty years the radio and gramophone would send the piano into that cultural graveyard that houses antimacassars, broughams, wax flowers, and other elegances of a past era. I hardly realized then that soon afterward I would be involved in the electronic media that supposedly were killing off the piano. Half a century later, of course, the piano survives, not just in my living room, where my brother comes to play his favorite fugues, but even on television and in concert halls. Though the piano is no longer an ideological symbol of a class given to the free play of the individual, and though the concert pianist is no longer greeted at the door by coaches with six white horses and runaway wives, and though the inexpensive portability of the rock-making machinery used in today's musical groups has lifted the stringed instrument to a higher degree of importance than the piano, this extraordinarily durable instrument remains with us. I believe it will continue to survive all that our electronic age can do to it.

On another scale unrelated to music my first patented invention was developed while I was at the institute. Every time I think of it I wince. It came about because I had noticed that the chauffeur who drove my mother and stepfather around town used to take his hand off the wheel every time he had to sound the horn. This was natural because Austrian engineering required that the horn be on the dash—elegance was more important than safety. If the driver changed direction, he had to extend his arm out of the window. He couldn't change direction, blow the horn, and drive the car at the same time.

I thought that was an inefficient misuse of motion and devised a simple switch that would enable the driver to honk the horn with his knee instead of with his hand. The switch

was located underneath the dash, and all he had to do was raise his knee. I called the gadget a *Knietaster*, or knee-pusher, and actually got an Austrian patent on it in 1931. Although I was quite thrilled with the idea, I must confess that I couldn't interest Viennese manufacturers in producing it. In retrospect, it seemed like a small contribution to the automobile, and I am embarrassed to mention it. My wife says that I just had to start somewhere.

# 2

# Postage-Stamp Television

MY first contact with the box, or tube, that was to dominate most of my life occurred while I was still in Vienna studying for my doctorate in physics. A medical student friend, Gerhart Schwarz, the son of a prominent radiologist, told me about a do-it-yourself television kit that was manufactured in England by a Scottish gentleman named John Logie Baird, a former underwear salesman turned inventor. Both of us sent away for the kit, which cost the equivalent of $22 apiece, and assembled it.

Our first experience with TV was unforgettable. The Baird kit was about the size of an ordinary suitcase with a fantastically tiny screen one inch high and one-half inch wide on the rim of a whirling disc. To see it work we had to stay up until midnight, when the London radio stations went off the air and the BBC broadcast the video signal on the audio band.

It was in the winter of 1926 when I saw my first televised image, a dancer. She was colored orange, and she flickered

nervously because the pictures were transmitted at too slow a rate for proper reception. Sometimes she disappeared in a vaporous haze, but when she was there before us and reasonably clear, what a sight! Here was a moving picture transported by electric energy through space from London to Vienna.

Perhaps some readers are too ho-humish to appreciate the phenomenon. I've often dreamed that if I were suddenly wafted into King Arthur's court, I could hold the populace spellbound with this feat. Even the brightest man or woman of the day would regard it as Merlin magic. He or she would have no way of understanding the scientific steps that led to the seeming miracle of transporting a human being from miles away into an image in a tiny box.

Even in the 1920s television had the quality of wonder to it, at least to me. Yet the story goes back to an earlier century. The principle of television was discovered in 1884 by a German, Paul Gottlieb Nipkow. He showed in principle for the first time how a picture could be transmitted electrically and indicated the instruments needed. Out of his vision emerged a device—ever since called the Nipkow disc—consisting of a thin record with a spiral array of tiny holes along the edge. As the disc rotates on a shaft, light passes through each hole and scans the entire picture line by line.

The job of the disc is to let the tiny fragments of light that make up the picture strike a sensitive photoelectric cell that turns the light into electric current. How this operates is the result of the marvelous properties of certain materials in the cell and is too complex to explain here, but it is enough to know that the amount of light that goes through determines the amount of current that is generated in the television circuit. In the dark places of the picture less light slips through

and hence less current develops; in the clearer places you get more current. Once the variations in electric current are transmitted, the large and small amounts are reconstructed at the receiving end into the original picture. Actually wirephotos—the forerunner of television—had been transmitted in Europe since 1907.

In order to transmit moving pictures, the film must be scanned very rapidly. Baird accomplished this feat in 1926, using the Nipkow disc. Twelve years would have to elapse before Vladimir Zworykin, a Russian scientist David Sarnoff implanted at RCA, devised the iconoscope, an electronic version of the Nipkow disc and the first practical television camera.

At the time I was observing the Baird televisor, as he called it, I discovered an intense curiosity in myself—stronger than anything else I had felt before—about the device. Not so much in what it was broadcasting, but in why the picture couldn't be larger than its postage-stamp size, and the dancer thus more enjoyable. At the time other scientists and inventors were also curious about visual broadcasting possibilities, and I think they were building sets in a number of basements in Europe. The methods of enlarging the picture from the equipment then in use were limited, but I did come up with the idea of using rotating spherical mirrors arranged on the periphery of the small rotating disc, each mirror being adjustable by a screw. The wheel would spin in front of a standup screen at a rate sufficient to project an enlarged moving image.

I did the work in a lab and machine shop that I had built in the bathroom of the family home. Despite the usual interruptions that occur in such places, I managed to put the whole thing together and proudly showed it to my parents,

who evidently hadn't learned to have faith in my machinery since I had burned up my mother's sheet years before in that ill-fated movie venture. They simply shrugged and then invited me to join their new string quartet. This was the sort of indifference I needed to move ahead. What's the point of working on something if you can't prove the other person wrong? I carefully evaluated my own device and filed for a patent with the Austrian patent office. The patent examiner, it turned out, had never heard of television, and I had to demonstrate it to him so there would be no doubt that my invention was workable. I guess the examiner was sufficiently convinced (or confused) because he gave me a patent without objection.

When the patent arrived—I think it may have the dubious honor of being the first television patent in Austria—my parents were amazed. My mother began to think that even though I wasn't as good a musician as brother John, I might have some talent nonetheless. My banker father also suddenly came to look at me in a new light. He called me aside: "You must talk to my friend, Boncompano Boncompagni," he said. "Bonny is an Italian prince and industrialist, and he'll tell you what to do next. If it's good enough for the Austrian government, maybe you can make money on it."

When I met the prince, he asked me pointedly, "What is television?" I explained in German that it was something that allowed you to see someone at a distance, *Fernsehen*, which means literally to "see afar." The prince's eyes gleamed. He told me he knew of a man who owned a clock-manufacturing company in Venice and wanted to diversify. He felt so sure his friend would like my device that he offered to see to it that my expenses to Venice would be paid.

In accordance with the speed with which business may op-

erate in the wrong direction the prince brought me to a pilot friend who agreed to fly me across the Alps in his two-seat, open-cockpit canvas plane. It turned out to be a hair-raising experience. We just barely missed a peak, and as I grew steadily sicker, every cloud became an enemy. When we finally landed in a pasture, there being no airports, I staggered to the railroad station, where I took a good, solid, close-to-the-earth train the rest of the way to Venice. The company was housed in an old pink Renaissance building on a canal. As I went through shop after shop and room after room where employes were working on bells, hands, faces, and other parts of alarm clocks, I wondered why the factory owner was interested in something so way-out as television.

When I showed him my device, his hand went to his head. "My god, I thought you had developed a new type of binoculars, or at least a telescope," he said. Evidently the prince, through a language misunderstanding, had translated *Fernsehen* into something more familiar than television. The factory owner, I admit, was gracious enough to ask questions and inquired into the cost of building a transmitter. I took a guess at a figure. He turned a bit pale, whistled through his teeth, and changed the subject.

Everyone involved—including the prince, who arrived later—seemed to be amused at the entire comedy of errors, except me. I was worried about getting paid for the trip, but the merchant of Venice finally felt into his pocket and pulled out a thick sheaf of lira, which he pressed into my hand. I went back home fourth class, somewhat deflated by the sortie, but happily with some money left over for future inventions. I had begun to understand the mercurial nature of communication and the virtues of an expense account.

Undaunted by this Venetian affair, I continued to read

technical magazines and found that the biggest activity in television was occurring in only one country, England. So in a moment of inspiration I composed a letter to the British Admiralty, offering my system as a secret coding device for the British Navy. The Admiralty responded with a salutation that began: "My Dear Mr. Goldmark." My parents, ever optimistic, thought that by starting a letter to me in this fashion, the British government was embracing me for my cleverness in suggesting a way to save the Empire from its enemies. But the content of the formal reply was a cold British turndown.

Well, that was only two strikes against me, and there was nothing else to do but continue. My father wisely said that persistence was the most important element of success. So I wrote a letter to the Baird Company, which had made the television kit, and enclosed a copy of my patent. Baird replied by inviting me to England, and I accepted with alacrity.

My first view of London still remains strong in my memory—the squat, black-box taxis (which I couldn't afford) turning spryly on their wheelbases, rounding corners looking like oversized bugs and mingling with the huge red buses in the steady stream of traffic; the handsome government buildings along the banks of the Thames all seemed whitewashed, not like Vienna, which was gray and seedy in comparison. London was truly the royal city of Europe.

I was not quite so impressed with John Logie Baird, whom I met for lunch at a London restaurant. I had expected to see a prepossessing figure of a man, some kind of hero out of the Norwegian sagas, as befitting the first man to demonstrate a working television system with real moving images, not just shadows and halftones, and to build a company on it. But the man who greeted me at the restaurant was a middle-sized fellow with bushy red hair, who spoke rapidly with a strong

Scotch burr. I just barely managed to understand him by paying very close attention. He was friendly enough, and over Dover sole he said that he first became interested in television by reading about Nipkow, the inventor of the scanning disc. He was so intrigued with Nipkow's work that he decided to build a system on it. He managed to attract considerable attention at the start, which in turn brought him financial support. At one point he had approached the Marconi Company—incidentally a company that itself grew out of an invention—with his idea, but they turned it down, possibly because the basic patent lay with Nipkow. Only the BBC's interest in television later saved Baird from oblivion.

After Baird ended the story of the historical development of his own TV, he pulled my patent out of a briefcase. Writing and drawing sketches on the white tablecloth, he criticized my system through the remainder of lunch, down to the tarts. I don't know what disturbed me most, the disfiguring of somebody else's white tablecloth (which was severely frowned upon at home) or the criticism of my invention. But I nodded to all of Baird's ideas and then, figuring there was nothing to lose, hopefully asked him for a job. He turned me down flat.

I returned to my hotel with my Hungarian temper aroused. Why had I come to England? Finally I said to myself to hell with Baird, he's not the only one in television. I borrowed a typewriter and quickly composed eight letters to eight radio companies, whose names and addresses I found in the telephone book. I suspect I wrote in broken English, but I didn't care. Somewhere there must be someone who liked my idea as much as I did. In a week there were eight responses—all refusals, except one. Mr. Ellis of Pye Radio Ltd. in Cambridge wrote that he found my idea interesting; in fact, I was

delighted to learn later that he liked it better than Baird's, which he thought was more cumbersome. Pye Radio offered me a job at sixty pounds a month and a year's contract to set up a television department. At last a start; I was delirious with joy. I wired my parents that I was staying on in this blessed land of roast beef and Yorkshire pudding, merrie old England.

In Cambridge, a charming university town with narrow, curving, cobbled streets dripping with history, only an hour's train ride from London, I rented digs in a neat Victorian home and proceeded somewhat gingerly to feel my way through the social life of the city. One day I met Mrs. Murray, a clergyman's wife who was a piano player of some talent and who liked to organize concerts and tea party recitals. When she discovered that I had some musical interest, she insisted that I join one of her trios and make the rounds of concerts at the university and private homes.

Mrs. Murray made a profound impression on me because she was eighty-five and endowed with a wiry strength. She used to crank her own touring car by hand and do it with an extraordinary, unladylike gusto. Moreover, she dared any young man to do the same. I once accepted the challenge and failed miserably, while she chortled over my unsuccessful attempts. In her nimble fingers the engine purred competently.

At Pye Radio I tried to put my invention to work but soon found that my rotating-disc approach was not likely to get anywhere. The cathode-ray tube was coming into use at this time and offered the possibility of performing electronically what I had been trying to do optically. The cathode-ray tube was simply an evacuated vessel connected electrically so that the gas would glow when electrons left the negative side, or

cathode, to reach the positive side, or anode. By focusing and directing the fluorescent light, one could obviously draw figures with the light and thus create images. It seemed to me that this was the way to go in television because it was simpler and provided clearer images.

To show that a great inventor can be myopic at times, Baird expressed no faith in the cathode-ray tube. But the large British companies like Electrical and Musical Industries were moving in that direction, and the BBC decided to forget low-resolution transmission such as Baird was obtaining with the Nipkow type of disc and to await progress in electronics. In the United States RCA and the now defunct Farnsworth Company, which was founded by Philo Farnsworth, a self-taught inventor who died in 1971, were also working on high-resolution electronic television. Pye allowed me to move in the new direction, and ultimately I developed the beginnings of a new system, which at one point I demonstrated to the Duke of Kent, who was visiting in Cambridge. The duke's only comment was it would never replace cricket.

After a year and a half Pye came to the gloomy conclusion that, as a practical matter, television was a long-range project and probably would never be useful for the home. On top of that the world in the summer of 1933 was mired in economic depression. Pye decided to close down television research. My contract was not renewed, and I returned to Vienna.

One day I came to the heady conclusion that if I wanted to continue my research in television, the only place to go was America, where the pioneer spirit and money were entwined in happy combination. Through a friend I was introduced to an American radio correspondent who was then in Vienna working for a New York company called the Columbia Broadcasting System. I had never heard the name before, but

it had a nice ring, as did the name of what I then thought must be America's greatest city, Atlantic City, because it carried the size and glory of the ocean in its name. I also liked the mellifluous name of the American radio correspondent, H. V. Kaltenborn. Years later, after the 1948 presidential election, he was to become Harry Truman's favorite commentator.

Kaltenborn listened patiently to my ideas about television and said he would give me a letter of introduction to someone in his company who might be interested. I gratefully took the letter, but as it turned out I never used it. I have always disliked letters of introduction. Either they are unnecessary—the ultimate example of absurdity is Lindbergh's modest carrying of letters of introduction on his famous flight to Paris—or they are a kind of invasion of privacy, hung over from a long-gone slow-communications century. You present a letter to somebody and say here I am. Both parties end up ill at ease. I don't like receiving letters of introduction, and I avoid giving them. If I want to do something for somebody, I use the phone.

I decided to make the trip to America with just the money I had saved up in England, about $150. My mother, an ardent reader of the news, urged me not to consort with gangsters in America. My stepfather, more practical, promised to send me an additional $25 a week if I decided to stay. Not enough to buy my way into luxury, but at least a defense against starvation.

Nonetheless, I was a bit uneasy when I boarded the ship in Le Havre for the trip to the U.S. When the coast of Europe disappeared in blue fog, I felt that the world I had known for twenty-seven years was at an end. It all seemed so final.

However, my sense of despondency didn't affect my sense

of survival. I had been accommodated in a small, hot inside cabin on a lower deck. Each day it grew more suffocating. Finally unable to endure it any longer, I sought out the purser, told him it was my first trip to America, and pleaded for a better cabin. I guess he took pity on the thin, slight youth, in crinkly trousers and with a hangdog expression, because he found me an unused first-class cabin, not only with a window but with a private bathroom. I learned from that moment on that traveling first class gives you a sense of self-importance that plays a significant role in your dealings with others. Since then I have always traveled first class whenever possible.

The moment the ship, the U.S.S. *Berengaria*, arrived in New York Harbor on the afternoon of September 8, 1933, I rushed out on deck to see the famous Manhattan skyscrapers, those eye-filling, stepped pyramids, windowed Cleopatra's Needles, and narrow, huddled, phallic towers I had read so much about in Europe. I saw nothing. The day was hot and humid, the sky was overcast. Only at the last moment did the buildings come into view, and I had a glimpse of these strange concrete trees, rooted in the valuable rock of Manhattan and groping through some hidden vertical drive, like a finger searching for the message of fate. The crowded power of the scene made me feel small and shrunken. Years later I would remember my sense of awe at the city when I began to strip it down in my mind into the layers of communication channels that bind together everyone in New York.

We crossed the wakes of tankers, ferryboats, and barges, moving slowly, sométimes grandly away from us. The harbor was so crowded, so busy, so full of sound and sight that it created a harmony of its own that I had never thought possible, a harmony made up of the screaming momentary

shadow of a seagull, the whistle of a tug, the smoke escaping from a scow, the ripple of waves lapping at the skeleton of a disused pier.

Finally I was on land and out of customs and immigration and ready to capture the city. Kaltenborn had suggested a place to stay, a small midtown hotel called the Algonquin, and had promised to cable the management of my coming. In my naïveté I expected a representative to be at the pier, but after waiting a reasonable period and watching my fellow passengers—Russians in blouses, Spanish women wearing dark shawls, and returning American tourists in sports clothes—all disembark and disappear, I realized that nobody was coming to meet me. So I hailed a taxi for the trip across town and obtained my first cab's-eye view of New York. After the splendor of London, New York looked incredibly seedy with its dark, unwashed tenements, garbage cans clinging like great gray plants to the brick walls, children playing in the streets with tin cans. Into this dark cavern the sun seemed to creep for only a moment before it was gone. On Broadway, which we soon crossed, I had a glimpse of the great density of people. I had not seen such crowds before. I was both horrified and excited.

At the Algonquin I was ushered into the smallest room I ever saw in my life, even smaller than my cabin aboard ship. The price for the room was outrageous. Today the rooms are still as small and the price is still as high. But, as I found out, some of the most illustrious names in show business and the arts frequented the hotel, and who was I, a poor immigrant, to object? I cursed Kaltenborn, the heat, and later that day the high-priced restaurant for eating mercilessly into my little sock of $150. The following day I looked around the city and happily found the glories of the Horn & Hardart Automat,

where, among other things, I could buy fresh orange juice for only five cents. This was a great delicacy. In Europe we used to pass the orange around, each of us getting one thin slice.

A few days later in search of a room I discovered the five-cent subway ride and made my way to Brooklyn Heights. The section had the elegant look of residential areas in Europe with which I was familiar—open, clean, and quiet, with streets lined with stately brownstones. I immediately located a room I liked at 99 Joralemon Street, put down an advance on rent, and turned my mind to the next important move, finding a job.

Since I could point to some measure of success in sending out letters in Europe, I mailed off a dozen inquiries to companies in New York. Within four days, a little faster than the British response, I had received a dozen turndowns, including one from RCA.

However, one letter produced a unique reaction. Two men showed up in my hotel room, the day before I was ready to move to Brooklyn. One was tall and very lean, the other very short and fat, like a Mutt and Jeff team. They told me that they had started a company on Long Island to develop television systems and were looking for a chief engineer. They asked me whether I had relatives in the States. I should have been suspicious at this question, especially as they looked relieved when I said no, but I was too impressed with the offer, $300 a month with a fantastic advance of $150, to think too much about it. They told me they had already recruited two other engineers who would work with me. I would have a chance to build a television department and hire my own staff.

This was indeed more than I had expected. I was overwhelmed. After moving to Brooklyn, I made my way to Long

Island to look over the plant, which by this time had grown enormously in my imagination. But when I got to the address, what a disappointment! All I could see was one small, nondescript building. Inside, a couple of gum-chewing secretaries surrounded by sparse furnishings contributed further to my discomfiture by hardly looking up. The owners greeted me with artificial heartiness. Seeing my unhappy look, Mutt and Jeff explained that they were in the process of organizing the company and they needed a man with my experience and background to include in their new prospectus. Once they collected enough assets, they assured me I would be able to go ahead. The whole setup seemed highly improper; as I learned later, from the perspective of the SEC it was also illegal. Nonetheless, it took me some time to break the contract with them. In retrospect, the best I could say for these men was that they were archetypal entrepreneurs capturing the enthusiasm for the future that resides in the American soul. The existence of speculation in television was a measure of its growing attraction, and the interest in a foreign engineer was, I suspect, the measure of American naïveté.

I finally secured a job as chief engineer and bottle-washer with a radio manufacturer who exported radios to tropical countries. At night in my small Brooklyn flat I continued to work on television systems and eventually saw one of my designs published in a prestigious British television magazine.

Months passed. One day I received a call from Paul Kesten, a vice-president of the Columbia Broadcasting System, the company that employed my well-meaning adviser in Vienna, H. V. Kaltenborn. Kesten invited me to see him at 485 Madison Avenue, headquarters of the company.

My first view of the CBS offices stood out in striking con-

trast to the shell I had seen on Long Island. Here, obviously, was not only a legitimate enterprise, but a prosperous one. The well-groomed secretaries busy at their desks, the paneled walls, and the thickly carpeted floors made me feel the future looked bright. I found out that my article had been brought to Kesten's attention by one of the CBS engineers, Ed Cohan, then chief of the radio department, and that the head of the company, William Paley, was interested in exploring the possibilities of television. Would I join the staff at $100 a week?

I had no hesitation in saying yes. The date was December 21, 1935, and the job started on January 1, 1936.

# 3

# CBS in the Thirties

PAUL KESTEN was a slight, intellectual man with arthritic hands who proved to be a brilliant and imaginative executive. His nimble mind absorbed knowledge like a sponge, and he possessed great promotional ability. Paul spoke and wrote exquisite English; an ordinary comment blossomed from his lips like the prose of Sir Walter Scott. He was also extraordinarily fastidious. Somebody once told me he was the only man who shined the bottoms of his shoes.

Kesten had an unerring sense of what was looming on the horizon that might affect the company, and he acted fast. A few months before my arrival, he had brought in Frank Stanton, a young Ph.D. son of a family of shipbuilders and seamen, who had done research at Ohio State University on audience reaction to radio. Kesten came across Stanton, as he had me, through reading a monograph in a scientific journal. The future of CBS, he felt, belonged to the scientific method. A serious student who was used to the careful methodology of academia, Stanton added a scholarly foundation to Kesten's lightning intuitions, and eventually brought respectabil-

ity to the flashy side of show business. In 1936 the spirit of research rode high at CBS.

My first task for Kesten was to explore the status of television abroad, so I returned to England and then traveled to Holland and Germany, where I knew work was also going on. There I poked into laboratories and talked to scientists and engineers about the new medium. I came away feeling that European research, which had been ahead a few years earlier, was now lagging behind that in the U.S. Indeed, RCA already was running an experimental television station and broadcasting live shows, as was Philo T. Farnsworth, the famous Mormon inventor who held 375 patents when he died. It should be noted that CBS also had made an early venture into broadcasting television, but it didn't take hold, and the company had abandoned it just before I joined the staff. Kesten felt that now was the time to revitalize our interest. Taking this as a cue, I recommended as a first step that we set up a department devoted entirely to television engineering and development, free of other projects in the company, and that we revive experimentation in TV broadcasting based on the latest technology.

I had not met William S. Paley personally as yet, but as far as I could learn, he had mixed feelings about television. On the one hand, he thought it much too expensive ever to be practical; on the other hand, he was persuaded to try again with an experimental station and take a chance that something might come of it.

At this time in CBS affairs Paley could afford to be enterprising. The company was doing better than ever. The critical, tumultuous years of 1933 and 1934 had gone by. Among other changes, the Federal Communications Commission was established to police the airwaves and to keep an eye on

the broadcasters. CBS emerged from these conflicts not only unscathed but stronger and richer than ever. President Roosevelt, who a year or two earlier had asked someone what the letters CBS stood for, was now very much aware of the growing influence of the new network, and so was the public. Two years of daily broadcasting and repetition of the name plus Paley's shrewd marketing sense all played a role. All this attention had boosted CBS sales to $50 million, with $8 million in profit in 1935. Sarnoff at RCA had his wary eye glued to the TV future and grandly predicted moving pictures in every home; Paley was keeping his eye on Sarnoff.

Actually, Paley could look back at an incredible success story since he had taken over the helm of CBS in 1928. It is important to go back over this story, I think, to understand the corporate and philosophic framework in which I was to operate in the next three and a half decades.

CBS started in the 1920s when Arthur Judson, a concert-artist manager, thought up a way to cash in on the rise of radio. Why not set up a concert agency to funnel big-name stars into radio? In this way he could expand his agency, make a dollar off the talent, and watch his wealth grow as radio grew. Judson approached Sarnoff, who promised that he would seriously consider the proposal. According to Judson, Sarnoff did more than seriously consider it; he implied he would be bringing the concert manager into RCA.

But Sarnoff had second thoughts and backed away. In a pique Judson promptly set up a rival broadcast organization. The decision must have amused Sarnoff at the time, but as it turned out, Judson launched what was to become one of the fiercest business power plays since Jim Fisk and Jay Gould tackled Cornelius Vanderbilt over control of the Erie Railroad. Judson had no trouble finding partners. With his first

partner, George A. Coats, he formed the United Independent Broadcasters. In 1927 Columbia Phonograph Company joined UIB in an anti-Sarnoff alliance to form the Columbia Phonograph Broadcasting System, with offices on the twenty-eighth floor of the Paramount Building in Times Square. Early investors in the new venture included Jerome A. Louchheim, a wealthy Philadelphia subway and bridge contractor, and Major White, a sports announcer. Both men put up $135,000, a substantial sum even for those high-riding years before the 1929 crash.

The company was loosely run in those days. In fact, Ted Husing, the treasurer, who later made a name for himself in radio sports announcing, kept all the records in his head. Years later Larry Lowman, a socialite friend of Paley who became one of the first true business executives at CBS, had the unusual job of sitting down with Husing and extracting the treasury records from Husing's memory, in order to set up the company's first accounting system.

At first times were bad for the young communications company. Its arch-rival, NBC, had just formed its Blue and Red networks and had cornered the talent and the ads. The treasury was running out of money, and there was nothing to do but seek new blood to keep alive. Louchheim was considered for the life-saving task, but he fell ill, so the investors turned to millionaire Sam Paley, owner and founder of the Congress Cigar Co. of Philadelphia, which turned out La Palina Cigars, a famous cigar of the period.

Sam Paley was impressed with the possibilities of radio because of what his son, William, was accomplishing for the cigar company. Bill had been brought into the business as an ad manager as soon as he had graduated from the University of Pennsylvania in business administration and soon had

shown his father some remarkable results from advertising over WCAU. This station was owned by the Levy Brothers—one of whom was Leon Levy, a dentist, who married Paley's sister, Blanche, and thus had the good fortune to become Bill Paley's brother-in-law. The La Palina program kept the cash register ringing for Sam Paley (and for young William) and introduced to the public such enticing figures as the La Palina Boy, the La Palina Smoker, and Kate Smith, who poured out music from her ample stature on behalf of the cigar.

Sam Paley wasn't sure how far his son would go in the broadcast business, but being a concerned parent, he invested in the fledgling company along with his son, who had money in his own right as an inheritance from his grandmother—the total amount is said to have been $450,000 at first, but ran to $1,500,000 later, according to several sources. In 1928 it was agreed to give young Bill a chance to make his mark in the world by starting him as president of the company. Bill was then twenty-seven.

In keeping with the dignity of his new position, one of Bill's first moves according to an old rumor was to remove his mother's picture from the bands of La Palina Cigars. More importantly, he set out on the business side to unite UIB and the Columbia Phonograph Company, which previously had operated under a complex business arrangement, into a single corporate enterprise, and he streamlined the name into the Columbia Broadcasting System. And that wasn't all. Paley and Leon Levy, who is today the longest-serving member of the CBS board, signed up sixteen stations into a network arrangement. Each station became known as an affiliate, and the reward for loyalty to CBS—that is, buying sponsored programs—was to receive sustaining programs free of charge. A fast-talking sales manager named

Weinberg used to do a lot of the selling, and Larry Lowman remembers that he carried two fountain pens in a vest pocket; that in case one went dry at the critical moment of signing a contract, he could whip out the other.

On a long-range basis Paley thus set into motion the system that was to make nearly every affiliate owner rich and to build CBS into the most powerful mass-communications enterprise in the world. The first station in the affiliate system, incidentally, was his brother-in-law's station, WCAU, which later was bought by the Philadelphia *Evening Bulletin*. Years later Sam Paley often used to come to board meetings, beam happily at the members, and in a heavy Russian accent speak glowingly of his son, the broadcaster.

All through the Depression radio appealed to millions of people. It was cheap entertainment. The result was that money rolled into the broadcasters' coffers. In the competition with RCA, CBS programming became all-important, and Paley's marketing genius, mixed with good luck, came into play. He had an instinct for programs with popular appeal—an ambivalent talent for a man who in later years was to become known as a collector and patron of the arts. As a case in point Lowman remembers an incident when he and Paley were on their way to Europe in 1931. While they were on the deck of the ship a melodious singing voice floated out of one of the ship's phonographs. Paley's finely tuned ears picked out the new sound. "Get that fellow," he said promptly.

Lowman did—and that was how Bing Crosby joined CBS.

Paley's acumen led to other lucrative contracts. He signed up Morton Downey, the Irish tenor, and later snatched from NBC those amiable con men in Negro dialect, Amos 'n'

Andy, who became perhaps the most popular and profitable comedy team in the radio business.

Paley also moved into other kinds of programming, much of it in response to pressures and often without ideological enthusiasm. For instance, although Paley's interest wasn't in the news, he was shrewd enough to respond to the popular and political rumblings that radio should offer more than just entertainment. He brought in Ed Klauber, a clever but abrasive editor for *The New York Times*, to start a news operation. Klauber, whose title was executive vice-president and who became personally close to Paley, was later followed in the news area by Paul White and Ed Murrow.

But if, as Murrow subsequently complained, Paley wasn't too interested in the news, Paley's men had the right spirit about democratic principles. At one time President Roosevelt sent Lawrence Fly, head of the FCC in 1939, to Klauber to say that the President didn't like the way news was being handled. According to Adrian Murphy, my boss at CBS after Kesten, Klauber told Fly to go back to Washington and tell the President that he would handle the news as he saw it. CBS was feeling its oats in those days as a communications empire and early had a concept of the freedom of press, which I am happy to say has remained ingrained in the company whenever conflicts with government occur. Frank Stanton's firm decision in 1972 not to give up the unused film clips of the embattled *Selling of the Pentagon* documentary to a congressional committee is the latest evidence of this long-held policy. I understand Stanton's decision was not made with the full approval of Paley.

Much more typical of the Paley hand was the way in which he responded to opposition to the laxative ads that once in-

undated the air. For some years listeners with delicate sensitivities endured hearing how Ex-Lax "cleans the world." Finally, under public pressure Paley banned laxative ads involving, as he put it, questions of good taste, but added that commitments then in force would continue until they expired.

According to observers, this proved to be a remarkable ploy. Laxative advertisers usually left the air in the summer, when apparently, for reasons unclear to me, there was diminished need for their product. If they left, they couldn't return under the ban. However, when Paley agreed to honor existing commitments, advertisers quickly exercised their renewal options (which were part of every contract) and so stayed on the air through the summer. Thus Paley found at the end of the year that CBS had made more money on laxative ads by banning them than by letting them stand. Nonetheless, it was a socially tasteful move, and he was hailed for his statesmanlike decision.

In the face of his success and the growing power of CBS my little television-engineering operation on the fifth floor was only of occasional interest to Paley and most of the broadcast types surrounding him. Paley was too busy to worry about his new chief research engineer and thus gave Kesten and me a free hand. Since Kesten enthusiastically believed in the future of television—he got the nickname of vice-president for the future (Murphy, his successor, I heard later got the name vice-president in charge of Goldmark)—the arrangement worked out well for me. I learned years later that Kesten cushioned most of Paley's objections to my ideas and ultimately helped convince him to keep the company in television.

One of the objections to experimental television was the

high cost of transmitting live programs all day. A program involved not only camera crews, sound men, engineers, and dolly-pushers, but control-room technicians, directors, and actors as well. This could cost hundreds of thousands of dollars as compared to mere thousands for a similar operation in radio. I suggested to Kesten that we could probably get around some of the cost by concentrating on films, such as the March of Time, which had been highly successful in the movie houses and was now sitting in cans on the shelf, gathering dust.

Since there was no good transmission equipment on the market, I also proposed that we develop our own. Kesten agreed. For the first time I felt the stirrings of the future. I could now begin to build my own television-engineering organization. The first two engineers to join me from the outside were Bernard Erde, our expert in optics, and John Hollywood, an electronics engineer, both of whom spent the next thirty years suffering my push to perfection, my moments of Hungarian single-mindedness, and my flights of fancy. (Hollywood is still with me today.) Our first machinist was Alfred Streuber, a diminutive German no more than five feet tall, who spoke little English but brought to our small department the high mechanical skill possessed by many Germans of that period. Because of his size Streuber could work only with tiny lathes and milling machines and other miniaturized tools, so we outfitted a special one-man machine shop for him in two rooms on the fifth floor of 485. This trio represented our research and engineering organization until early 1938, when we hired another man and acquired an extra room on the tenth floor and thus became known at CBS as the "five-and-ten department," a rather prophetic designation, as it turned out.

With this team I attempted over the next few years more or less to tie technology to the service of show business, a union that from time to time proved to be somewhat unstable. However, some good things did come to pass. To carry out my early proposal on film broadcasts, for instance, we developed a new type of film scanner, which I look back on fondly because it enabled me to publish my first technical paper in America. The device allowed us reliably to transmit high-resolution motion pictures over the airwaves. It was of a much simpler design than those available. It also proved to be useful later in color broadcasts.

To demonstrate the film scanner I had the idea of using a large screen and went to Allen DuMont, a manufacturer of oscilloscope equipment, who later became a TV broadcasting pioneer. DuMont made a tube for audience display that turned out to be the first large-screen television set in the U.S.—five feet deep with a two-foot screen. Among other things, I used it later as a prop in CBS's "radio playhouse"—a theater based on an idea by Kesten for providing live audiences for radio performers. Audiences saw on the screen the "look" of sound—the myriad interplay of wave shapes changing form with different voice inputs. Incidentally, we were worried in those days about explosions, and this monster tube was carefully protected with thick plate and surrounded with boxes of cotton to capture any exploding glass in case of an accident.

A more direct contribution to the world of entertainment that we enjoyed putting together at this time was a gadget I called the "synthetic reverberator," a device that acoustically turns an ordinary room into a concert hall. During the development of radio broadcasting the engineers used to deaden the studios to keep out street noises, a technique that we in-

herited in the sound pickup for television broadcasting. The performers hated to work in these acoustic mausoleums because they couldn't recognize familiar sounds, including their own voices. I remember that my friend, conductor André Kostelanetz, a former trainer of choruses who became one of CBS's big stars, sounded dead when I first heard him and his orchestra play in the studio. I thought he deserved better of acoustic science. How could Kosty's studio—a matchbox as far as sound was concerned—be turned into a sonic cathedral?

I thought the answer lay in livening up the sound by salting it with artificial echoes. It is the reverberation, the honeycomb of echoes, in Carnegie Hall that makes the full, beautiful sounds that reach the ear. My crew and I devised a black-box device that modulates the acoustic signal, and we designed it so that the sound engineer could heighten electronically the sonic effects within the studio simply by pushing a button. We got great response when we heard the playback. Kosty loved it. The singers reported that their voices never sounded more vibrant. Drama producers leaned on us for sound effects, and we became known in the trade as "the guys who brought the studio back from the dead."

At this time television rumblings began to grow louder. The two nabobs of communications were watching one another's moves carefully—or rather, Sarnoff was making moves, and Paley was responding. Paley, for instance, was acutely aware that NBC had been telecasting from the top of the Empire State Building since 1932. Just before I arrived at CBS, Sarnoff issued a Radio City pronouncement to the effect that he would increase his investment in television to the then unbelievable sum of a million dollars. In response Paley decided to build a competing transmitter, one bigger

and better than RCA's. Kesten called me into his office and told me about it. "Can you do it, Peter?" Kesten asked me.

I wasn't sure how I could climb higher than the Empire State, but I quickly said yes. I was learning fast the importance of positive thinking.

My first step was to poke around New York, sticking antennas out of the windows and domes of the upper stories of tall buildings. Height gives you good coverage for the signal. I must have traveled up and down a dozen buildings and made a few hundred tests before I settled on the Chrysler Building, then the second highest building in New York.

On my recommendation Paley ordered a transmitter for the Chrysler tower, and the real estate department of CBS found space in nearby Grand Central Station for a studio. I measured the studio's dimensions carefully and drew up the design, and when I was finished, while I couldn't claim victory on height, I could happily report, after checking on RCA, that CBS had the largest television studio in the world —a fact that may have delighted Paley and for a moment made me feel a significant part of show business. The whole venture involved an investment of close to a million, which I must say was courageous for a $30 million corporation like CBS. The urge to beat RCA and its ruler, David Sarnoff, was such an overriding force at CBS that it actually began to shape the direction of my own career.

Well, we had a studio and a tower; now we needed a TV camera. I searched around the country and finally narrowed my choice to two cameras, the Farnsworth and the RCA. The Farnsworth camera required too much light, so ironically we were forced to buy our first TV camera from RCA.

I must say I felt some momentary trepidation about stepping into the empire of the enemy to ask for a camera. RCA

greeted me with unexpectedly open arms, however, one of the few times they were to have this urge. A major reason, it turned out, was quite simple; they wanted CBS to go into television broadcasting so as to have another customer for RCA equipment. I don't think they ever envisioned CBS as a serious television competitor. We were too small. In fact, RCA did business, I discovered, by pointing out to other companies that CBS was buying its equipment from RCA. Such benevolent marketing rattled us a bit at CBS.

In 1939, just as we were ready to broadcast our first show, RCA made its own debut into commercial television with a splashy broadcast featuring President Roosevelt. The President was persuaded to show his faith in the future by consenting to open the New York World's Fair on RCA television. In those days the President had to travel to the equipment, not the reverse, as is true today. I watched the inaugural at home on one of the few (200 or so) experimental sets available. A master showman whose fireside chats on radio were extremely successful, Roosevelt carried his magnetic personality to TV. One could see he was intrigued with the new medium, and RCA drew considerable publicity from it.

In contrast to the champagne atmosphere of the RCA inaugural CBS quietly went on TV a few months later. At first our biggest problem was to fill the time. If you didn't fill the time slots, the government could take away your license for the channel space. To avoid such problems, we were forced to resort to all sorts of tricks. I recall that Gilbert Seldes, the well-known New York drama critic who was our first director of programming, brought in a Greenwich Village friend who wrote musical plays and compositions that were never produced. We were delighted to put him on television for

half an hour a day. Since nobody complained, we figured he was a hit. He did, too, because he asked for money, which we couldn't give him, and so he went back to his loft in the Village, and we filled the time with less demanding talent.

From an engineering point of view we also had some unique problems. One of them involved transmission in winter. Our antennas, sticking out of the upper reaches of the Chrysler Building, attracted ice—like the wings of a plane—and we had to devise special de-icers. Even these didn't work all the time. Once an emergency call came into my home, where I had a TV set to monitor our broadcasts—NBC's chief engineer, by the way, operated out of his home in Westport—telling me to get down to New York immediately. Evidently a chunk of ice had fallen from the tower and almost hit a passerby. The street was roped off by police, and television came under newspaper attack the following day. We were told we'd be banned from the Chrysler Building if we didn't do something about the safety of our antennas. This was one of the uncontemplated hazards of early television.

Underlying all our efforts at this time was our optimistic feeling that some day television might be commercially viable. Others were very skeptical. Many CBS executives flatly said that television was an idle exercise, and even having an allocation of spectrum space from the government, they pointed out, didn't mean you could sell the time to sponsors. Some executives and stockholders resented the high rent we paid for space in the Chrysler Building and in Grand Central Station and complained of the costs of experimental TV.

On the other hand, Paley himself later used to count the aerials on rooftops while traveling back and forth on business trips and expressed his fascination with the rising numbers. So the TV operation had high-level support at CBS. At

the time a total of thirty people were involved in CBS-TV, costing $300,000 to $500,000 a year, a large sum for CBS, but, I suspect, worth it to Paley to keep up with Sarnoff. The movie industry, of course, complacently regarded TV as something that would never work commercially because, they said, people were gregarious and didn't like to stay home.

Meanwhile at CBS we worked toward proving Hollywood wrong by trying to get larger pictures for family viewing—the largest tube commercially available at the time was only nine inches wide. We could increase the screen size to twelve inches by using a plastic lens in front of the tube, but that wasn't much of a gain. I felt the twelve-inch screen was limited, and despite its appealing novelty it would eventually turn people away from television and back to the movie houses. After all, nobody at home would want to strain his eyes day in and day out to look at what amounted to post-card pictures—at least that was the thought around CBS until the Japanese invented the miniature "tummy TV" set, which you can put on your stomach as you lie in bed.

Picture size, incidentally, is an interesting phenomenon. Long before the Japanese miniaturized television—in fact, before transistors were available for TV—I built a tiny portable as a personal set. Frank Stanton, a perennial gadgeteer who uses wireless to communicate with his secretaries and puts sensors in their chairs to determine whether they're at their desks, loved the idea of personal TV, but the set-manufacturing people at CBS turned it down, saying a small screen wouldn't show the viewer enough material to be interesting. I had trouble pointing out that picture size in itself—whether for movies, TV, or photos—is meaningless. What counts is the distance from which you view the picture.

For instance, a twenty-foot, movie-size picture seen from forty feet will appear the same to the eye as viewing a one-foot picture from two feet.

For family use, however, we needed a screen large enough to accommodate comfortably a number of pairs of eyes. To help us in this effort I began to gather additions to my staff. A German-born engineer named Martin Freundlich was persuaded to come to New York to join CBS. Emanuel Piore, a former assistant to Zworykin and later chief scientist at IBM, came on board and eventually made important theoretical and practical contributions. We devised a way to project images two feet wide, a great innovation. Unfortunately, what we gained in size through our technique we lost in brightness. Although this projection method became important later in color television, the size problem was licked in another way —through industrial developments that made the cathode-ray tube larger and larger.

Nonetheless, I think our work stimulated progress in the industry, and toward the end of the thirties we looked with pride on our fully equipped laboratory and experimental station. In just three years my colleagues and I had brought CBS to be a major contender in the TV field and established it as a pioneer in the new art.

In March, 1940, a fortuitous event occurred that was to open a new dimension to television. I was in Montreal with my former wife, Frances, on a delayed honeymoon trip, and while waiting for a train back to New York, we decided to spend the time at a movie. I seldom go to the movies because I've never felt my eyes were strong enough. Looking for faults in television pictures put them under a strain. But we

couldn't resist this particular movie about which we'd heard so much: *Gone With the Wind.*

For me it was a uniquely exhilarating experience, not because of the performers or the story, but because it was the first color movie I had seen, and the color was magnificent. I could hardly think of going back to the phosphor images of regular black-and-white television. All through the long, four-hour movie I was obsessed with the thought of applying color to television.

During the intermission I slipped into a corner of the lobby, whisked out my notebook, and started to calculate what would be required for color in television. In the hotel and on the sleeper back to New York I continued to fill the pages with equations. It was perhaps fortunate that I had seen the movie at the end of my honeymoon trip, or the honeymoon might have been shortened.

Back in New York I hurried to Kesten's office bubbling about the color in *GWTW.* I told him with some passion that color was the wave of the future and that I had a way of making it work for TV. Black-and-white had the dull, cold reality of an Eskimo Pie; color was the language of nature, of its wonder, warmth, diversity, and depth. Once you've seen it, you can't forget it. I added that I felt it was my duty to suggest that CBS move into color television without delay.

Kesten's eye took on a dreamy look. "Color is nature's own sweet and cunning hand laid on," he murmured, and then he smiled. "If you think you can do it, Peter, go ahead."

So in the next week or so I set to work on what has since become a well-known development known as "the field-sequential system of color TV" and occasionally by irreverent critics as "Goldmark's whirling dervish." John Logie Baird,

whose TV kits were the rage of amateurs in the 1920s, was the first to demonstrate in TV the sequential-additive method of color formation, in which the eye becomes a Waring blender and mixes the colors as they are flashed in rotation before it. But Baird's system was of poor fidelity. Moreover, since it was combined with the Nipkow disc, it provided limited resolution and therefore was hardly practical for home use. It was a totally mechanical system!

Over the years a few American companies had also looked into color television. Bell Telephone Laboratories, in fact, had demonstrated a crude color system in 1929 using telephone lines, but I knew they were putting no real effort into it, and I thought that if I worked fast enough, I might help CBS leapfrog black-and-white and become the first color-television broadcaster.

The details of how the field-sequential system was finally made to work are highly technical and probably have no place in what I hope is a human-interest document, but for purposes of completeness I am including some of them here. Moreover, I think they are important because of the historic role played by our color system in medicine and in space exploration and because before we at CBS were through we had not only created the first practical color TV but we had established the basic principles for all color television, including the system eventually put into consumer use by our arch-rival, RCA.

The heart of the field-sequential system is a method of sending a series of primary colors to the eye, and allowing it to mix them and turn primary colors into all hues and intensities through the persistence of vision. The method uses a rotating disc containing sets of filters of the three primary colors: red, blue, and green. On the transmitting end the disc

is made to spin rapidly behind the camera lens in synchronization with the action of the scanning electron beam, the basic idea being that the electronically scanned pictures—or fields, as they are known—are transmitted in rapid sequences of red, blue, and green light. Thus, consider a rustic sunset, with the blood-red sun in a blue sky setting over a green pasture. First the red sun is scanned and transmitted, then the blue sky, and finally the green pasture. Thus, three fields are transmitted. They are then repeated, so that the total picture is transmitted in six scannings. This process is made fast enough so that the colors can be picked up at the receiving end in rapid sequence and reproduced for the eye.

One point should be made clear at the outset: CBS's field-sequential system is electronic and not mechanical as later charged by RCA in an attempt to denigrate the system. The only mechanical part is really the device that inserts the color at the transmitter, and the only reason we used a revolving color filter at the receiver was that no color tubes capable of performing this function were available at the time. Today, by the way, an electronic field-sequential system is available, though not in general commercial use.

In strictly technical terms the early RCA color system was sequential, too; the colors of each picture element were transmitted in series in the form of color dots, or pulses, rather than as fields. However, the RCA system sent all the primary colors within each field simultaneously. This approach later became the heart of the great problem of compatibility with black-and-white television that was to arise after World War II.

The early system used three separate tubes, one for each of the primary colors. At the studio the scene to be televised was picked up by a color camera that contained three camera

tubes. Special mirrors and filters sorted out the three primary colors from the incoming light and transmitted them in pulses to the receiver, where three similar cathode-ray tubes received the appropriate colors and presented them to the viewer. This system of mirrors and tubes was very bulky and costly. With the development of a single-color tube that reproduced all the colors, the mirrors and all but one tube were eliminated on the receiving end to make it more efficient and practical.

But I am getting ahead of my story. None of this might have occurred had we not found ourselves frantically figuring out how to transmit colors properly and rapidly and thereby stimulating the TV industry with our energies. Indeed, the problem consumed us night and day for six months. We tore colors apart, put them together, studied their physiological effects on the eye, and otherwise turned ourselves into experts in the art and science of the subject now known as colorimetry, which once haunted Sir Isaac Newton and has engaged many other physicists ever since. Among other things we discovered that color filters acted as a gray filter in front of the tube, which cut down the effect of ambient light so that the picture remains bright and clear in a lighted room. This gave rise to today's tinted faceplate—a feature of modern color sets.

In scanning the picture for color transmission we used the technique of interlaced scanning to achieve better picture detail and to avoid flicker. In this technique the scanning occurs not in line-after-line sequence like reading a page of a book, but on alternate lines. First the odd lines are scanned through red, blue, and green filters, then the even lines are scanned through the same filters. The process ends with scanning six fields—three for the odd lines of red, blue, and

green, and three for the even lines—which gives the completed picture. All the colors in the system are constant and correct at all times and alike on all sets. The colors are locked in permanently and never change in intensity. All colors are transmitted within the "fusion time" of the human eye.

All that was needed—as I saw the operation in the prewar days—was to make sure the revolving discs at the receiver and the camera ends are properly synchronized—like two windshield wipers. Although addition of color theoretically may take away detail from a black-and-white picture, in practice the information in the picture is enhanced because many objects are more recognizable and distinguishable through their color content. Even two objects that are close together, such as an orange flower and a turquoise flower, will tend to fuse in black-and-white because they appear to the eye in the same shade of gray. In color, on the other hand, they are easily differentiated.

Several months after Kesten's go-ahead on color my colleagues and I had put together a "breadboard," or laboratory model, of workable television for still pictures. We were so enchanted with the results that we invited management to see the set in action. One day in June, 1940, Kesten, Stanton, and others crowded into my laboratory to see what I could deliver in color. At the transmitting end I used a series of color slides including a lovely Spanish dancer—dressed in a strong red-and-white costume—her arms above her head with castanets in hand. The image was three inches wide at the receiver—the width of the tube available. With a magnifier in front of the tube she "danced" in living color. It was beautiful.

Management liked what it saw, and we had their support to continue. We moved to motion pictures through the film

scanner we had developed for black-and-white. We strung a coaxial cable from the lab to the Chrysler Building, and using the black-and-white transmitter, we began slipping in experimental color broadcasts from the Chrysler Building.

While we were thus immersed in artificial color, Europe was involved in a real war, and each day's newspaper headlines announced a new crisis. It began to look like America would soon enter the conflict. But in my lab on Madison Avenue I was so embroiled in the excitement of color, I am afraid that I paid little attention to these worldly events. The FCC hearings on black-and-white TV standards for the industry were coming up, and I had in the back of my mind the block-busting idea that I just possibly might convince the FCC to go into color. As the first step in this direction I decided to propose our color scheme to the National Television Systems Committee (NTSC), which was then holding meetings to debate the kind of black-and-white standards they would present to the FCC on behalf of industry. I was chairman of a panel on new systems, and that seemed as good an opportunity as any to make the announcement of our own new color system.

To place all this in some perspective, one can compare the nature of the television industry to another great industry, automobile manufacturing. The automobile industry, which started in small shops, developed vehicles run by steam, gasoline, and electricity. They could all compete on the same roads. Even a horse might manage. Moreover, the vehicles had great flexibility; they could go at different speeds from lane to lane, use different octane ratings, and turn to other roadways if they found the ones they were on too crowded. New roads could be built to accommodate increased traffic.

On the other hand, television uses roadways that are math-

ematically limited. No two stations can operate on the same roadway, or channel, without clashing. Moreover, TV stations and receiving sets had to be keyed to the same channel width and to the same number of picture lines scanned per frame, so that every set would get the same broadcast; in short, identical technical standards had to guide all transmissions throughout the country. The FCC, the congressionally authorized arbiter of communications, had the job of granting licenses to experimental television stations, allocating channel space, and setting standards for TV operation. The FCC also had the power to judge the operation of the broadcasting industry on behalf of the public interest.

The net result was that the force of competition, which might settle such issues in industry, including the auto industry, made way in the case of television for the influence of pressure groups in Washington. Lawyers snapped shut their briefcases and hustled down to the capital, where they made their pitches to other lawyers. FCC engineers leaned on industry engineers. A shift of standards one way or another could benefit one corporation over another and decide the pattern of the TV industry for years to come. It is no wonder that there was confusion between the private and public interest, and there was constant investigation or threats of it.

With this background one can understand that the TV industry had enough problems and didn't need any new ones. So it was no surprise to encounter the reaction that occurred in August, 1940, among the assembled industry representatives gathered to discuss their first black-and-white standards when I rose and calmly announced that we could transmit pictures in color, and I invited the assemblage to a demonstration in the CBS laboratory of a broadcast from the Chrysler Building.

I couldn't have created a greater explosion if I had lit a stick of dynamite. The people sitting in front of me represented strong vested interests in black-and-white; General Electric, RCA, DuMont, Philco and Farnsworth. They didn't look fondly at the possibility, real or imagined, that color could hurt this investment. Where did I come off to shake up the business?

As the meeting continued, I could feel the resistance rising. An RCA spokesman stood up to say that he and his associates had been monitoring our broadcasts; they had analyzed the signal as color, determined what it meant, and then made the judgment that our system wouldn't work commercially. Other company spokesmen agreed with RCA. Fortunately, I wasn't alone; several companies, mainly Zenith and Stromberg-Carlson, came to my defense and argued for color. When the meeting finally broke up, it seemed there was nothing to do but bring the color system to the FCC and let them be the arbiters.

I returned to my lab and set the wheels into motion, including the one with color. We stayed up night after night refining our color system, running the show over and over again, and on September 4 we demonstrated our color to the FCC. It was a success. I remember that Larry Fly, head of the FCC, right then and there announced that he was a champion of color. The commission itself, however, was officially cautious. They suggested that we prove that the system would work with live pickup as well as film before they could give it any further consideration. That presented a new engineering problem. Live pickup seemed impossible unless we could increase the studio illumination or make the tube more sensitive.

I tormented myself with the problem day and night. Then to stimulate creativity I did something that has become a pattern for me whenever I find myself in a puzzling situation; I took off from the lab to contemplate the problem and hopefully come up with a solution. This time I took myself to Cape May, where my mother-in-law was living. Each day I took out my dog-eared notebook and scribbled, thought, and scribbled. One evening, while dining in a restaurant, the solution suddenly hit me. How marvelous is the human mind! You oil it, torment it, keep it awake, and just when you think it will do nothing for you, some creative spark flies from the anvil of the mind and the solution is there in front of you. This is the deepest satisfaction you can have, the moment of creativity, when cerebral chaos becomes pleasurable order.

The solution required a special camera tube. I quickly discovered that we didn't have sufficient experience or time to make it ourselves; only camera tubes of certain characteristics were available, and they didn't work for live programming. I checked every company in the U.S. and Europe before I discovered that the answer was literally at our front door. RCA was using a new type of tube known as the orthicon—a "next generation" tube that followed Zworykin's ingenious iconoscope—for transmitting live black-and-white scenes. This tube lacked certain characteristics for color transmission, but it had the sensitivity I needed, so we started to experiment with it, and found that if the light-sensitive surface of the tube could be thickened by a specific amount, a proper color could be achieved with it.

But how to modify such a tube? The answer was simple: let RCA do it.

I went to RCA's Camden plant and spoke to the head en-

gineer. He told me RCA would be willing to make the tube to our specifications, namely, with thicker mica on the surface, but he added it wouldn't work.

"That's all right," I said hastily. "Make it anyway."

I expect he figured I was a scientific nut, but nonetheless a customer, so he went ahead. Two weeks later RCA delivered the tube. I slipped it into our experimental camera, and it worked. The result was great live color pictures.

December 2, 1940, was a big day for the Goldmarks. Two births occurred. My first son, Peter, Jr., was born, and at the same time the first live television pickup of color on our experimental station was broadcast. Paley, Kesten, Klauber, et al. loved it. Kesten dashed off a wire to me and in his inimitable fashion complimented me on a perfect synchronization of births.

Washington hearings quickly followed. Some companies continued on our side, notably Zenith and Stromberg Carlson. But other companies, sparkplugged by RCA, let us know quickly that they were strongly opposed, and they continued to bark at us for the rest of the year. They said that we would be ruining the market, that our color was impractical and wouldn't work. It is interesting to note that Zworykin of RCA wrote that while it might look like a backward step to use a mechanical system, "it produces better results than any immediately available." We heartily agreed, but nonetheless RCA management continued their blasts at us. We retaliated by petitioning the FCC to use color in our daily broadcasting, and in June, 1941, we got their permission to broadcast on an experimental basis. But just how far would our opponents go in bucking us? I once heard it said (but I am sure it isn't true) that in an effort to neutralize me RCA had actually hired as a consultant a clever engineer named Goldsmith,

whose name was close enough to mine so the trade would confuse him with Goldmark.

In the midst of the television turmoil world events took a dramatic turn. Adrian Murphy phoned on a Sunday afternoon to say that I had to come to New York and put on an important special broadcast.

"What is so important?" I asked.

"Haven't you heard?" Murphy shouted. "The Japanese just bombed Pearl Harbor."

Although his statement was electrifying, I thought it was strange to put on an emergency broadcast over our own experimental station for the few hundred viewers who comprised our limited audience, but I hurriedly called in my crew and we got together charts and maps to explain what had happened. I recall that one visual we quickly developed was based on Roosevelt's announcement that we'd have 50,000 planes in the air. To show how large the number was, we poured kidney beans on the floor. I thought the flood of beans would never end, and I've often thought that had we continued with this symbolism into the modern decade of multimillion numbers, we would have had to corner the entire kidney bean market.

In retrospect, our show was the first "war" broadcast on color television. It also marked the end of our color work for the duration.

# 4

# The Fake Navy

NONE of my children ever asked me point-blank how I single-handedly won the war, a question that has faced many parents of my generation, who can remember when wars were being won and lost. Nowadays, with the Vietnam horror still fresh in many minds, I doubt that such a question is raised. Be that as it may, I felt sorry that I never was asked about my role in World War II because I always thought I had a good war story to tell; now at last I can talk about it.

It all began one day in January, 1942, while I was giving a talk on television at an engineering convention at the Commodore Hotel in New York. After the talk a husky, bespectacled man came over to me, quietly identified himself as Professor Frederick Terman of Stanford University, and in a soft voice, invited me to meet with him at a subsequent date. I was delighted and honored. To every engineer Terman was a renowned name; his book on radio engineering was (and still is) the bible of the business. When we did meet, Terman had more in mind than a social get-together. He wanted me to join him in a new venture. The OSRD (Office of Scientific Research and Development), a new government arm set up

to organize science on behalf of the war effort, was expanding rapidly and, among other things, was setting up a special radar lab at MIT, called the Radiation Laboratory, under the direction of physicist Lee DuBridge. In a parallel operation under OSRD Terman headed a group at Harvard known as the Radio Research Laboratory, whose specific function was to develop electronic countermeasures to enemy radar—in short, jamming devices. He asked me to join him.

This was an exciting opportunity to help defeat the Axis. I was in fact restlessly looking for some way to participate in the war, and I instantly agreed to go. A plan was worked out with Terman whereby I remained on as a CBS employe, but my laboratory and myself were subcontracted to the Radio Research Laboratory. CBS continued to pay 20 percent of my salary, thus allowing me to retain my seniority and its benefits, while Harvard paid the rest.

The Radio Research Lab was so secret the upper echelon thought it wise to hide it from public and student view. After a thorough examination of possible sites Terman let us know he had found a quiet, isolated spot on campus. It proved to be the biology laboratory, where in those pre-James Watson days nothing more violent was heard than the occasional accidental smashing of a test tube. The biologists were quickly hustled elsewhere, and we moved in. To this day when I think of the lab, my nostrils twitch with the odor of carbolic acid.

I am sure the entire project was from the start designed to test my Hungarian stamina. I spent five days at Harvard and one day, usually Saturday, at CBS in New York. Sunday was reserved for commuting. Friday night I left Boston on the night train, the Owl, and arrived in New York on Saturday

morning to go to work on the tenth floor of 485 (which incidentally was also classified secret because some of the war work took place there). On Sunday I managed to spend a few brief moments with my family before I hopped back on the Owl.

This routine went on, week in and week out, for a year and a half. The train, a fossilized throwaway of the New Haven Railroad, which I am sure is still creaking around, stopped everywhere along the route, usually announcing the event to the sleeping passengers by a screeching of the brakes. If you missed that signal, the engineer managed to make sure you would awaken by again slamming on the brakes, this time throwing you out of the berth. At South Station in Boston the war between train and man went into a final convulsion—a shunting back and forth, with constant grunts, tears, screeches, and jolts. Red-eyed and sleepless, I usually staggered off the train more eager than ever to help shorten the war.

As head of one of Terman's six groups my mission, once we got going, was to devise an instrument that would locate enemy radar electronically and put it out of commission by jamming. This was especially critical in the early days of the war. The Germans had installed in Occupied France radar that was able to "lock" electronically onto our bombing planes, so that the planes were always visible to the radar. The Germans then were able to use the echo of the radar signal to direct and trigger batteries of antiaircraft guns and wreak havoc among our bombers. The USAF's B-17s, which were being flown at that time, were designed for tight formation flying, eighteen to a formation, to make it difficult for an enemy fighter plane to attack. But the Germans' clever use of radar signals enabled them to disturb the formation with

concentrated ack-ack fire and then send up Luftwaffe fighters to catch up with the stragglers and shoot them down one by one. American losses to antiaircraft fire or to fighters were considerable; in fact, the high-altitude strategic missions of the Eighth Air Force were in grave trouble at that time.

How do you jam the German radar and break up the entire operation? The principle of jamming, of course, is simple. Since radar sends out a radio signal and then picks up the echo when the signal hits something in the air, you simply block it by generating a radio signal that is powerful enough to blank out the echo going back to the receiver. The radar can no longer identify the signal representing the plane and thus fails to trigger the mechanism that controls the antiaircraft batteries.

If the principle was simple, the ability to take advantage of it was not. The first step was to find out what the German radar was really like. British intelligence, it turned out, knew only that the Germans were successfully developing radar and installing sites along the coast and around sensitive military targets. We didn't know the precise frequency of the signals emitted by the radar or anything technical about them.

So one day at the prodding of our scientists the British and Americans took the logical military step. They agreed to raid the French coast and capture a German radar station. It was obviously a highly dangerous mission and took some of our staunchest commando volunteers. The target decided on was the small town of Bruneval in Belgium, six miles north of Dieppe on the Channel, where it was known that the Germans maintained a major radar installation, defended by heavy batteries.

The raid came off on February 28, 1942, and proved to be costly to our commando forces. Indeed, when the news of the

raid came out, with the great losses of men, the press thought it was insane. The military defended it as a necessary test of German defenses. The real purpose, of course, was kept secret. But those who returned from the raid brought back to England and the U.S. the first bona fide specimen of the Wurzburg, the code name of the German radar. Our group went down to Signal Corps headquarters at Fort Monmouth, N.J., to examine it. The first surprising thing we noticed was the German manufacturer's label and the date of manufacture—1936. Evidently the Germans had developed practical radar much sooner than our intelligence knew. With such an early lead it was no wonder that by 1945 the Germans had installed 4000 such radars on their territory, each manned by ten trained men. I learned later that this represented an investment of about a billion dollars.

The Wurzburg was a sophisticated piece of equipment, which also startled us because we had been led to believe that the Allies had more advanced radar than the Germans. We took down the electronic characteristics of the system, and my close associate, John Dyer, a CBS engineer who headed another group under Terman, went to work to design a jammer—a box of electronic circuits about the size of a shoebox—that a plane could carry on a mission. What he came up with was essentially an electronic noisemaker that emitted a "raspberry" when its frequency was tuned to that of the radar. Its code name was "Carpet." In principle it was just like the sound of an electric razor when it drowns out the audio. In the case of radar, of course, the noise was not something you heard but something you saw as "grass" on the radar screen.

In conjunction with this jammer our group designed an intercept receiver, which pinpointed the radar frequency we

needed to jam. It was first used in connection with the Allied invasion of Africa, when English planes carried it on a volunteer basis against the African defenses. The British called it Goldmark.

One of the sidelight mysteries of the war I heard about at this time was the disappearance of the famous British actor, Leslie Howard, on a flight from Lisbon. According to an unpublished story Howard was on a special plane, which we were told carried our new equipment, when he was shot down by the Germans. Another more romantic theory held in some circles is that Howard was aboard a plane that carried a double of Winston Churchill, who was then on a secret mission in another part of the world. The Germans were fooled for the moment at least into thinking they'd hit the wartime jackpot when they downed the plane. Instead they destroyed one of the finest actors of our time.

As soon as we had working models of the intercept receiver and jammer, the OSRD asked me to set up a counterpart of the Harvard radar countermeasures lab in England. I was to be the technical head of the lab, which was called American British Laboratory 15 (ABL 15). Our job was to test a jamming transmitter on a mission. Before I could do so, I was to bump up against some unexpected problems.

Kesten agreed to my going. The company at that time was playing an increasingly important role in the war, especially in communications. Paley himself had accepted a commission as a colonel and joined the psychological-warfare branch in Europe, which was set up to work on the minds of the Germans in preparation for the invasion. Interestingly enough, at the same time David Sarnoff was also a colonel in England on behalf of the Signal Corps to orchestrate the Allied communications effort. Because of their intense rivalry

back home, it wasn't surprising to find stories going the rounds. One of them, possibly apocryphal, was that Paley was housed in the elegant Claridge's Hotel in London, while Sarnoff at first was billeted in modest quarters in the country. When he heard of Paley's elegant setup, he made loud noises and was finally moved to Claridge's. As soon as he settled in, there was a phone call to his room. A feminine voice said, "Hello, Bill." It turned out that Sarnoff had moved into the room Paley had just left for even better quarters.

Generally speaking, the war years were golden years for the communications sciences. Experts in sociology, psychology, anthropology, and what have you left the colleges and industry and flocked to Washington, where they created volumes of charts and graphs on how people act and react. Stanton, who was one of those who commuted regularly to Washington, measured GI reactions to everything from movies to Melanesian women to determine how best to improve morale of the soldier. Elsewhere, other investigators measured human reactions to determine how best to reduce the morale of the Germans.

As for me, I had more than charts and graphs to worry about. To set up the countermeasures lab in England I had to move an entire laboratory across the Atlantic piece by piece. This meant that seventeen tons of miscellaneous objects, from Phillips screws to generators, had to be packed, labeled, and shipped. Miraculously, we managed to do it, down to the last keg of nails, and including cases of canned orange juice and chocolate (I had heard that these commodities were scarce in England).

Our destination was a prestigious old ladies' summer resort in Malvern, near Worcester, which was picked because it was thought the Germans would never suspect that a peaceful-

looking country place with wide cricket fields concealed an important military establishment. This planning proved to be correct. The German bombers left Malvern strictly alone. But as it turned out, the British didn't. As soon as we arrived, ready to install electric wiring, the British workers thought we were taking over their jobs and called a strike.

The following day I went to visit Colonel Curtis LeMay, the commanding officer of the Third Bombardment Group of the U.S. Eighth Air Force at Elveden, an estate owned by the beer and ale magnate, Guinness, but turned over to the U.S. LeMay's Group was chosen to test our device in action over Germany. I hoped he might also intervene in the strike situation.

As soon as I arrived, however, I could see that this was the wrong day for a visit. The place was in an uproar. The Bomber Group had just come back 25 percent short from a raid on Schweinfurt, site of a ball bearing factory. A stocky, rugged firecracker of a man known as Iron Pants, LeMay was more than usually upset that day. He didn't even remove his cigar from his mouth to roar at me. The words shot out like machine gun bullets.

"What the hell do you want?"

"I have instructions to install a jamming transmitter on one of your flights," I said. "I am here to work out the installation."

He swore at me. "You fool around with this electronic stuff. What we need is bombers." He walked off, leaving me standing there. All I could do was turn around and leave.

The next day he was a little calmer. "What will it do?" he asked.

"It'll jam the enemy's radar," I told him. "And it'll cut your losses."

LeMay scratched his head skeptically. But he finally agreed to let us install the jammer. The idea we worked out was to have a jammer on one plane in the middle of the formation. This jammer would knock out the radar and hopefully permit the formation to complete its mission. In the meanwhile with LeMay's support we proved we were not displacing British workers and settled the strike.

The first mission with a jammer was a raid on a plant at Vemork, Norway, which the Allies thought was producing heavy water for the German atom bomb. As things turned out, it was one of the false alarms of World War II. The production of heavy water proved to be useless.

But for our purposes the raid was revealing. It was a successful bombing sortie, with no losses. There was no question that our jammer had done the job. When the jammer was there, planes came in unscathed, one after the other; other sorties without the jammer suffered losses. We used to sit in LeMay's headquarters and count the planes as they came in.

One day LeMay appeared at my side. "Why can't we get more of those g.d. boxes?" he rasped.

"I just have one," I said.

"Well, make more. The pilots want them."

"We need more operational experience," I told the general (he had now been promoted). "Besides, I anticipate trouble."

"What kind of trouble?"

"The Germans aren't dumb. They'll unjam."

"Goddamn."

On the next raid over France we found that jamming had indeed lost some of its effectiveness. The Germans simply changed the frequency of their radar. We knew then that our jamming transmitter had to be quickly tunable. Our strategy

changed. One idea of mine was to devise a special new receiver that would permit us to tune the jammer to the new frequency of the German radar.

The trouble with new gadgetry is that one needs parts, and the Americans were as tough on us as the Germans. I recall trying to get ninety-five special 25-ohm resistors. The British didn't have enough of them in stock, and even in our careful moving operation we hadn't packed that many. So I proceeded to enter the order through the Navy, which was our link with the United States mainland. Unfortunately, telegraphing was slow. One reason was the censorship, which was then headed by a pompous fellow called Archambeau, who worked for OSRD. The agency was so slow and full of red tape that we at ABL facetiously referred to it as the Office for Suppression and Rugged Degeneration.

Seeking to break up this bottleneck, I talked with CBS newsman Paul White. He suggested I contact Ed Murrow, who was then doing those marvelous broadcasts from the embattled city of London. Murrow agreed to send my message on the transatlantic phone.

A few hours later the request was in the CBS offices at Madison Avenue, and my resistors were on the way.

When Archambeau heard about it, he was furious. He accused me of violating regulations, and we were criticized somewhere along the line for using news channels for military purposes. The idea later became fascinating to movie authors, who included it in spy pictures. At any rate we went ahead and emerged with the development of a new jamming device, nicknamed Pimpernel. (My staff had actually started on it in New York, but it was still unfinished when I went back to England.) The Pimpernel box was carried by a good many planes of the Eighth Air Force and helped, I think, to

bring back many of our pilots safely. Being a fan of Leslie Howard, who had just brought Baroness Orczy's Scarlet Pimpernel to the screen, I couldn't resist adding to the instructions: "We seek him here, we seek him there, we seek the Jerry everywhere."

Along with the jammers, another device developed at this time that tormented the Germans was chaff, a name that came originally from the United States but an idea that actually began in Britain, where sheets of aluminum foil were hurled out of planes to set up false signals on the enemy's radar sets and fool the Germans into thinking that there were more planes out there than there were. The British—who called the sheets "Window"—made it supersecret for fear the Germans would steal it and use it against them. The Germans thought it up independently and also made it supersecret for fear the British would use it against them.

Window became high priority back at Harvard. A Chinese scientist named Chiu determined analytically how many sheets you needed to cut up to simulate a B-17 on a radar screen. He worked at first with cylinders of aluminum. Astronomer Fred Whipple, who was then on Terman's staff, had the bright idea of cutting the sheets of aluminum foil into strips because he saw that strips would give more reflection per pound of aluminum foil over a wider band than cylinders or any other configuration. A clever MIT engineer went a step further by figuring how to bend the strips into the form of a V, ten inches long, and went on to invent a machine to do it. By V-E Day some 10 million pounds of aluminum foil had been dropped over Europe by our British-based bombers alone. As a result, U.S. aluminum-foil production tripled during the war. The saving in planes (not to mention lives) amounted to at least twice the cost of the program.

The OSRD, with the War and Navy departments, concluded that the combination of chaff and jammers had made the life of the Germans miserable. "According to a reliable German estimate," they reported in 1945, "90 percent of their ultrahigh-frequency engineers were working on antijamming attachments." An average figure was certainly 50 percent, or roughly 4,000 people, whereas only one-tenth that many trained U.S. engineers were employed in devising radar countermeasures. The Luftwaffe in desperation even announced a public competition with prizes totalling 700,000 reichsmarks (free of all taxes) for the best solution to the problem of Window.

Quite by accident, years later I learned personally what had been going on behind the scenes on the enemy side. I was in Frankfurt, and while at a luncheon I met a German engineer named Paul Goericke. During the course of our conversation he asked me what I had done in the war. I said I was in radar countermeasures and told him about my problems with the German radar. He laughed and then went on to tell me that it was he who had changed the frequency of the Wurzburg to meet our jamming. Over dinner we fought out the countermeasures war in strange amiability. It occurs to me that World War II may be the last war in which after the conflict onetime enemies could settle in a friendly fashion an event that had drawn so much blood and emotion during the actual fighting.

The high moment for our jamming enterprise, and for me, occurred one day when a Navy commander came to Malvern and sought me out. He introduced himself to me as Douglas Pleasanton, a member of Ike's headquarters staff, then called COSSAC, and later changed to SHAEF. Pleasanton told me

he had orders to escort me to London but couldn't tell me why. All he said was that I was not to tell OSRD.

Feeling flattered and highly privileged, I accompanied him to London. Pleasanton drove me to Grosvenor Square, known as Eisenhowerplatz, in Mayfair. We walked through a gate into an imposing building and thence into a room where a group of naval officers, both American and British, were in earnest discussion. They stopped talking when I arrived and acknowledged introductions.

Pleasanton walked up to a wall, which I saw was heavily shrouded by a curtain. "As you may have heard, the High Command is considering invasion of Europe," he said. Then after letting that sink in, he added dramatically, "This curtain hides a map of France that shows our invasion plans."

Suddenly I sat very still. It was a climactic moment. Pleasanton then went on to explain. "Hitler can't afford to spread his forces," he said. "He can resist an invasion only if he concentrates them in the right places. So our job is to make him believe we're going into one place while we choose another far away to draw off his forces. I mention this because we think you can help us in our invasion in a unique way."

He asked me if it were possible to create a "spook" navy, an armada built entirely out of electronics that could deceive the Germans into believing there was a real invasion force at their door. "You're in the business of fooling radar with devices on planes," he said. "Why can't you fool the entire German detection apparatus into believing that we are sending in a fleet, say to Calais, while we invaded on the Cherbourg Peninsula? Give us a way to convince their radars that we have a fleet about to land men at Calais."

All the way to Malvern my head was in a whirl with ideas for a spook navy. You could of course send a fake signal to

the German coastal radar as a diversion, or you could jam the entire coast—making all their radar "blind"—so they would not be able to pick out the real signal of a ship. Neither method looked good. For one thing German radar was very dense along the French coast from Dieppe to Cherbourg: no less than fifty air warning and coast-watching sites, with two radar installations per site, had already been detected by our reconnaissance planes. On top of that the radar was not uniform; a dozen different types were represented. The installation seemed impregnable.

There might be just one Achilles heel in the coastal radar —small wooden barges might be used to simulate an invasion fleet. Would it work? We set up an experiment with a simulated German coastal radar situation, using one of the captured German radars planted on the shore. A few camouflaged barges were anchored a short distance away. On the barges we modified the oncoming signal and retransmitted it to the German radar receiver. On the German radar screen it appeared that a fleet was off the coast. This method, we felt sure, would fool the Germans on D-Day. Like most others we had no idea exactly when the actual invasion would take place.

The entire equipment for the electronic-countermeasures program, including the spook navy, however, had to be assembled and working by May, 1944, so it wasn't hard to guess that things were coming to a head around that time. Some of the equipment had to be built at CBS in New York. COSSAC agreed to send me back to the United States to initiate design and manufacture of the equipment and then allow me to come back to Europe to participate in the actual invasion. Before setting out, I sent Paul Kesten a message through Ed Murrow to insure the company's support in initi-

ating a new emergency program at the lab, saying I wanted their help in returning to Europe, but adding that I couldn't explain why.

"We'll back you," came a return wire from Kesten.

But when the moment arrived to go to the U.S., it wasn't so easy. I applied for transport, but Archambeau looked at me coldly. "Where are your travel orders?" he demanded.

"I don't have any."

"Why?"

"I can't tell you."

Archambeau snapped, "No transportation." I brought it up to Pleasanton, who said he didn't want to explain the function of his group to OSRD and therefore couldn't apply for orders on my behalf.

In desperation I wired Terman. "Urgent I come back. I can't give you reasons."

Three days later: "Sorry, you're needed on ABL 15. Terman."

I wired Guy Suits, Terman's boss in OSRD. Same reaction.

So once again I went to Ed Murrow. "Ed, you've got to get me back to New York," I told him. "I can't tell you why, but you'll have to trust me that it is important."

A man unfettered by bureaucracy, Murrow made a quick decision. "OK," he said. "From now on you're correspondent Peter Goldmark of CBS."

He told this to Naval Transport, and there was no problem. We flew from Shannon in Ireland to Dakar, and then across the ocean to Para, Brazil. On the approach to the Brazilian airport the plane dipped too low and a wing hit a sailboat in the bay. Nobody was hurt, but there was a gash in the

wing that would take two days to repair. I remember that it was December 22 and hot summer weather in Brazil.

That night we slept in a maternity hospital in Para because there were no hotels. In the wards of the hospital there were more nuns and pregnant women than I had ever seen at one time. During the night we were awakened by chanting; imagine a hundred women chanting the "Song of the Unborn Infants," which to my irreverent ear seemed like a yell of defiance against nature.

The plane was finally repaired, and we took off, arriving in New York at what is now La Guardia Field. I fully expected to see Archambeau at the airport holding an accusing finger in my face when I landed. But he wasn't there, and best of all I was home for Christmas.

When I appeared at CBS, Kesten was amazed. "I thought you were in London," he said.

I told him all about it. He shook his head. The lab was under contract to OSRD; here I had come in on a Navy plane with a Navy job and no Navy papers to prove it. From the point of view of the orderly bureaucracy of war it was an incalculable mess. I went to Cambridge. Terman didn't blink an eye. He arranged to send Dyer to England to take over the countermeasures lab, and I was left alone to develop a spook force on the tenth floor of 485.

In the second week of May we had to pile all our electronic invasion gear into a plane and fly it over the Atlantic. I asked OSRD for transport. The agency refused on orders from Vannevar Bush, who said I had violated orders in coming to New York, and he wouldn't do anything about sending me back.

I appealed to Kesten, who quickly got hold of Harry

Butcher, Eisenhower's able aide. But evidently Bush reached him first, because he wouldn't help. I am not sure that Ike appreciated the place of science in the war. No mention of technology was made in his book *Crusade in Europe*. Pleasanton was angry at what had happened but pleaded that his critical position prevented him from getting involved in administrative battles between OSRD and the Navy.

Not to participate in the critical testing of the spook navy on which I had labored so hard left me heartbroken, but I was happy to hear that the pre-D-Day rehearsal went off satisfactorily in England under the leadership of my associate Orville Sather, a CBS man whom I sent in my place. The night before D-Day Allied airplanes carrying jammers cruised up and down the coast and "blinded" the Germans' early-warning radar. The next day the Air Corps attacked the radar sites. The Germans never saw the formation of the D-Day squadrons. Fake flotillas of harbor launches drew Luftwaffe planes from their bases and engaged them in fruitless battle. It was one of the best-orchestrated hoaxes in the history of war, and it saved many lives.

As for me, while I was unhappy at not being part of the operation in Europe, I did manage to close the days of my participation in the war working with an intriguing development. The image orthicon, the major tube of television, had been developed during the war. Continually on the lookout for TV applications, I thought that TV might be used for military purposes. Several of us proposed a remote radio-TV link for arming bombs while in aircraft and guiding them to enemy targets. We got a government contract to test out these ideas. This was the era of automatic eyes and ears created by electronics, and other scientists, including, I must admit, some at RCA, were working hard in the field.

One remotely steered bombing system reached a point of development where it was installed in a British plane and sent on a test mission against a submarine pen at St.-Nazaire. The plane was in effect a flying bomb, which could be triggered from the shore. To determine its accuracy and operation, Joe Kennedy, the oldest of the four famous brothers, volunteered to baby-sit the system while it was armed in the air. Tragically, he failed to bail out in time. The plane exploded and he was killed.

My last assignment of the war was with Admiral Nimitz in the Pacific, to help the radar countermeasures effort against the Japanese in preparation for the then contemplated invasion of Japan. The invasion, of course, never occurred. The A-bomb intervened, and two weeks later the Japanese surrendered. The war was over.

# 5

# Clash over Color: Initial Sorties

BACK home at CBS I faced an organization that had grown in numbers and expertise. The first thing we did was declassify the fifth and tenth floors and, like others in industry, set about holding conferences, exchanging memos, and in general figuring out how we might use our wartime wisdom in the postwar communications world. Two great ideas emerged out of this and kept me busy for almost a decade. One was the LP (which I'll discuss later) and the other was color television.

I remember that in 1944, shortly after VE Day, I had told Paul Kesten that one of the major spin-offs of World War II technology was the development of high-power systems capable of long-distance transmission of energy at ultrahigh frequencies (UHF). Such systems had been at the heart of our successful development of radar countermeasures. Now I felt they could be used to open up a great new unmined section of the airwaves. Imagine, in one move we could give the

public forty more channels (only six were available on very-high frequency [VHF] up to the end of the war) and a wider choice of TV programs than they had ever had before, and all in color, with finer detail than proposed by us before the war.

I made the suggestion to Kesten that we pursue this great new potential of UHF. He looked interested, but he was then busy writing poetic ads for CBS, and I couldn't tell whether the encouraging gleam in his eye was technological or merely lyrical.

In any case I took his apparent interest as a good enough go-ahead and proceeded to lock myself into a corner of the small lab on the fifth floor of 485. I toyed with the paraphernalia of electronics and dreamed of the new visual and audio world that was coming. I often drew down from a shelf the color TV wheel I had worked on before the war, gently rotating it, seeking inspiration. At odd moments I conjured up in my mind the spirit of Rauscher's technical curiosity shop in Budapest, where I first got started on the road to innovation.

Here in color, I thought, was the technology for a new art. Management had bought it once—why not again? With a little engineering I improved the mechanism of the whirling disc and watched the color come through true and fine. I felt that with a little work we could coax color into the UHF bands and be the first to bring commercial color to viewers. One day I decided the time was ripe to return to Kesten and tell him what I had been up to.

This time he was in a mood to give me his full attention, or perhaps I was more convincing. As always, when he put his mind to it, he had the wonderful knack of enlarging an idea into an enterprise without moving from his chair. Immediately he saw in his mind's eye the scene of the future: CBS

providing color programs and color sets everywhere. People glued to the rainbow realism of snow scenes in winter, green forests and limpid blue streams in summer, art galleries, millionaires' homes, and everything else in vivid hues. Money flowing into CBS. Paley happy. "Very well, Peter," he said. "Let's tell Paley and get on with it."

This was the first time I had a chance to meet for any length of time with the magician of broadcasting in his own office. Paley struck me as being extraordinarily handsome; boyish in face and manner, he sported a suntan though it was winter. From that time on I don't think I ever saw Paley without a suntan, which may account for the nickname he got around CBS of Pale Billy.

He listened with an air of mixed impatience and interest and quickly told us that he loved the idea. I would discover later that love and hate with Paley were emotions that quickly followed one another. Paley, of course, could use a block-buster device. Competition was then intense for audiences, and here might be an answer to Sarnoff's belligerent push to promote black-and-white TV as well as radio. The following week Kesten and I approached the FCC to get their initial reaction to locating all TV broadcasting, including color, in UHF. "All you need to do is prove that you can transmit and receive UHF," one of the commissioners told me. "If you can do that, we'll consider a CBS proposal for a hearing." This was a real engineering challenge, to take advantage of new technologies and to move TV ahead by a giant step. But as things turned out, it wasn't just an engineering problem. I found myself squarely in the middle of one of the biggest corporate battles of the century.

It was clear at this time that the bulk of the radio industry —dominated by RCA, DuMont (long since swallowed up by

Fairchild and Emerson), and Philco—wanted to keep the new TV in VHF hands, where all their prewar experience lay, and not in UHF. And some VHF representatives who were then busily applying for TV licenses in that band weren't about to let us take over another territory, which might lessen the value of their own preserves.

At first the industry leaders expressed surprise that we were daring to advance the cause of color again and, heaven forbid, in the ultrahigh frequencies. When they realized we were serious, they girded for battle, with a campaign against CBS in the press, on radio, and occasionally on the lecture forum. General Sarnoff had no hesitation in mounting his horse and leading the attack. He declared that CBS would never get color accepted by the FCC, by the industry, or by the public.

In the face of such a wall of opposition, I felt more stimulated than ever. I was sure we were on the right track. Invention was one thing; important innovation that might move the art and shake up corporate alignments at the same time was quite another thing. Back in the laboratory I again tinkered with my old friend, the color wheel, and with the associated electronics. A few more adjustments here and there might make the system less bulky and less awkward to handle. Our efforts paid off. With ITT we designed a color transmitter, which was built by ITT and installed at the Chrysler Building. The quality of the resultant color picked up by our receivers was superb, brilliant, stable. The blues were blue, the greens were green, and the flesh tones natural. Stanton, not one for overenthusiasm, took one look and said it was great. From on high the word filtered down that Paley felt the same way, although he hadn't yet seen it.

We ran demonstrations in a suite on the fifth floor of 485

for special clients, including advertisers and distinguished visitors from business and government. I found myself in show business, giving performances at two and four o'clock. I must admit I loved it. We handed out questionnaires to collect peoples' reactions and found nothing but enthusiasm.

So with this strong public mandate, CBS in 1946 decided to arrange a special demonstration of color TV for the FCC. The place we chose for the major portion of the demonstration was the Tappan Zee Inn at Nyack, a luxury hotel on a hill overlooking the Tappan Zee, the widest part of the Hudson River. The hotel was about forty miles from our transmitter at the Chrysler Building in New York City, a reasonable distance to prove the point that color was not only feasible, but practical. The test, we figured, would be followed by others in various cities.

The demonstration was vital to CBS, and knowing this I felt a little on edge about the whole thing. The earlier shows were more-or-less appetite-whetters, but now I knew that our company, which was lagging behind others in the rush to market television, was prepared to invest a great deal of money in the future of color. If everything went as well in the hotel as it had in the laboratory, I felt that I would be in a position to help nudge a new era of communications into existence.

To make matters worse, Kesten called me to his office one morning and confided that he was more ill than I realized and that he was going to retire. He had been slated to become the new president of the company (Paley elevating himself to chairman of the board), but he felt he couldn't accept the responsibility. Frank Stanton would probably move up and replace him. I must have showed concern because he

quickly assured me that Stanton would back me up in matters having to do with research.

In the next few days I threw myself into preparations for the demonstrations. I am a fusspot about such things. A detail out of place can send me crawling up a wall, and to avoid this vertical disaster I press very hard. Some of my people have chided me on the overattention to details. I plead guilty. I think it comes from my musical training, where I learned early that a single discordant note can ruin the beauty of an entire rendition.

Unfortunately, there is nothing more alien than a hotel facility for conducting a sensitive experiment. Hotels may be satisfactory for their main purposes, but for an engineer they're examples of uncontrolled environments. The plugs don't work, and generally there are no tools at hand to fix them. The lighting is terrible. The maid invariably comes in at the wrong time bearing towels, and slack-jawed bellhops stand around waiting for tips. But despite such interruptions, and we had them all, we did manage in time to set up and wire the TV color sets—several laboratory models, each with a ten-inch tube magnified to a twelve-inch screen.

On the eventful day the judges of our fate and other distinguished guests trooped into the hotel room one by one. Charles Denny, the slender, austere-looking new chairman of the FCC, appeared in the company of several associates, along with FCC engineers and lawyers. CBS management was represented by Frank Stanton, looking nautically handsome, every hair in place, and self-assured. Why not? He knew we'd be a success. On top of that he'd just received official word that he'd been made president of CBS and at the age of forty was one of the youngest top executives in the

country. After pleasantries had been exchanged, we all sat down and hunched forward in front of the TV sets. I gave the necessary introduction to the assemblage, threw the switch, silently prayed a bit in Hungarian, and waited.

In an instant starlet Patty Painter, our nineteen-year-old heroine from Beckley, West Virginia, filled the tube. Her skin glowed a natural flesh pink, her long auburn blonde hair glistened, and the piquant smile and dancing blue eyes drew appreciative smiles from all of us.

Denny sat mesmerized. After a few moments he turned to me. "I wish I could ask her how she feels," he said with a smile.

I turned toward him.

"Why don't you?" I said.

Denny looked surprised. I must admit I had anticipated the possibility of such a request, and I quickly stepped to the phone and called the studio. As Denny watched, an engineer appeared on the screen with a handset and gave it to Patty. I handed Denny one of our own telephone sets. He asked her about the lighting.

"It's warm but not bad," she said in a clear and charming voice.

Denny's face again lit up. He said something gracious in reply on how wonderful she looked. The rest of the show went on and was soon over. Everyone looked pleased as they filed out of the suite. I thought we were in. So did Stanton.

When the news of our color experiment came out in the papers, RCA's reaction was near vicious. If they had fought us before in low gear, they now opened the full throttle. They said flatly that the public was not ready for color and that the industry was not ready for UHF; furthermore, the CBS system was a big mistake because it was not instantly compati-

ble with the black-and-white sets in use. There were 250,000 sets in American homes at this time. These set owners who wanted to receive CBS color programs would have to buy a converter in order to view color broadcasts on their black-and-white channels, and the converters, continued RCA, were "inefficient, ugly, and expensive."

As an inventor with some pride, that last insult really stung. I had stayed up night after night working out a converter that was relatively small, simple, and neat, one that I felt would add little cost to the set owner. Backing me, CBS spokesmen insisted that we had a practical system that provided color at reasonable cost, and we were willing to take the risk of testing it in the marketplace. When the electronics were up to it, we could look into methods to make it "compatible" with black-and-white. At the time electronic compatibility was nowhere near realization. We awaited the FCC decision with some confidence.

Actually, at one point during the FCC hearings, RCA had unveiled what they called an "all-electronic color system for VHF." It was a premature model that didn't work, and RCA admitted that it would take five years to produce. Later, with no additional development to back up the assertion, they lowered the time lag to three years, and then ultimately reduced it to eighteen months. But it was only talk. On the basis of what they knew and had actually observed, the FCC was not impressed. It seemed that RCA was dealing cards from all parts of the deck—anything to stall, to keep our effort on the sidelines.

My laboratory was a center of intrigue. At one point a memo crossed my desk from Adrian Murphy, the former head of the radio division who had succeeded Kesten, comparing RCA's color television pitch with the von Rundstedt

offensive in the Ardennes during World War II. The memo read as follows:

CBS and the Allies had things pretty much their own way after the landing (CBS landing on the beaches of the UHF band was January 31, 1946).

Then when the forces were being marshalled for the final push, the breakthrough came. In each case it was a reckless last minute effort to stave off what would otherwise be inevitable defeat. In each case the normal conventions of war were discarded. The Germans, for instance, used American tanks manned by English speaking men in American uniforms. RCA put its system into an "electronic" uniform, which is one of our color uniforms. The von Rundstedt Offensive was a gamble for time. If they could reach and destroy Antwerp, the Allied offensive could not be supported, and the Germans could reach large scale jet-propelled aircraft production, and bear down on England with V-2's. Time was what RCA needed, too.

During the period of the breakthrough, both the Allies and CBS imposed a news blackout so the attackers would not know the effectiveness of their operations. In both cases the counter-attack started about two weeks after the initial attack.

The fantastic thing about the analogy is that in the case of the Ardennes battle, the Russians started their big offensive in the East about two weeks after the start of the Allied counter-attack. And that was the beginning of the end. In this case RCA may find itself having to cope with a similar offensive on a different front. And who should it be this time but the Russians.

Murphy's memo was more than prophetic. The fact was that I had met with a group of Russians at a color demonstration. After viewing our presentation, the Russian technical committee told me they had decided that Russia should have CBS-type color television. As things turned out, our color system became a major part of Russian TV for some years, and I believe it is still being used for educational and medical purposes.

Finally, during the heat of the color controversy the FCC commissioners announced they would meet on January 30, 1947, and make their decision as to whether to open up commercial television to UHF and at the same time include color, or to wait. In the grasp of this small body of officials was the unique opportunity to expand communications services—indeed, to open a new era. The commission's record in the past had not been good, especially in the case of FM, which it had delayed for fifteen years because of pressure from AM radio interests. Now in my view Denny had the opportunity to do what his predecessors had failed to do, to move communications forward by a quantum jump by opening up UHF.

The night before the meeting Stanton phoned me. I detected an edginess in his voice. "I am not as sure of the FCC decision as I was when I left the demonstration," he said.

"Why?" I asked in surprise.

"I've just talked to Denny. He seems to have changed. He now seems cool to color." Stanton wouldn't elaborate further. I knew he had a built-in antenna for such things, and for the first time I felt a clutch of nervousness in the pit of my stomach.

The following day our worst fears were realized. Denny, the man we thought had been swayed by our Tappan Zee demonstration, announced that the CBS color system was "premature." The FCC reaffirmed the old black-and-white standards in VHF. I was in a labor meeting when Stanton phoned to tell me, and I found it hard to keep my mind on the affairs of the meeting. We felt we had been dealt a foul blow. Everyone in the CBS camp noted cynically that six months later Denny accepted a post as vice-president of NBC, which is wholly owned by RCA. Indeed, members of

industry and the press took to calling him the "invisible vice-president." A subsequent congressional investigation of the affair resulted in a change of FCC rules and an amendment of the Communications Act, prohibiting a commissioner from representing a company before the commission for a year after resigning from the FCC.

For CBS management the decision in March, 1947, was traumatic in another way. Anticipating FCC support, the company was ready to apply for UHF channel licenses in a number of cities where we already had radio licenses. To show good faith about UHF color, we agreed before the FCC decision to withdraw applications for VHF licenses in four major cities, keeping only the license we had at the time in New York City. I must say this was a bold and courageous move on the part of management. It showed the industry that CBS had so much faith in color and in UHF that it was willing to give up something potentially worth millions of dollars. It is interesting to note that RCA public relations decided to interpret our move as "proving" that CBS had lack of faith in the future of television. Eugene Lyons, writing an authorized biography of his cousin, David Sarnoff, said that CBS passed up the TV licenses as an "expensive gesture of contempt."

After the FCC turndown CBS had to scramble to buy the four VHF licenses it had spurned. The owners, smelling a nice gain, boosted the price, and it cost the company tens of millions of dollars. They paid $6 million for one station in Chicago alone, which they might have had earlier for "peanuts." As TV took off, Stanton even offered to buy the ABC Network for $28 million, in order to obtain three important TV outlets. Paley never got over the setback. Years later I

heard it said that he firmly believed that the mad Hungarian in the white coat had cost the company a fortune.

CBS was not the only loser. In my opinion the public's loss was much greater. First, it was cheated out of the opportunity to enjoy color fifteen years sooner. I suppose this isn't important now to a new generation, and some might even consider it a good thing, but the present quality of life is made by the gains and losses of the past. And one should learn from this the lesson that governmental decisions as much as corporate ones must be constantly examined by an alert public if one is to end up with more of the pluses than the minuses out of innovation.

In this case the public also lost the opportunity to explore a new art form available in the UHF range. Indeed, if Denny had not been swayed from his original course, the history of communications would have taken a different turn and many of today's television headaches, such as the battles over allocation of the few available channels, would not have arisen; critics of TV news would have had to seek new subjects for their speeches instead of the charges of monopoly, news bias, and conspiracy, which were inevitable consequences of competitive scarcity. For instance, the greater number of channels that would have been available nationally with UHF would have provided an opportunity to spread more views and approaches to the public, in the tradition of magazines and newspapers. This would have made television more responsible to the infinite variety of the American public interest.

Certainly educational television would have started earlier and possibly with more excitement and on more of an even footing with commercial broadcasting. The second-class citi-

zenship accorded the UHF, which today is hardly known to the public at large, could have been avoided. Who is now aware that with a simple converter he can get on his set at least eight other channels? Of those who are aware of the converter, how many bother to attach it to their sets? Not till 1952 did the FCC allocate seventy channels in the UHF band and make suggestions about educational outlets. The sets and antennas for VHF are everywhere and are more convenient for the public to use. Since UHF came in as an afterthought, the FCC in effect made it a chore for people to tune into most of the available educational TV channels. As a writer in *Fortune* put it, the FCC made a tremendous botch in starting an industry of such importance as television by keeping it down to twelve channels. But, of course, that is 20/20 hindsight.

# 6

# Clash over Color: Medical TV

DESPITE our setback in opening up UHF, in 1948 VHF television took off almost breathlessly. Sets began to sell like proverbial hotcakes, and the more they sold the more it became difficult to monitor the airwaves. For one thing VHF waves aimed at one city would bounce off hills and appear on the sets in another city, interfering with its own channels. People in Oshkosh would tune into channel 2 and hear and see channel 3 from a neighboring town. Confusion set in because there was no careful allocation and distribution of wave lengths to different stations. Obviously, the airwaves were overcrowded. The FCC finally had to step in and exercise its police power before the new medium became a jungle of conflicting air channels. In December they declared a freeze on all television licenses, thus preventing new channels from opening up and bringing the manufacture of television sets to a temporary standstill.

CBS wasn't too concerned over this development. They

were moving ahead in other directions—more important ones to Paley. On radio he had snagged several of the leading comedians of the day, including Jack Benny. The scheme that Paley offered was a tax-avoidance arrangement that was irresistible to the new breed of businessmen-comedians. Paley shrewdly pointed out that the Jack Benny program, the Amos 'n' Andy program, and other such programs that happened to be on NBC at the time could be considered properties in the tax sense. If sold, they would be taxed at the capital-gains rate, which was lower than the rate on individual income. Paley was willing to buy them as packages, and the comedians would gain the benefit of low tax rates while continuing at regular salaries. Beginning in 1948 the big comedians switched from NBC to CBS.

As for me, I couldn't forget color TV. It was a burr in my soul. I just had to try it again. Unexpectedly my chance came in 1948, when Joseph DuBarry, assistant to the president of Smith, Kline and French Laboratories, then a small pharmaceutical company in Philadelphia, called to ask whether I knew of any way television might be used to help teach surgical procedures to medical students. There had been some closed-circuit, black-and-white attempts that had not been effective in expressing the realism of the operating room. In fact, an attempt was made to televise a "blue baby" operation in which the heart is repaired, but in black-and-white it was disappointing to the doctors. Color, DuBarry thought, might hold the answer to electronic medical education.

Here was the missing ingredient needed to propel me back into color television. I was excited once more. Of course, I said I would be happy to do what I could. My colleagues were equally enthused.

The special engineering problems of color television for

use in medicine were resolved, and we soon reached the stage where we had a unique small camera that we were ready to demonstrate to the pharmaceutical company's representatives and to the medical profession as a whole. My associate John Martin had a knack for dramatic programming. He suggested we use a life-size dummy as the patient in surgery for our studies and later for demonstrations. Well, why not?

The dummy we got was a nude female built lovingly by the Japanese out of pink, skinlike plastic. It looked so natural that one of my associates said he felt embarrassed carrying the unclothed model around the lab. Indeed, when "she" was taken out of the taxi in front of the CBS building—where you'd think New York passersby had seen everything—a few of them actually gasped and called the police to report that we were carting the dead body of a nude girl into the upper reaches of CBS. Mike, our big doorman, had to push the crowds aside so the dummy could be hurried inside. Martin personally escorted her to the laboratory, alerting the various receptionists along the way that they might expect a visit from the police.

We propped our model on the table and set about taking her apart, limb by limb, layer by layer. Visions of myself as Dr. Caligari flashed through my mind, as we opened her belly and took out the organs. We televised the entire activity from kidney to liver in color. The telecasts were so realistic that one camera engineer, John Wilner, turned pale and had to rush out, holding his stomach.

I called DuBarry and arranged for a demonstration of our medical television setup. He brought along several professors, including Dr. Isidor S. Ravdin of the University of Pennsylvania, an internationally known surgeon who later became a member of the team that operated on President Ei-

senhower in 1956. The system worked well. The color was superb. Every one of the observers was suffused with praise.

Dr. Ravdin was so enthusiastic that he immediately ordered a setup for the university hospital. We devised a small camera on a long beam that could be lowered over the patient on the operating table by remote control, so as not to interfere with the surgeon. Zenith quickly built us a receiver with a twelve-inch picture tube with a lens. One nice thing that I learned later was that in coming to us they locked out RCA, with whom they had been negotiating for a black-and-white camera.

The first live operation under our camera—in fact, the first live television operation in color anywhere—occurred at the University of Pennsylvania on May 31, 1949. It was a Cesarean section. The members of hospital staff present were enthralled, literally sitting on the edges of their seats. I myself enjoyed the clarity and beauty of the telecast so much that I forgot to be sick over the blood and gore spilling on the screen. The CBS crews got used to watching operations and soon started to make comments on the quality of the telecasts. Dr. Ravdin, a small man who had to stand on a stool while operating, used to come up to the console room and watch the operations performed by his associates. We inserted microphones into the surgical masks, so the surgeons could keep up a running commentary. Meanwhile in the console room a producer would yell, "A little more blue, a little red, fade in," and so on. It seemed terribly callous for us to be concerned with the quality of color while a human being was under the knife, perhaps facing death.

This experiment in Philadelphia marked the debut of closed-circuit color television in medical teaching. Instead of peering with opera glasses from the gallery at a distant oper-

ating table, the students could see everything up close. It was almost as if they were participating in the surgery themselves; in some cases they saw more than if they were assisting the surgeons. Later we took one of our cameras abroad and showed it at the Vienna Fair at the request of the U.S. State Department. Eventually we donated it to my old alma mater, the University of Vienna.

The climax of our medical-television experiments came in December, 1949, during the American Medical Association's annual meeting in Atlantic City. Zenith built twenty color receivers financed by Smith, Kline and French. We set up equipment in the operating rooms of Atlantic City Hospital and ran "shows" piped to 15,000 doctors in sections of the convention hall. Even *Life* magazine, the late, great organ of photojournalism, covered the event.

The operations were so realistic that some of the viewers, including doctors, fainted in front of the television screens. There is something compelling about a human eye in a corneal transplant suddenly pulled out of its socket and looming at you in immense size with a look half intelligent, half unreal, like a monster from another world. We began to measure the impact of our television shows by the number of faintings we could count. Young pages from the pharmaceutical company came along with bottles of smelling salts to revive the unconscious viewers.

CBS received a great deal of praise for the medical-television work. Congress said we had made an important contribution to mankind. The press gave us accolades. Morale at the labs picked up. We actually thought that we might sell cameras.

Interestingly enough, this seed demonstration grew through the years into a major innovation. In 1951, for in-

stance, the first transcontinental color telecast occurred, in which a twenty-year-old Los Angeles man named Richard Russell was operated on for a constriction of the aorta. The surgeon in Los Angeles reported what he was doing to listeners and viewers in New York, who in turn asked questions heard in Los Angeles. Some years after this breakthrough the first color-television treatment of psoriasis took place in England and was Telstarred to Maine and relayed by microwave to Washington, D. C., where the International Congress of Dermatology was meeting. Telediagnosis appeared in the fifties, followed by telecasts of surgery in countries throughout the world. Two dozen babies during the next two decades were born on camera.

When we got home from Atlantic City, however, flushed with the doctors' praise, Murphy phoned me. At first he was full of compliments. Then he paused, as if to think over what he had to say next. Then it came. "Bad news, I'm afraid," he said. "The chairman has decided he has no further use for the lab. He'll give you just thirty days to shut down—and lay off the personnel."

I couldn't speak for a moment. "Why?" I finally managed to whisper.

"I guess the chairman simply feels there's no more purpose in the lab for CBS," he replied lamely.

I slowly hung up the phone. How could I tell my staff that after years of sweat, of cleverness, of devotion that enabled them to create something useful and important, their reward was that CBS no longer wanted them? I just couldn't pass on the message. What could be done? I went to see Murphy and pleaded with him for a ninety-day delay, so I might find a buyer for the laboratory or get someone to subsidize our expertise. Murphy, perhaps somewhat shaken by the intensity

of my feeling, must have convinced Paley because I didn't hear anything further. I decided not to say anything to my staff.

Evidently I had bought time, but I had the unhappy sensation of living with a gun at my head. In order to save the laboratory I had to come up with something big and important in a hurry.

# 7

# Clash over Color: The Onslaught

THE next few days and nights I prowled the laboratory like a caged animal. When my staff spoke to me, I didn't hear what they were saying. My mind was dark with resentment. How could Paley have so little feeling for the lab, for the staff, or for the simple fact that we'd built a team that had brought prestige to CBS and could, we thought, also contribute substantially to profitability. Since Paley's cash register was not clanking at that instant, however, we had been sentenced, shackled, and beaten down without a chance to enter our plea. At night, before I fell restlessly asleep, I tore through the paraphernalia of my brain, seeking to press it for ideas that I could build confidence in, enough confidence to sell others and to save the laboratory from extinction.

Only a few members of the staff knew what was happening or what I was up to, but I am sure they sensed that something was amiss. There seemed to be an air of depression around the laboratory. Some of the staff, perhaps weary of life in the

corporate jungle, left for other jobs. John Martin, my able assistant whom I had sent through the special color school I had set up at CBS for employes, resigned to enter the priesthood.

What? What? What? Suddenly I remembered that in Atlantic City during the medical convention several members of the FCC had come up to me and bemoaned the unhappy fate of color broadcasting. I was surprised to learn at the time that color had more support than I realized despite the commission's decision against it in 1947. This set me to thinking that if CBS brought color back to VHF, as they had before the war, instead of to the more controversial UHF band, the FCC might possibly urge me to come back at them with another proposal for a license. In a flash it occurred to me that by a simple mathematical transformation of the video signal, I could put color into the VHF band and make it sharp, with even greater clarity than before.

Here was a path to pursue, something positive to work with. I quickly brought my dwindling staff together, and we took the problem apart, element by element. The net result after a month of weight-losing, intensive concentration, and frenetic activity was the development of a new method of broadcasting color in the low frequencies and at the same time making the image crisper than it had been. We called the sharpening process "crispening," and it later became of considerable importance in the television industry. Briefly, what we did was to electronically enhance the signal to emphasize the image sharpness over the rest of the information carried in the signal. It worked well. I called in my boss, Adrian Murphy, and told him I hadn't found a buyer for the lab, but we had something better—an invention.

We showed him our new color and compared it to stand-

ard black-and-white in the same channel width. He broke into a smile. "Absolutely great," he said. "I'll tell Stanton immediately."

I cannot say that this engineering innovation took the upper offices of CBS by storm, but my timing was right because it came when there was some renewed public interest in color. Word of the success of the Atlantic City medical telecasts had spread, and suddenly increasing numbers of people wanted to know why special groups were being favored with color, while the public had to wait. A Senate subcommittee was convened to look into the matter, and delegations visited Paley to ferret out his intentions on color. The chairman evidently succumbed to their interest in color because the ninety-day order to phase out the laboratory suddenly evaporated, at least for the moment.

From then on things happened fast. The chairman of the FCC, Wayne Coy, a former *Washington Post* executive, who had taken over the job from Denny, invited us to the capital to demonstrate the color system before the full commission, and suddenly we were all aware that color was "in" once again. The demonstration was so good that CBS took out full-page ads announcing color shows in Washington. On January 12, 1950, the first public broadcast of our new color resulted in fantastic response. Senator Edward Johnson, chairman of the Senate Commerce Committee and a "color-now" advocate, promptly demanded that the FCC clear the way for color before the public became saddled with black-and-white sets.

With important politicians in the act the color cause developed cloak-and-dagger overtones. Dick Salant, then a legal assistant of Sam Rosenman and now the president of CBS News, Adrian Murphy, and I formed a triumvirate operating

in secrecy. To conceal our relations with Washington, we never took the Pennsylvania Railroad from New York because the press and RCA spies might wonder why. Instead, we took a circuitous route over the Baltimore and Ohio. When we arrived in the capital, we registered incognito in a small hotel and held meetings with various influential senators. I might add that these undercover precautions made little difference. The next day we read about our meetings in the papers.

Meanwhile the RCA-NBC troops down the block in fortress Radio City and in Princeton, New Jersey, the headquarters of RCA research, were growing restless. RCA announced that they too had developed color, compatible with black-and-white and able to go directly into black-and-white sets, the number of which, incidentally, had jumped to 2.5 million in five years and was growing at the rate of more than a million a year. Unlike our system, no additional converter would be needed, RCA pointed out. So far as I could determine—from preliminary revelations made by their engineers —RCA color at this stage was not very good, and I thought they were putting up a bluff. The FCC, however, had no choice but to examine the RCA system and compare it with ours, along with another system from a small West Coast firm, Color Television, Inc., which had suddenly emerged in the running with its own brand of color.

The FCC called for a demonstration in September, 1950, and almost immediately the pressure groups became intensely active behind the scenes. A few days before the demonstration, for instance, the Radio Manufacturers Association warned the FCC to go slow in accepting color to protect the investment of the black-and-white set owners, giving the impression that the public would be caught with useless sets

in their homes. (Within one year the same warning would be issued to protect 7.5 million owners, then 9 million, and finally 12 million.)

Of course, I felt it was not quite true that black-and-white television was in danger of going out of business because of color. A simple converter—consisting of circuit changes in the system along with a spinning disc of three color filters mounted in front of the screen—would place CBS transmission in color and thus give the black-and-white set owners an additional option if they wanted it. The anticipated costs were reasonable in terms of total outlay for television equipment; we hoped in time that the converter would sell for perhaps $100. Black-and-white television sets were then selling for about $300 to $500.

With this background we all arrived somewhat excited with anticipation at the FCC offices. In a large, square room all three competing sets were placed side by side, like athletes at the starting line. A spokesman for the commission read us the ground rules. The sets had to receive color simultaneously from New York by coaxial cable and from Washington over the airwaves. Each broadcast had to be transmitted in six megacycles, and the color pictures had to be sharp and true.

My nervousness at the demonstration two years earlier was compounded now; I felt like a limp paprika. It didn't contribute to my sense of well-being to learn that Paley in his penthouse office at 485 was overviewing the activity with generalissimo interest, one finger on the button to release money and the other on the button to fire those white coats.

The results of the demonstration can best be described by the headline in the next day's copy of *Variety*: RCA Lays Colored Egg.

How superbly true. While CBS color behaved beautifully, with Patty never lovelier, RCA's three-tube electronic device shifted shades "like a crazed Van Gogh," as *Newsweek* described it. "It took the color on the wrestlers and spread it across the bodies and gymnasium wall." I remember that in a preliminary demonstration a bowl of fresh fruit contained green cherries and blue bananas. Why RCA had decided to enter the contest under these conditions I never really knew, though later they were to excuse themselves by saying that their "coaxial cable was preempted by Far East expert Owen Lattimore, who at the time was testifying before a congressional committee on his alleged communist connections." Without the cable RCA claimed they had to resort to a makeshift arrangement that ruined the broadcast. The third firm—Color Television, Inc.—also failed to produce satisfactory color and was dismissed from the running.

CBS had won what was the first major prize in the color fight, a commercial license to proceed with color TV, and in October, 1950, Paley, the impatient antitechnologist, found himself with an exclusive franchise in a device made by the latest technological research. November 20 was set as the date for the debut of CBS color.

RCA did not waste time bringing the fantastic resources of a quarter-billion-dollar corporation to bear against CBS and the seven-member FCC. General Sarnoff ran the opposition like a military campaign. Ads, rumors, noise, confusion, and then attack on two fronts. Gathering strong industrial forces on his side—industry had a big stake in black-and-white—the General took the FCC to court in Chicago to try to reverse their decision. At the same time he lashed out at the members of the commission, declaring they were working against the public interest in adopting what he called a "de-

graded" system. Fulton Lewis, Jr., a well-read columnist then, snidely pointed out Wayne Coy's connection with the *Washington Post*, which owned a CBS station in Washington. Demands to investigate the FCC were raised in Congress. In Chicago, Hallicrafters Co., a maker of radio and TV sets, ran an ad with the headline: FIVE MEN AGAINST THE AMERICAN WAY.

While the General and his friends kept the FCC on the run, they launched a second front against CBS. A million-dollar kitty was set up by the Radio and Television Manufacturers Association to finance an "educational campaign" (that is, to inform the public of the General's truth as distinguished from the CBS and the FCC truth). RCA broadsides found space in friendly newspaper columns and articles. The CBS system was described as a Rube Goldberg device "that looked like a bicycle and ticket chopper hauling a small suitcase from the fireplace to the hall closet." One Bible-oriented cartoonist showed color TV in the shape of a serpent in the Garden of Eden. Decorators were described as being puzzled over how to incorporate the CBS system into the decor. Even manufacturers whipped up by Sarnoff joined the campaign against the FCC and CBS—in fact, one of their strategies was to saturate the market with as many black-and-white sets as they could, so as to gain time against color.

Every slight victory that Paley managed to wrest in the press would only stimulate the General to send fresh troops into the fray. It had the earmarks of the Vietnam War, with Johnson pouring in new troops and bombs every time North Vietnam dared raise its head. At one point Stanton urged unity in the industry, but such peacemaking overtures had little effect. In fact, one newspaper reported that Sightmaster Corporation, a New York TV manufacturer, sued Stanton

for $750.000 for "his misleading statements," which it was alleged had led the manufacturer to discontinue making sets.

The public, of course, was noticeably confused. On the one hand, Stanton cautioned potential television set customers to wait six months before buying their sets so they could take advantage of color. On the other hand, the RCA forces shouted that the customers better buy their black-and-whites now and forget CBS color, which wouldn't work and was too expensive. Senators got into the act, saying the manufacturers were on a sit-down strike and urging them to get together. The biggest issue of the day was to buy or not to buy. Cartoonist George Lichty ran a panel showing a group of unshaven radicals in a meeting with one talking. The engaging caption: "It is difficult arousing downtrodden masses to revolt. Comrade, when all they think of is whether to wait for color television or buy now . . ."

Some reporters began to investigate the effect of color on those behind the screen. It was said that platinum blondes who did well in black-and-white would suffer in color, while redheads would win points. Costume supervisors began to worry about their wardrobes. Men were expected to flare out in dazzling plumage, but the comedian Fred Allen had the last word: "It won't bother me," he said. "I don't blush."

In the midst of all this hullabaloo the RCA case came up in federal court in Chicago—the same day that CBS presented free color television to the public in New York, with carrot-top Arthur Godfrey as the center of attraction. I suspect CBS was going to show that the people cared, even if industry did not. And indeed, the public response reported in the newspapers the following day was great. The *Wall Street Journal* headlined a "smash."

The atmosphere in our lab was now charged with excite-

ment. Many people made it a point to tell us that the colors were beautiful and they could hardly wait for regular color broadcasts. In the midst of this adulation we learned that the court had granted RCA a temporary injunction and that our first color telecast scheduled for November 20 would have to be delayed until the court studied the data and made a decision.

RCA, meantime, was working feverishly on its compatible color system, and early in December they were actually able to show improvements. *The New York Times* TV columnist, Jack Gould, an objective and well-regarded reporter, wrote on December 10, 1950, that RCA color was almost as good as CBS color and suggested that the FCC might have pulled a boner in its premature approval of the CBS system. That opinion caused us some uneasiness, and we multiplied our own efforts to seek out a compatible method that we could apply to black-and-white. Despite the public clamor and its oversimplified way of looking at the controversy, we felt that we would eventually find an electronic substitute for the color disc and move into compatible color. In our view that futuristic hope had nothing to do with providing color now.

I must admit to a certain admiration for the cockiness of General Sarnoff. He was plucky, no doubt about it. Before he was through with the color war, he was to pour $150 million into color-television research and development—the highest investment up to that time on a strictly private industrial gamble. Sarnoff offered his engineers prizes as high as $10,000 for any breakthrough in the color field. Some men are said to have suffered nervous breakdowns because of the competitive strains. I wonder if it was worth it?

In that December, however, the FCC didn't agree with

Sarnoff's own glowing estimate of RCA color television, but did suggest that if a suitable compatible system were developed, it could be adapted to the CBS receiver. In fact, the FCC asked RCA to turn over its blueprints, technical data, and test models of the three-color tube to CBS in the public interest. The president of RCA, Frank Folsom, issued a scathing reply, in which he said it was like asking the Yankees to turn over Joe DiMaggio to the Phillies just before the World Series. (This was before CBS acquired the Yankees; I am sure RCA wouldn't have minded if it meant that CBS would lose the ball game.)

Meanwhile, on December 22 the court in Chicago handed down its decision, one of those decisions that enabled both sides to see in it signs of victory. In effect the court let the FCC decision stand, but it continued the delay on public broadcasts, pointing out that manufacturers couldn't go ahead anyway because of the Korean War. One of the materials needed in the magnets used in TV, cobalt, was on the critical list of war materials.

Actually, the court had ruled against Sarnoff. In March, 1951, the General carried what he considered his righteous cause to the U.S. Supreme Court.

The color battle had finally reached the highest court of the land. I am sure Paley was as amazed as I was to find ourselves sitting in a pew amid the tall columns in the solemn antechamber, where decisions on slavery, war, the rights of man, and the very fabric of our civilization were debated and decided. Paley, Stanton, and I were sitting in the back behind Sarnoff and his associates. Suddenly as one of the judges was cupping an ear to the attorney's brief, Sarnoff turned around to Paley, and I heard him say: "Bill, we could have avoided

this headache if I had hired Peter in the first place." I must admit that there were some dark moments in my CBS career when I wished that Sarnoff had done just that.

On May 28, 1951, the High Court handed down its decision, which said that the FCC had acted properly within its mandate, thus letting the commission's decision stand. In effect, this was a victory for CBS. We had taken on the great Sarnoff, the king of Radio City, and won. CBS was no longer a tiny enterprise but a major power—David (the biblical one, not Sarnoff) had beaten the Goliath of industry. We trumpeted our victory from the pages of every important newspaper in the country. Paley okayed announcements of the coming of color with an intensity and efficiency that might have been matched only by the coming of that more august Personage. We were set to go.

Even though he denied it, I think Paley came away from the decision a transformed man. He had just trumped the General in the place it hurt—the prestige belt. He was also outsmarting the General at the money game, having become notorious for his ability to raid NBC of its radio and TV talent. Now I think he wanted to exercise a secret ambition—to become a manufacturer. I always had felt that despite his jet-set executive veneer, Paley secretly admired Sarnoff's propensity for empire-building, his Horatio Alger adeptness in creating an industry. I suspect that Sarnoff, on the other hand, may have been secretly jealous of Paley's urbaneness and easy social graces.

The first glimpses of the new Paley as a manufacturer came from Adrian Murphy, who one day asked me to look at the technical expertise of a Brooklyn electron-tube manufacturer, Hytron Radio and Electronics Corp., and its set-manufacturing subsidiary, Air King Products Co., which was then

making sets for Sears Roebuck and Montgomery Ward. Paley apparently was thinking of entering the TV business through merger.

I shot out to Brooklyn to see Air King's set manufacturing and then to Newburyport, Massachusetts, to look over the firm's tube plant, and I came away with the feeling that the company knew how to make excellent tubes and TV sets at low cost. It was in fact the fourth largest manufacturer of radio and television tubes in the country. But I pointed out in my report to Murphy that if we did go into manufacturing, we should not attempt to emulate Zenith, which was noted for high quality in engineering and manufacturing, without a base in research. Accordingly I urged that we marry our own research organization with the expertise in manufacturing of Hytron and Air King by creating a central research division to serve the entire corporation, including the manufacturing arm. I suggested also that we retain Sears as a customer because it would force us to maintain the quality of manufacturing.

Paley was hypnotized with Air King. So was Stanton. Both men personally traveled to Brooklyn in chauffeur-driven limousines and became involved like goggle-eyed kids with the style and coloring of the sets and what knobs and ornaments to use. Long discussions ensued over the answers to such questions as should the tuning be horizontal or vertical? I guess if you're in the entertainment business, you carry these small superficialities wherever you go. It seemed incredible to me that two of the leading communications figures in America should be spending so much time fiddling with dials and knobs.

The only other time I knew Paley to be so deeply enamored with operational minutiae occurred when he trans-

formed himself into a restaurateur of haute cuisine and fathered the Ground Floor Restaurant in CBS's new headquarters on the Avenue of the Americas. Paley frequently poked into the kitchen, personally checked the chef's specialty, and read the menus; it was said that he would fire the maitre d' if his wife, Babe, found fault with the food. Interestingly enough, despite this lavish personal attention on the part of Paley, his wife, and his socialite friends, the Ground Floor never reached the upper stratum of New York's great restaurants.

To return to Hytron, Paley loved his new role as a manufacturer of TV sets, and the acquisition went through smoothly. The Coffin brothers, who owned the Hytron and Air King firms, became overnight millionaires and members of the CBS Board of Directors. Dave Cogan of Air King and Stanton became inseparable. Being market-oriented, Paley brought in from Zenith a merchandiser of considerable reputation, Henry Bonfig, and made him head of the new CBS–Columbia Manufacturing group. Dealerships were created to market the sets. Stanton now loosened up the corporate structure to develop semiautonomous divisions—tubes, sets, radio, TV, research—each charged with being a profit center. This proved in my later years at CBS to be a mixed blessing.

Meanwhile Paley brushed aside my suggestion about establishing a central research facility ("We're not in industry," he said; "we're broadcasters"), and my other proposals about Hytron got equally short shrift. During the course of the many meetings that ensued, I called attention to the development of the transistor—beginning shortly after it had been announced by Bell Telephone Labs—and said that the tube business could well become obsolete if the semiconductor (a tiny crystal that does the same job as a tube) lived up to its

incredible potential. I urged the company to let the labs get into semiconductor research.

At one meeting Paley turned to Cogan and the Coffins and asked them if they believed in my suggestion of the need for the company to finance research in semiconductors. They said no. Paley then asked Charles Stromeyer, the Hytron chief engineer, for his opinion. "The transistor is a toy," said Stromeyer. "It will never beat the vacuum tube." Stromeyer for his vision was later awarded the presidency of Hytron.

In my opinion CBS made many wrong moves during this period. For one thing, the company stopped manufacturing for Sears, which I thought was silly, and they bought a semiconductor license from Philco, which involved a tremendous investment. Had Paley listened to my imploring, the future of CBS might have taken a different turn. We could, in fact, have led an industry that subsequently was to break out on the West Coast and to make fortunes for Fairchild, Texas Instruments, Motorola, and many others. It is interesting to note that all the big, old-time firms, including GE, Westinghouse, and RCA, failed to take the lead in the semiconductor business, leaving it to a group of young Turks to establish the companies that turned the semiconductor industry into an integral part of the American corporate scene.

In a few years vacuum tubes began to disappear in radio and television sets, as everything became transistorized. When Paley finally unloaded Hytron in 1961, it was an empty shell. Because I had recommended the acquisition, I again became known in Paley's book as the man who "almost ruined CBS." Some reports had it that Paley dropped $50 million on color television. Paley never got over it. I recall a story told me that Bill had grown so rich that his mother didn't know what gift to give him for his birthday.

Being a wise woman, she finally offered to get him a valet and left a note saying, "This is to remind you that you should never do for yourself what others can do for you." I wish Bill had taken that advice to heart.

The great obstacle in television's accepting new technology is the personality of the broadcaster, and the world in which he lives and operates. Don't forget it is he who built a big business out of nothing. Who is he? I think he can be well defined. He is somebody whose life, training, and daily involvement center around taking a very expensive, precise, but short and ephemeral offering and making it appealing, not to just millions but to tens of millions of people. This is the framework that characterizes the world of the broadcaster. To be successful you have to have developed the expertise or the luck or the stamina to put together such a package and cram it into an incredibly short space of time. At the same time you are bound by regulations. So if you succeed at what is the fastest game in town, you are somewhat unique.

Now, it is virtually impossible to do this consistently—to stay on the tightrope and not fall off requires twenty-four hours of concentration and involvement in those problems that constantly bombard you from the public, from competitors, from state, federal, and local governments. You are literally functioning in a goldfish bowl, where you have tremendous visibility because of your success, and because you are highly visible you are vulnerable.

The personality that is successful in this kind of world is not necessarily the type capable of coping with changing media or long-range planning, particularly because broadcasting is a quick-turnover commodity where your guesses, plans, and gambles pay off or fail to pay off in an incredibly short time, sometimes weeks, hours, even minutes. In other

industries, where you are not dealing with time and rapid turnover you can have investments as long as a year and your returns come back in dribbles. The life cycle, the time periods, and hence the way of life in most American industries is quite the opposite of broadcasting, and I don't think therefore that the broadcaster is adaptable to the way of life of new technology.

In retrospect, it was just as well that we hadn't plunged deeper into color TV manufacturing than we did. Larger events had intruded on the television picture. As mentioned earlier, the Korean War had made it difficult to obtain certain materials necessary for the mass manufacture of color TV sets. Meanwhile RCA worked hard at improving its "compatible" system and did. In 1953 the FCC reappraised the color situation and made an about-face. They threw out the CBS color-wheel system and approved a modified version of the RCA system. (Ironically, it was then that Sarnoff's real travail began. It took RCA years to bring color into public acceptance, but the General did manage to see it become a reality before he died.)

Stanton informed me that Paley was bitter over the FCC decision. So once again the fate of the lab hung in the balance. Instinctively I knew it was a rerun of the old film. I had to come up with something positive and new or move on. Was it possible to sell the lab, remove it to another corporate nest, as other groups were doing during the 1950s? With Stanton's approval I called up various people to see if they could use our talents. Our staff numbered about 150, and we could count expertise in sound, video, solid state, and other fast-moving electronic specialties.

One of my calls struck a bull's-eye. Dick Hodgson, president of the Fairchild Camera Co., was intrigued with the new

science of the period, and on behalf of Sherman Fairchild, the eccentric millionaire founder of the company, he was investing heavily in the new miracle semiconductors. He was interested in our research expertise and subsequently called back to say he'd like to buy the lab from CBS and build us new quarters in any area we designated. I told Stanton I was developing an interesting deal, in which CBS would make money out of Fairchild. Paley's wish to get rid of us would be fulfilled, and I would run a lab to handle advanced research for Fairchild.

The word reached Paley like lightning, and the thunder from on high was immediate. "Not on your life," said Paley, the arch-entrepreneur. "If the lab is good enough for Fairchild, we'll keep it."

So at 485 I found myself nodding to Mike, the doorman, and taking the elevator to the tenth floor as usual, where I continued to dwell on ways of beating the RCA color system, the chief irritant in CBS's eye. I had always resented Sarnoff's public-relations ploy in demeaning our color system by calling it a "horse-and-buggy mechanical system" as compared to RCA's "progressive, all-electronic system." We always knew that if a good color tube ever became available, or if we came up with one ourselves we could apply it to our system. But at that time there was nothing practical either from our lab or anywhere else, and I didn't think much of the RCA color tube demonstrated at the various FCC hearings.

The idea behind the color tube was reasonable, of course. Remember that in black-and-white television the screen of the tube glows only in shades of white, when electrons strike it, but in color TV the screen glows red, blue, and green—the three primary colors needed to generate a color picture—because of the fluorescent materials in the screen. The eye

mixes the colors. Knowing this, the engineer has to paint the TV screen uniformly with a mosaic of millions of tiny phosphor dots, divided into groups of red, blue, and green, and to arrange for firing electrons at the screen in such a way that the proper colors result. This is done by three separate electron guns: a red gun bombards only the red phosphor dots; a blue gun, the blue dots; a green gun, the green dots. The intensity with which the phosphor dot is struck determines the shading of color. Incidentally, at the proper intensity the colors can add up in the eye to white, or, in the absence of any signal, just black, thus making the color-television set capable of producing black-and-white.

In operation the studio television camera uses colored filters to separate the three primary colors and transmit them in the form of electronic signals to trigger the electron guns in the picture tube of the color sets. The problem is, how can you ensure that each gun will automatically strike the right color dot? RCA consultant Alfred N. Goldsmith had cleverly devised a mask pierced with holes to be placed in front of the phosphor screen, so that the electron beams going through them are thwarted from striking all but the proper color dots. In this way the three primary color images are fired simultaneously across the face of the phosphorescent screen, creating the color picture that reproduces the one taken by the camera in the studio.

That was the theory, and it was sound. But from the instant I had seen the RCA pictures at the FCC demonstrations, I knew that the tube then proposed by RCA was impractical for mass production. The phosphor screen and the mask—a perforated, flat, metal foil—were clamped together, a fraction of an inch apart and installed in the glass envelope, in a kind of sandwich, and then pumped down. In manufac-

ture the foil, nicknamed the "drumhead," had to be mechanically stretched so that its perforations would remain exactly matched to the positions of the red, blue, and green phosphor dots; there were 1,200,000 dots and 400,000 holes in the mask, which had to be carefully aligned for each individual tube or the image on the screen would be wildly distorted. I didn't think RCA would get anywhere for quite a while, if ever, with this sandwich system, because it was expensive, it limited picture size, and the maintenance of matching was too critical, and I so testified at the 1953 FCC hearings.

I asked myself, could you place the color phosphor dots on the inside surface of the glass envelope, just as you do with a black-and-white tube? That would eliminate the need for the tricky sandwich construction. One approach to the development of an electronic color tube had already come to CBS from Berkeley, where Dr. Ernest Lawrence, the Nobel Prize-winning inventor of the cyclotron, was working on color tubes in his spare time. The tube he developed (which, by the way, led to Sony's excellent current color tube) used stripes instead of dots, which are laid down by silk-screen technique. But it also used a flat sandwich construction that suffered from critical alignment problems. Nonetheless, we at CBS felt it was on the right track and we set out to modify it. Ironically, we had completed our modification just as our system was turned down by the FCC.

I thought we could improve on this method for manufacturing and hired Marshall Wilder, an MIT graduate who came to me with the seemingly wild idea of using a photographic method to make the phosphor pattern match the pattern of holes in the shadow mask. Actually, Wilder's idea came from photoengraving. You deposit on the faceplate phosphor together with a material known as photo resist,

which is affected by light. With the aid of light from the red gun, you project a test pattern through the mask onto the faceplate. After washing the plate with developer, you are left with a distribution of red phosphor specks in the same pattern as the projected holes in the mask. Then you follow this procedure with blue and with green.

I approached Paley for funds to pursue this method, but Stromeyer, the chief engineer at Hytron, thought the idea was preposterous, so Paley turned us down. We went ahead anyway, with bootleg material scrounged from scrap or bought with petty cash. After the method of laying down the phosphor dots was successfully devised, the atmosphere at CBS changed radically. Stromeyer set up a group to pursue the idea further, and two Hytron engineers, Norman Fyler and William Rowe, came up with the currently used curved-screen curved-mask tube, which they patented. It produced better resolution at the edges of the picture and provided better viewing. So the "way-out" methods suggested by us and developed almost surreptitiously in our laboratory took on respectability as they succeeded, and I learned once again the wisdom of an old cliché, that it always pays to follow your hunches.

When it came out in the mid-fifties, the curved shadow mask from CBS stopped RCA dead in its tracks. They gave up their own research efforts on their color tubes and agreed to accept our license for the next seventeen years (the patent expired in 1971). So the irony is that the company that stopped us from color and invested a fortune in developing the so-called "electronic color system" ended up by having to pay their arch-enemy, CBS, a substantial sum in royalties.

In later years, through the efforts of John Christensen at the labs and attorney Milton Neaman in corporate head-

quarters, CBS formed a legal team to extract a formidable income for the labs through patent-infringement suits. So in time, and slowly, management came to recognize the contribution of the shadow mask. Meanwhile, a new era was emerging for CBS as a result of something else we had been secretly working on—the long-playing record, or LP.

# 8

# The LP Caper, or the Case of the Missing Fuzz

WHEN social critics pounce on technology as the modern equivalent of the devil's work, I think very happily of the long-playing record. Here is a piece of pure technology, a combination of invention and development, that resulted in something fine and beautiful. Is there a critic of technology anywhere who can point a doubting finger at the LP?

The LP has brought delight to people around the world. In Siberia Russians in mukluks enjoy the sound of Shostakovich; in lonely military bases GIs occupy the slow-moving hours listening to current pop; indeed, in deepest Africa there may be blacks who listen entranced to Nat King Cole. What was it the poet Howard Nemerov wrote about Casals' famous recording of Bach on an LP?

> Deep in a time that cannot come again Bach thought it through, this lonely and immense reflection wherein our sorrows learn to dance.

And deep in the time that cannot come again Casals recorded it.

Playing it back, and bending now over the instrument, I watch the circling stillness of the disk, the tracking inward of the tone-arm, enact a mystery wherein the music shares: how time, that comes and goes and vanishes never to come again, can come again.

Not only music of any era, but lectures, language instruction, sounds of distant lands and of strange objects, of birds, heartbeats, cries of babies, even conversations on the moon, all have emerged from this circular phonograph disc. The long-playing record has captured it all, from the words and music of the immortals to the utterances of dictators, presidents, and kings. Who can forget the ringing tones of Churchill as he rallied the British people in World War II, or the eloquence of Ed Murrow's CBS wartime reporting in "I Can Hear It Now"? Naturally this has helped make CBS one of the largest communications enterprises in the world; since 1948, when the LP was introduced, the LP and its broodhave grossed more than a billion dollars for CBS alone. Today more than one third of CBS's yearly income from its record business comes from long-playing records.

My initial interest in the LP arose out of my sincere hatred of the phonograph. All my life I had what we engineers call zero response to the phonograph, because it seemed to violate what I thought the quality of music should be. I am sure Thomas Edison never thought of it just this way, but to me the phonograph was a machine that learned how to talk but never learned how to make music. During World War II, while I was in England, one of my Army friends kept playing a phonograph in his room over and over. He listened in apparent rapture to what I thought were the most appalling sounds to emanate out of any machine—tinniness, scratchi-

ness, and clicks—all mingling with the music and adding up to one discordant mess. To my ears it was so bad that I had to find an excuse to leave every time he turned on the machine.

This unpleasant experience came back to me one evening in the fall of 1945 shortly after VJ Day, when I was visiting two Westport, Connecticut, friends—Helen and Mack Morgan. When these two richly talented people weren't making their own music, they were absorbed in listening to records. After dinner they played a new recording of Brahms's Second Piano Concerto, rendered by Vladimir Horowitz, with Arturo Toscanini conducting.

In the midst of listening to the first movement of this record, a terrible thing happened. There was a click, silence, and strange noises, and then the movement continued. This happened again and again. I counted twelve sides for the four movements and eleven interruptions, of which eight were unplanned by Brahms. So eight abominable times during the rendition I was in turn enthralled and jarred, like having the phone ring at intervals while you are making love. Gritting my teeth, I asked my friends to play the concerto through a second time, only to relive the horror. There was no doubt in my mind that the phonograph though in far better technical shape than the one in the Army was still murdering Horowitz, Toscanini, and above all Brahms, and I felt somehow impelled to stop this killer in its shellac tracks.

That same night I asked myself why records had to be as bad as they were. I hadn't the foggiest idea of how to produce good sound; the state of the art of good recording and reproduction was not well advanced in 1945. I simply had an instinctive feeling that the sound one hears directly in a con-

cert hall should be and could be duplicated in quality and timbre by technology.

So as a first move I took out a pad and pencil and set down a few simple numbers; the wavelength of sound on the record, for instance, the cause of distortion in the sound, the speed of the record, and the length of playing time.

I asked myself, what is the principle of the phonograph? How is sound captured in a record and held there? When music is played, or when someone is speaking, the sound vibrations travel through the air to a microphone that converts the vibrations to electrical signals. These signals are then amplified and fed to the recording head, where they are converted to mechanical vibrations of the recording stylus. The vibrating stylus then cuts a wavy pattern in a rotating wax or lacquer plate, called a master disc. The pattern cut is actually a picture of the sound waves—one can see them under a microscope. A sound of high pitch, for instance, causes the wiggles to be bunched together; a sound of low pitch causes the wiggles to be wide-spaced. The wax plate is used as a master from which the records that go to the public are pressed.

To complicate matters further, to get sound from a record a needle on the phonograph must move along the track and follow the wavy pattern. The pattern produces vibrations in the needle of the same pitch and amplitude as the original. These vibrations are converted by the pickup cartridge to electrical signals that are sent through an amplifier to be emitted from a loudspeaker as the sounds that made the trace in the first place.

The duration of the recording is determined by the record diameter, rpm, and the number of grooves per inch in which the needle operates. I counted eighty of them to the inch in the Brahms Concerto simply by placing a ruler across the rec-

ord. Obviously, if you want to add more playing time, you can decrease the revolutions per minute at which the table is turning, or you can increase the number of grooves per inch, or both. To change the rpm is a simple matter of mechanics, but increasing the number of grooves is a difficult problem involving record material, stylus design, and a host of other factors. Finally, the quality of the record is determined by the ability of the stylus to follow exactly the pitch and amplitude of the music, and that in turn requires a record material that will faithfully capture the movements of the stylus.

By the time the evening was over I had worked out a set of numbers and a set of characteristics that I felt would be desirable in order to reproduce Brahms or anything else as it should be reproduced. And so the CBS long-playing record was born in my mind.

The vision of such a magnificent record kept me awake most of the night, and the next day I looked up Jim Hunter, a friend who was chief engineer of Columbia Records. Would he take me through the company's record plant in Bridgeport, Connecticut, and show me exactly how records are made? He would and did.

It was a fantastic sight. As far as the eye could see—if we could see through clouds of steam and dust—there were rows of shellac presses noisily turning out thousands of black discs of Brahms, Beethoven, and Glenn Miller—all 78 rpm. Records were stacked everywhere amid containers of shellac. Along the side were little cubicles where records were checked for defects. Workmen dashing in and out contributed an air of urgency to the entire operation.

One thing I remembered very clearly from this visit and from followup visits to the broadcasting operation in the company was that CBS recorded everything that went on the

air on a standard lacquer transcription disc, which rotated at a speed of 33⅓ rpm. There is nothing holy about this speed or about the diameter of the record, which was sixteen inches. I thought that the transcription was a good starting point from which to build a long-playing record, though I want to clear up an erroneous impression that has developed over the years, that the speed is the essential fact in long-playing. It isn't, as we shall see later. The important underlying development of the long-playing record was a combination of factors, of which the speed of the record was only one.

Incidentally, I never found out exactly how the figure 33⅓ was chosen, and over the years nobody asked me or seemed to care.* For that matter I never knew the origin of the 78, nor could I find a written record of how this speed was derived.

After my tour of the Columbia factory Jim took me to see his boss Edward (Ted) Wallerstein, an assertive fellow, full of self-importance, who ran Columbia Records. Wallerstein had been hired out of RCA by Paley because it was reputed that he was the best phonograph salesman of his day. He listened to me patiently for exactly three minutes, put an arm around my shoulders, and suggested in a fatherly manner that I should drop the entire project and do something in the television line instead. RCA, he pointed out, had toyed with the 33⅓ record for the consumer and had gotten nowhere. That was his final word to me on the matter.

Such a patronizing attitude drove me harder to ferret out a way to accomplish what Wallerstein and RCA believed was impossible. I checked RCA's work and found that they had tried to tackle the long-playing record, but all they had ac-

* Only lately I discovered that in the early movie days a man named J. P. Maxfield settled on 33⅓ because it enabled the background music in theaters to run as long as a standard movie reel.

complished was to slow the 78 down and make it worse. The idea was to slow the record down and make it better.

I looked deeper into the recording industry. Many manufacturers had huge investments in the business of pressing shellac records. Like Columbia's setup, the typical factory was steamy, dusty, and smelly, something out of England at the turn of the century, I would imagine. Moreover, nothing had ever really happened in the U.S. to change the quality of the records, and the feeling in the industry was that nothing ever would. The record industry was like the bicycle business at that time—seemingly immovable, unchangeable, like Gibraltar.

As I continued to probe, I found only a few major technical papers notably by acoustical scientists at Harvard and Bell Labs, who had tried to provide some foundation to the scientific aspects of sound recording. But in the industry itself, almost everything had been done by trial and error since the days when the gramophone had emerged from Edison's fertile brain. The record business was, in short, a hell of an area for a young man to try to make his reputation, or even to do something to satisfy his thirst for good music.

One of the places to break out, I felt, or at least to consider early, was the material used in making the record. If we could find a smooth, hard material to replace shellac, we might beat the economics of the record business. Vinylite, a World War II era development, was then being used in a very limited way, mostly for garden hose and children's records. It was unbreakable and light but cost twice as much as shellac, and that seemed too expensive for any ambitious purpose such as recording a classical symphony, which then required five or six records. On the other hand, I reasoned that if you could put an entire symphony on one vinyl rec-

ord, you not only could afford to make vinyl records, you could make a handsome profit on a product that would eventually be less expensive to the music-lover.

How exactly did one put an entire symphony on a record, stopping only where the composer intended the orchestra to stop? I haunted the music files, pulled out the heavy, dust-laden folios, and compared the lengths of classical movements. Every conductor has his own tempo, which seemed to complicate matters at first, but as I looked at scores of symphony scores, I found no more than 10 percent difference among them. The average classical piece, I discovered, took thirty-six minutes from the first note to the last. Ninety percent of all works could be put into forty-five minutes of playing time on a record. Brahms's Second Piano Concerto, we discovered, was one of those works that took a bit longer.

With the aid of simple calculations one can determine the number of grooves that must be cut in a given diameter record to provide the necessary forty-five minutes of playing time. I chose twelve inches as a practical size because the turntables of the time were designed for records of that diameter. You can calculate the permissible pressure of the stylus to cut the groove, the kind of material best suited for the record, and the resultant amount and type of sound distortion that might result. But determining the most effective relationship among these items was a very tough problem indeed, though in my view it was not an insurmountable one.

Armed with these preliminary ideas and with a full dose of Hungarian bravado in my soul, I approached Kesten late in 1945 and presented a plan to attack the entire system of record making. Looking back, I think it was my first practical contact in civilian life with what has come to be known as the

"systems approach," which I was to use time and again during my years at CBS and outside it. Actually the idea had been born during World War II. It was exciting for an engineer to turn to a war-born approach to overhaul something like the phonograph record that had been around for half a century and lain essentially dormant.

In the systems approach one looks at any complex interrelationship as a whole. If one element has to be changed, the remaining elements may also have to be changed in accordance with the overall purpose of the system. So in the case of the long-playing record I proposed to change a number of things—the amplifier, the material of the record, the shape of the groove, the cartridge and stylus, the method of recording, the turntable drive, and, I remotely hoped, the musical taste of the nation.

By then I had decided that a playing time of forty-five minutes was all we could give on two sides of a record. If the time went any longer, it would require two records, and we might have to add another overture to fill out the remaining portion. I told Kesten about Wallerstein's turndown. He didn't seem to think it was important.

"How much would the project cost?" Kesten asked.

I took a hurried guess: "A hundred thousand."

That seemed like a lot to me, but Kesten was made of stern stuff. "If you think you can do it," he said, "it's all right with me. We'll finance you." I learned later that Kesten was again instrumental in persuading a then reluctant Paley to go along.

So our program was launched before the year was out. It ran parallel with our color-TV effort. I hired a Belgian-born recording engineer, René Snepvangers, to cut records. René had been in charge of NBC's transcriptions. I was delighted

to have him aboard since I had never cut a record, but I didn't tell him at first what I had in mind because I felt that if he didn't take the job, he might reveal what I was up to. RCA would then know enough to try to beat us.

Snepvangers accepted the job, and after I told him about my plans, he promptly gave me reasons why I shouldn't try to build an LP record, mostly because of the failures at RCA. He subsequently grew enthusiastic over the LP, however, and eventually contributed importantly to its development.

I also brought in a number of other first-class men: David Fidelman, a circuit engineer; Thomas Broderick and Bertram Littlefield, CBS technicians; and Dan Doncaster, an able machinist.

Amazingly, there was relatively little science in the record field. As I said earlier, I could find very few technical papers on records or components or, for that matter, on recording technology. When something went wrong in production, a manufacturer might seek to avert the problem the next time, but he would never think of creating a research project to improve the overall technology. At the start we had to learn how to measure everything—pickups, turntables, stylus materials, to name but a few. We discovered that sapphire styluses used in cutting records were ground by specialists who worked at nothing else and were the Tiffany jewelers of their trade. It was a delicate craft, in which a stylus specialist had to know whether a record will "take," that is, whether the stylus will cut the lacquer smoothly and produce a continuous threadlike material, or "chip." If the chip broke, the record would be lost, and that cost money.

Wallerstein hovered over our efforts like a wicked witch, waiting to pounce. Even when we were making progress, he objected. After we had labored to cut grooves finer and finer

and we had developed our first record with fifteen minutes of playing time on one side (the duration of one movement), he promptly reminded us that for Berlioz it would take twenty minutes. I am sure he thought it would defeat us to extend the playing time. But with more labor we finally managed to work in twenty-two and one-half minutes on a side. Later, with the help and innovative talents of Bill Bachman, an engineer brought to Columbia from General Electric, we succeeded in making the grooves so fine that we could get a full twenty-five minutes. At one point we even reached half an hour, with grooves as thin as human hairs.

I recall that we gave Wallerstein a rendition of Tchaikovsky's Violin Concerto on one of our first demonstration records. I can still see the two turntables in action side by side, with the sapphire stylus carving its canyons into the soft body of the lacquer of the LP master, each canyon implanted with the Russian composer's wonderful music. Actually the LP that emerged wasn't all that good—the violin sounded like a flute, for instance—but it was our first LP and we loved it. We had to do it a number of times because small variations in cutting would change the pitch, and we knew Wallerstein had ears like a bat. Every time the pitch changed, he'd yell. Fortunately, René and I each had a good ear for pitch, or the development might have been held back for months. Finally we called in Wallerstein to hear the first orchestral recording with accurate pitch. We had done it on vinyl. He listened and shook his head. "Where is the fuzz on the bow?" he demanded. "When you can get the fuzz, then come back."

I told him the fuzz was shellac noise, which we had eliminated by substituting vinyl. The fuzz arose in the shellac because the record-makers put an abrasive substance in the groove to make the surface more resistant to the wear of the

heavy steel needles then used with the 78. He shook his head and smiled knowingly. To him the fuzz signified the scrape of the resin, the sign of quality. The fuzz, he said, is the violin talking to us. To some extent he was right. Violinists and cellists have always carried mysterious little bricks of reddish resin to rub over the horsehair ribbon on the bow to make the hairs sticky, thus making it easier to draw vibrations from the strings.

So we headed back to the drawing board to resolve the mystery of the fuzz and why our recording failed to reproduce it faithfully. As a way of testing this René suggested we fire pistol shots, record them, and then compare the actual shot sounds with the recordings. A pistol shot is a sort of sonic boom, or train of shockwaves with a pulse of its own. I agreed. So he brought in a gun to the studio one day and fired it into a heavy mattress; the noise was sharp. At the same time we made a record. Then we listened to the two sounds. The recorded shot sounded like a baked potato falling on the floor.

What had happened in the system to do this? I decided to analyze the electronics system, component by component. To show the level of our sophistication, I would have René fire a shot, and with the memory of the crack in my ears, I would rush into the studio next door, where the equipment was housed, to listen to the recording. After a while an assistant held the door open so I could make better time.

We went through dozens of tests in which various components were checked out. I got winded dashing back and forth, and after every component had been tested, we still had no answer. The only component left was the microphone, an instrument that was regarded as inviolate. Nothing could be finer, said the industry, so there was no point in

changing it. Our broadcasting studios swore by it. Actually, I myself was getting a bit dubious that it was that good. My childhood experience with Koenigswusterhausen and the infallible textbook came back to me. I suddenly remembered seeing a German study in a professional periodical which hinted that the ribbon microphone we were using was affected by an electronic evil called "phase distortion." When you spoke into the mike, the frequencies in the sound that traveled along the ribbon in the microphone failed to arrive at the end of the ribbon in the same sequence as they left the source, and thus caused unnatural reproduction of the original sound. The Germans, in fact, had devised a new type of condenser microphone that eliminated this phase distortion, thus improving reproduction. It was still in an experimental stage.

Once we decided it was the "phase response" that was causing our own problem, we knew that we must try out the new type of microphone. In Germany, after a search, I finally found a firm that was just beginning to manufacture these mikes for public use. I obtained a few samples and hurried back to the lab.

I could hardly wait to try out the new microphone, and I must confess that as soon as it was installed I had a feeling that we would make it, that here in good measure was the essence of the fidelity of the LP. Here was the solution of the fuzz. Actually, the effect was dramatic. René fired the pistol, and we listened to the recording. It was exactly like the original sound, only not so loud.

We had built a small soundproof studio, about nine by ten feet, on the tenth floor, where we secretly brought in instruments to record the first LP with a condenser mike. One of our engineers brought a violin and incidentally surprised me

by the quality of his playing; a secretary played the piano; I lugged in my cello. I guess nobody thought much of it on the elevators in a building devoted to the ins and outs of strange-looking, harassed musicians.

Eventually we had a piano trio, not very good in musical terms but satisfactory in terms of cutting the world's first LP record with fuzz. When we finished the Bach piece we had chosen for this historic rendition, we rushed to hear what we had put on record. Beautiful! We knew we had solved the problem of the fuzz and immediately called in Wallerstein. For the first time he broke down and showed some enthusiasm.

"Peter, you've got it," he shouted. But then he quickly returned to his old self. "Okay," he said. "That's fine with your little musical group. How about a symphony orchestra with fuzz?"

So we went back to the lab and gave him Mahler with fuzz. He listened and shrugged. He still felt we had a long way to go. "What about the stuff on the masters? How are you going to put them on LP? If we can't do that in some automatic way, we will soon be competing with our own records."

This was a problem that I hardly dared think about. Of course there was only one way to transfer the content of the 78 onto the LP—by joining the music of the short 78 masters together, a process known as splicing.

In theory the notion was simple. We would build turntables that we would then synchronize. When one turntable was finished, the other would carry on, then the next, and so on until the full rendition was recorded on the LP. To avoid hearing the gap due to the splice, we had to operate within one twentieth of a second. A longer gap could be detected by the listener. That meant that for a four-minute segment—the

usual playing time of an orchestra making a 78 record—the precision in switching from one turntable to the next had to be one part in 2,400, an accuracy that doesn't sound like very much in these days of space-age precision technology, but was considerable at the time. Could anything like music be so well synchronized?

The answer so far as Wallerstein was concerned was no; so far as I was concerned it was yes, via electronics. We developed a "musical computer." First we played the record and timed it electronically (by means of an oscillator) to a hundredth of a second; then a timer was used to start up the second table, and the third, within the time required. The actual electronic work was done by feeding the times into a memory bank, which in turn would energize the switching action from record to record.

We played it again and again until we could make the synchronization as acceptable to our ears as possible. After a while I could tell almost by instinct where there was a splice. Then one day a new problem arose. When making the original recording on the 78, the orchestra would record in four-minute sessions but they would spread them over a period of several days. Consequently the pitch of the orchestra would not be consistent over the entire movement, and we found that in splicing we had two different sounds from the same orchestra. So we had to time it at the same pitch. I had to listen on two records and switch back and forth and adjust the speed until the pitch was exactly the same in all segments. Later we introduced electronic components to make these adjustments automatically.

I sent our musical computer contraption to Columbia Records, and the first thing I knew another crisis was at hand. Wallerstein was watching like a hawk. As the Columbia engi-

neers began to cut an LP of Brahms's Fourth, they set my timer to work on the four-minute segments. The first turntable played it through, and then the second turntable came in.

Suddenly Wallerstein came alive. "Hold it," he yelled. "You lost a bar."

The man was inhuman. I permitted myself a minor artistic luxury. I swore politely under my breath in Hungarian.

But Wallerstein was correct. The machine had missed. A young music school graduate named Howard Scott, who had been assigned to make sure the splices were accurate, and Bill Bachman, director of research at Columbia Records, worked out a cueing system for the use of the engineers. Twelve sections were marked on the circumference of the turntable and numbered to guide the engineers in setting down the stylus. Then Scott would listen to the ends and beginnings of the sections to be spliced and make appropriate notations on the score. When the time came to set the second turntable in motion, he would call "Cue." When the time came to set down the stylus, he would call "Go" and snap his fingers. The splices were, I think, as good as anything one can do today in tape. Scott proved that Brahms's Second was written as though spliced.

All through this work we made demonstrations for CBS management. They judged our progress by comparing our record with the original 78 to see if we had improved the sound. Paley was interested, but since he knew nothing about classical music and he had no sense of pitch, he depended on Wallerstein's ears and subsequent shouts. Every time Wallerstein frowned, Paley looked a bit worried. I hastily assured him that the splicing was in hand. Stanton was also present at these LP sessions and would tell us not to worry about Wallerstein's mutterings.

As it turned out, Paley was less worried about the success of splicing than he was about his arch-competitor, RCA. Sarnoff had not made any public announcements about records as yet, but Paley had no way of knowing what might happen if he came out with the announcement of the LP. Sarnoff was tough competition, and though Paley felt confident that we had a better product than anything Sarnoff could come up with, he saw only a limited market of classical music lovers. I once heard him say that he felt music was only background for conversation. To avoid possible unexpected competition, Paley came up with an ingenious idea. Why not invite RCA to join forces with CBS in putting out the 33⅓? Philco, which had earlier come in with us to manufacture the record players, agreed. Paley phoned Sarnoff and invited him to a demonstration of CBS's new record. Sarnoff was intrigued and agreed to come.

I will not easily forget this momentous meeting. Sarnoff arrived promptly in the paneled CBS boardroom, followed by a retinue of engineers. I counted eight of them. Paley, Stanton, Murphy, Wallerstein, and I greeted the RCA contingent at the door and watched them file into the room and self-consciously assume their seats. I must admit I felt nervous. Years of arduous work had gone into this moment, and here in a sense was the day of judgment. It was important for the company, for Paley, for myself and my group. Impeccably attired as usual, Paley stepped forward, smiling urbanely, and smoothly explained that I would first be playing an ordinary 78 and then I would follow it with the CBS invention. I could see Sarnoff stiffen and become attentive. His engineers sat quietly around him. I played the 78 for about fifteen seconds and then announced that I would switch over to the new record. I put on the needle.

With the first few bars Sarnoff was out of his chair. I played it for ten seconds and then switched back to the 78. The effect was electrifying, as we knew it would be. I never saw eight engineers look so much like carbon copies of tight-lipped gloom. Turning to Paley, Sarnoff said loudly and with some emotion, "I want to congratulate you and your people, Bill. It is very good."

Paley offered to delay the announcement of our long-playing record if RCA would join CBS in a simultaneous move so that both could benefit from the growth of the business. Paley offered know-how and a franchise. Sarnoff said it was a generous offer that he would discuss with his staff. With that statement Sarnoff and his entourage rose and left the boardroom.

I subsequently learned what happened after the group returned to RCA headquarters. Sarnoff, who had been so affable and congratulatory, had gone into what could only be described as an executive tantrum. How could little CBS, with a two-by-four laboratory, beat RCA? he demanded to know. A few days later Sarnoff phoned Paley to say that he had decided not to come in with us on the record. Paley called to tell me.

I also learned that Sarnoff was not without his usual acumen. RCA engineers had developed a seven-inch version of the 78, spinning at 45 rpm, which they called Madame X. They had kept it on the shelf, perhaps because they weren't so sure of it. The record played four minutes, but the RCA machine, with its large center spindle, was designed to change the records faster than a 78 changer, hence in-between pauses would be shorter. But music to music it was like the 78 because each record had a lead-in, thus producing an interruption as long and annoying as that in the 78.

I don't know whether the staff, goaded by Sarnoff, convinced him the 45 was better than our record, but he went along with it. He made his phone call to Paley to turn down the offer only because he still thought he could beat us.

So CBS decided to go ahead with the 33⅓ microgroove record. We held our debut at the Waldorf. It didn't make big waves; I am not sure that Paley actually looked upon the long-playing record as anything more than an adjunct to the existing records. Earlier, Stanton thought we needed a name and ordered a companywide contest. Twenty-five names were considered, but all were rejected. "I guess the LP isn't going to have a name after all," I said.

Startled, Stanton said, "What did you say?" I repeated my statement, and that's how LP got its name.

Our announcement was met by a kind of ominous quiet from Radio City. Then a few weeks later, with appropriate thunder, RCA came out with its 45, announcing virtual "instantaneous" and inaudible change from one record to the other. The 45 record was made with a big hole in the center —requiring an adaptor—so as to make it difficult for potential set owners who had a 33⅓ rpm turntable to use.

I went to the RCA press demonstration and found it incomprehensible how a sophisticated company like RCA could come out with such a weak competitive item. The change took a long eight seconds between records, from music to music. There had to be a lead-in groove, which meant seven seconds dead time alone, and a run out to activate the changer. It was clear that for classical music the 45 just couldn't compete with the LP.

For a number of years RCA was the lone holdout in the LP. Subsequently Snepvangers told me how RCA got into the long-playing business. It seems that Toscanini, who was a

friend fo René's, had listened to Bruno Walter conducting on a Columbia LP and couldn't stand his going on uninterrupted, while he, Toscanini, was constantly interrupted by changing records. So he pressured Sarnoff into going into the long-playing record business.

The LP–45 battle between RCA and CBS escalated and at times got vicious. RCA went so far as to put out record changers at no cost, in effect subsidizing the 45. We countered by turning our sights on a new breed of changer, a multispeed one that could go from 78 to 45 to 33⅓. Many people said we couldn't do it. How could a heavy and a light pickup exist in the same machine? But we went ahead and redesigned changers to handle the different weights. We discovered how to control stylus pressure by means of a change in tension, and thus we developed the first turn-around stylus with dual speed, giving the manufacturer a universal instrument.

On the record end one of our problems in production was maintaining the fidelity in the cutting process as the stylus moved from the outer grooves to the slower-moving inner grooves. At one time I thought of devising a system in which the stylus moves from the inner groove out, so that the fastest moving, highest fidelity curves would be faithful to the great crescendi that end most classical pieces. But we discarded the idea because it would give the record-changer makers headaches.

An elegant solution to the problem of improving fidelity by noise elimination in the cutting process finally came from Bill Bachman. After watching the record monitors hunched over their microscopes following the grooves, Bachman devised a tiny electrically heated coil that could be fitted

around the cutting stylus. The heat softened the lacquer of the master discs just enough to let the styluses cut smoothly.

Bachman also cleverly worked out a way of getting a maximum of playing time on a record side without sacrificing fidelity. In his method, called variable pitch, the between-groove space is broadened when a loud passage is coming up so the stylus can swing wide, and it is narrowed when the volume is decreased. In the past the grooves were spaced to accommodate the loudest signals, leaving more space than needed for the softer passages. At first the variance was done by hand, but later it succumbed to progress and became automated.

All through the months in which we sweated out a disc that could be commercial, we encountered incredible problems in production. There were the ticks in the record that emerged after the fuzz problem was solved. I recall once visiting our Bridgeport plant and noting that a section had been turned over to the LP at the end of a long line of steamy, dusty shellac presses. I went to the chief engineer and said there were impurities in the record. They were causing ticks. The engineer held up his hand. "We'll take care of that," he said. Lunch came up at this time, and I watched several employes come in with mops and brooms and sweep around the LP press, leaving vast clouds of dust. "Nobody else gets such service as you do, Doc," he said. It took me some time to convince them that this was not the way to handle sensitive LPs.

After the introduction of the LP Wallerstein became a believer but never lost his old habit of dealing with shellac. Once when he had a brand-new LP that he was going to demonstrate, I saw him raise his arm to brush off the record

with his sleeve. It was traditional in the record business for a veteran record man to use his sleeve to wipe off the dust that usually accumulated in the 78s.

I whispered, "Don't, Ted." But it was too late. His sleeve added more dust than he wiped off.

Among other problems of the day that I remember was that we all had a pet recording headache, a balky composition that simply refused to work for us. The *Eroica*, for instance, had twenty-nine minutes on a side, which gave Bachman trouble. One record that bothered us was Beethoven's Opus 132, which had pianissimo passages where we could hear the impurities. I wasn't too surprised, however. It was a recording by a Budapest string quartet.

Before the announcement of the LP, in thinking about a total system we had devised a seven-inch record, a brother to the $33\frac{1}{3}$, to play pop tunes. I had them pressed in our plant at Bridgeport to use it in rebuttal to anyone who thought we couldn't play popular music with the $33\frac{1}{3}$ system. At one meeting I had it in my pocket. Only Adrian Murphy knew about it, and he forbade me to pull it out. He thought a short and long record would confuse everybody.

Later, when RCA came out with the 45, I showed the record to our management. "Why didn't you show it to us before?" Stanton demanded. Had we announced it earlier, RCA would have had its tail clipped. There would have been no excuse for the fanfare surrounding the 45, and we would have captured that business as well. We did come out with a seven-incher later, but it bombed because RCA had come on too strong.

Despite the smoke of battle the long-playing record business didn't take off in anything like the sensational burst that was to occur several years later. The changer we devised

helped launch it, but it wasn't until Goddard Lieberson, long-time head of Columbia Records, put the musical play *South Pacific* on LP that it really caught the money bug. An entire Broadway show on a record was sensational, and people who saw the show bought records in droves. Publisher Bill Schwann convinced me of the scope of the business when twenty years ago he typed up a catalogue of a hundred or so LPs and started what has become the bible of the business. Now the *Schwann Record and Tape Guide* has over 100,000 listings and publishes about three hundred pages of LP titles each month.

How nice to have developed a system that industry says cannot be done. How beautiful to weld a team into action and see it victorious. You start alone. You become committed when you ask for money to pursue your goals. Once we got the money, we didn't retreat, despite setbacks. We never reported slippage. Ninety-nine percent of the battle is thinking; the rest is perseverance. What was it that Edison once said?

We had no idea we were starting a new industry when we began the LP. If anything, we thought we were revolutionizing an old one. But we found that the quality in the LP brought constant demand for higher fidelity reproducing equipment. This grew and grew, and one day we found that we had seeded not only the LP but what is now the multibillion-dollar hi-fi industry.

Incidentally, so many people think I made a fortune out of the LP that I'd like to set the record straight. There are no patent rights accruing to me. But I do get something from Columbia that makes me very happy—a copy of each new LP record.

# 9

# Inventing in Suburbia

THE 1950s were the golden decade of innovation in technology. Advances in magnetics, video, sound, and solid state poured out of American laboratories. The continuing success of the LP and to some extent the shadow mask in color TV had helped raise the lab's stock with management. I began to dream of expanding our facilities and possibly of opening a lab in the country. We looked around for new ideas to develop, but, as often happens, the ideas that were to emerge and create the most excitement appeared unexpectedly and faced uncertainties we never dreamed of.

I remember that one day in 1953 my young son, Peter, and I were driving through the countryside in Germany. We were on vacation, a long-promised one that I finally had decided to take with my family in Europe. The radio in the car was playing. Somebody was talking, and I could see that after a while Peter was growing restless, even though he understood some of the German. I turned the dial, but there was nothing else on to interest him.

"Dad," Peter suddenly blurted out. "Why don't they have adventure stories on the radio? Something you can put on yourself. This stuff can be so boring."

Well, why not? How many times has one felt the agonizing boredom on long trips, the irritating fights between brother and sister, as young minds and bodies start to feel cramped? I suppose I could have dropped the idea and gone on to the things that were of more immediate concern at CBS, but I kept thinking of my son's question. When I got back to work, I started to wonder how much information one can put on a small record for use in a car without a changer. The answer, it turned out, is easy to figure. To give us forty-five minutes of playing time on a side, as much content as both sides of an LP, and to give us a record small enough to fit with its mechanism inside the glove compartment, the record would have to be seven inches in diameter and would have to revolve at $16\frac{2}{3}$ rpm, one-half of the LP speed. In addition it required almost three times the number of grooves per inch as did the LP.

I talked it over with my colleagues. I never know whether they're affected by my enthusiasm or by the idea itself. I generally try to restrain the excitement that surges through me so that my associates won't feel they are being dominated by my ideas, which I must admit sometimes may seem to go far beyond immediate realizations. In any case they liked the notion of playing records in an automobile, and they seemed to mean it.

So we got to work immediately. Our earlier experience with the LP stood us in good stead, and in just six months we developed the narrowest microgroove in the business, the ultramicrogroove. It was one-third the width of a human hair. The fidelity was superb.

For playing in the car, however, the most important problem was to get rid of the effects of road vibration and shock, which obviously would distort the music or story on the record. To accomplish this, you have to call upon some elementary physics. Vibrations—ups and downs or sideways motions—are mechanical, and they can be neutralized with another compensating mechanical motion, a cure known as damping. So the problem boiled down to devising a suitable mechanical system that would absorb the vibrations and prevent them from being transmitted to the turntable and tone arm. In the case of the turntable, horizontal and vertical vibrations were absorbed by a system of springs coupled to masses and damping material. My associate John Christensen developed a vibration-free drive for the turntable, which was run by a tiny motor also developed by him. To test the system he and I drove the car down Third Avenue, whose cobblestones under the elevated provided the worst bumps in New York City. Weaving in and out of the elevated's pillars gave us lateral shocks. Throughout, the music came out free and undistorted. I wish I could have said the same thing for my ear canals and lymph glands. On one occasion in Long Island City the Chrysler motor mount broke as a result of the punishment the car was taking, and the engine nearly fell out, but our hi fi—bravely playing "Tenderly"—kept right on without a care.

I made another less arduous test of the hi fi on my honeymoon—my second one—with a new wife. Frances and I were divorced in 1954, she to marry Dick Salant, President of CBS News, and I to marry Diane Davis, my former secretary. Diane learned rapidly about my interests—and listened to the hi fi and to my explanations of what I was doing while we drove through the countryside.

It was time to show it to Stanton. I told him I had a gift for him and installed a custom-designed player in the glove compartment of his jet-black Thunderbird. He loved it.

"I thought you'd given up the idea," he said. Then he added, "I'm glad you didn't."

I thought that the ultramicrogroove record turntable might not only work in an auto, but also might become a standard in the record business if radio stations went into broadcasting pop music, which generally comprises short numbers. Remembering the earlier interest of Murphy and others at CBS in the seven-inch record, I proposed it to management. Paley didn't think much of this market; in fact, he didn't think pop music was a market at all. He also felt that record players installed in cars might cause drivers to turn off the radio to listen to records, and thus CBS would lose listeners. I must confess that I didn't think the world would suffer if car drivers occasionally turned off *The Shadow* and listened to Debussy.

Here is another case where I couldn't allow my enthusiasm to be dampened by management's negativism to new ideas. I decided to go ahead on my own and to see how far I could get with the automobile installation. Since I was then driving a Chrysler, I thought the Chrysler Corporation might be interested in the device, and got in touch with a man named Kent, who was the company's chief electrical engineer.

A ruddy-faced, middle-aged man who was then pioneering air conditioning in automobiles, Kent was interested in new ideas and invited me to Detroit. When I arrived, I told him I had something in my car that he just had to see. Curious, he agreed to go with me to the parking lot. Inside the car, I turned on a switch. The music came pouring out of the loudspeaker of the car radio, clear, beautiful, and static-free.

Kent was startled. I opened the compartment and showed

him the setup. He looked at the strange, homemade tone arm on the player and shook his head.

"It's fine while you're parked," he said. "But what about driving on the road?"

"You drive," I said, offering him the keys.

He slipped behind the wheel, put the car in drive, and slid down the highway. The music continued to pour out faithfully. Then he turned into a lot and stopped.

"Do you mind?" he asked, pointing to a field ahead.

I looked at a spot of land that must have been created out of an auto engineer's nightmare. There were cobblestones, potholes, washboard earth formations, trestles, and almost any other strange irregularity one could find. This was Chrysler's testing ground, he told me, where new models were jolted up before they were sent to distributors. My heart sank. I consoled myself with the thought that if the machine is properly balanced, nothing can throw it off. Nonetheless, I couldn't help but worry.

Kent shot the car over the trestles, but there was not even a waver in the sound. He ran over cobbles, skidded past washboards, climbed up and down small, jutting mounds. Still the music came forth, loud and undisturbed. Kent was impressed and immediately said he would demonstrate the set to the president of Chrysler. One thing I learned later was that each set of cobblestones had its own frequency of vibration when in contact with the moving car, so I later had to design a filter that worked for more possibilities of vibration than I had ever thought of.

Several days later we went down to the Chrysler garage, where several people joined us. We all piled into one of the executive cars, which had been outfitted with one of my sets. Lynn Townsend, who later became president of the auto

company, sat in back with me while the then president of Chrysler drove. The executives gave the tone arm the same test as before—over cobblestones, around curves, over washboard roads, slowing down, speeding up, even emergency stops. The jolts were incredible. But so was the record player. Nothing could stop it from carrying out its appointed mission. I, on the other hand, was getting sick.

With music filling the air, the president wheeled the car into the company garage. Townsend turned to me and said, "I must have it for the Chrysler." Everybody else agreed and chanted, "Yes, we must have it."

Actually I didn't know until later that the timing for my innovation was right. Chrysler was then preparing for its annual face-lifting—a model change—and they wanted to focus their advertising on a new development. Our machine was glamorous, novel, and it wouldn't add great expense to the cost of the car. The Chrysler people named it "Highway Hi Fi" and designed it to fit under the dashboard with a two-way switch, one for radio and the other for records. We agreed that everything would be ready for the 1956 model. We made plans for a spectacular debut and a press showing.

I thought that our new CBS Electronics Division (the Hytron–Air King addition) could manufacture the players and discussed it with Dave Cogan, head of the division. "Sure, Pete," said Cogan, waving a cigar at me. "Sure thing." I wasn't sure what that meant. Columbia Records was interested in supplying records, but only if Chrysler placed an order for 20,000 machines, so they could sell that many records to start with. Chrysler seemed to be willing to oblige. So CBS Electronics went ahead.

All went well until two weeks before the press showing. I was summoned to the phone: emergency call from Chrysler.

Something about the installation. I immediately flew to Detroit. As soon as I arrived, the engineer put me inside a car and started driving with the record player on. It was incredible. The machine wheezed, fluttered, groaned, jumped grooves, and made noises I had never heard before. It did everything it was designed not to do. What had happened?

And then I glanced at the dashboard and almost jumped out of my skin. The engineers of the Chrysler Corporation had installed my machine in Dodges and Plymouths. The characteristics of those cars are quite different from those of the Chrysler line. They were lighter and harder riding, for one thing, with different kinds of suspension. Obviously a record player installed in these cars needed a different kind of damping. Here was a major corporate goof on the part of Chrysler's engineering department. I couldn't call it anything else. There was no reason to believe that any device geared to one type of car had a universal spirit in it that made it happily adjust to all cars.

Back in the laboratory we simulated the vibrational behavior of the Dodge and Plymouth and discovered what we had to do to fit them with our machines. The night before the press affair we were still feverishly at work, but by morning we managed to install our last hi-fi system in the last of several cars to be used in the display.

I must say that the press conference was a success, and CBS Electronics soon went into preliminary production with 18,000 units.

Somehow this nice cultural addition to American autointoxication didn't take off with the kind of sales we had expected. Chrysler carried on interminable meetings with CBS engineers. There were complaints from both sides about the way the record players worked. But the chief underlying rea-

son for the middling response, I think, lay in the fact that Chrysler and Columbia Records failed to do proper marketing by not advising potential customers how to obtain additional records. Dealers failed to stock them, and little or no attempt was made to see that they did. Without this stimulus to buying, the car buyer didn't order the optional record player in the numbers that we envisioned. Columbia persuaded Chrysler to pay for the initial set of records and phonographs and then grew apathetic, leaving followup to Chrysler. Seeing the slow sales, the auto company relaxed its promotion. Ironically, even though the business declined, the record-changer manufacturers were so enamored with the $16\frac{2}{3}$ that they included the new speed in their changers—"so you can take home your Highway Hi Fi"—even though there wasn't a $16\frac{2}{3}$ rpm record in sight.

As a spinoff from the new record technology I developed for the Library of Congress a seven-inch record that plays four hours of spoken word and rotates at $8\frac{1}{3}$ rpm. This came into being because of my association with Recording for the Blind, an organization that has brought the beauties of the spoken word into the homes of thousands of blind students. We used the identical tone arm as we did in the automobile, so that it could be pummeled around a bit without distorting the sound. My wistful hope is still to bring back the past glories of the radio days, so that one can listen to drama, comedy, and stories on one's own portable talking machine, and by so doing remind people that their senses are not related only to the primitive visual ones utilized in TV viewing.

Although our car record player died out, I like to think that during its brief life our system set up important waves throughout the audio industry and that it paved the way for the cartridge by showing the possibilities of owner-selected

music, children's shows, lectures, and what have you in that strange home away from home, the automobile. I must say too that I think our original auto record player had some major advantages over the cartridge player that replaced it. It had fabulous fidelity and was somewhat cheaper to produce. In the home I think it might eventually have amounted to a smaller, cheaper LP. On the other hand, had we stuck with the seven-inch record, I might not have thought of the audio cassette—that cartridge of miniaturized tape—which is now a huge business, though still only 25 percent of the LP.

I became interested in the audio cassette through a strange series of unrelated events. In 1953, while scouting new ideas in terms of exploiting our two greatest strengths at the lab, tape and video, I came up with the idea (as did others independently) of what is now known as the video tape recorder, a type of recorder that combines pictures and sounds on magnetic tape. I discussed it with my colleagues, who liked the idea, and then I went straight to Stanton. This time my enthusiastic approach failed to catch him, and he turned it down. He thought it would be too difficult to produce.

At the time I didn't know that Ampex, an up-and-coming magnetic-recording firm on the West Coast, which was headed by the brilliant Russian pioneer, Alex Poniateff, was then working on a similar idea. In April, 1956, Ampex came out with the same system I had proposed to Stanton. Its impact was immediate, even though the first recorder cost $75,000. Tape soon became the medium of exchange of television. Instant replay, the product of video tape recording, became a household word. Events happened so fast that in November, 1956, CBS became the first network to broadcast a regular program on tape, "Douglas Edwards and the News."

I recall that Sir Harold Bishop of the BBC visited New York and was given a luncheon by Stanton. In the course of the affair Frank told the assemblage about my suggestion for video tape several years before Ampex and how he had turned it down. He ate his crow, I thought, with good grace.

Electronic innovations continued to be in the air during the middle and late fifties. Technology was rushing ahead. Many of the German inventions of World War II were being rediscovered and turned to consumer utility. Magnetic recording, for instance, which had created in Germany the illusion that Hitler was speaking in one city while he was actually in another city, was being refined in several places in the United States to lead to a revolution in tape recording.

Despite these emerging technologies, our dreams of moving to the country seemed remote. The lab was still in a precarious position with CBS and Stanton, who was as concerned as I was, said that Paley didn't want CBS to pay for research, so the feeling arose once again that we had to sell the lab. Paley went off to Europe, expecting, I think, that the lab would be gone by the time he returned.

Stanton, however, had not expected Paley's earlier reaction to Fairchild; as soon as he realized that Paley would love the lab if somebody else loved it, he and I became conspirators to see to it that the lab looked desirable. We just had to save what Stanton once proudly called a "jewel in the crown of CBS." I finally had an idea—let's make the lab a profit center by getting contracts from industry or the government, and deliver real money, or the smell of it, to Paley. Strangely, for psychological reasons I cannot really determine, I really wanted to stay in the bosom of CBS. Perhaps it was because I suddenly realized I was at war, and I wanted to win.

In this curious atmosphere Dr. Carl Barnes, vice-president of central research of the Minnesota Mining & Manufacturing Company, called me one day, and we had lunch at the Berkshire Hotel in New York. Barnes told me that he wasn't getting many new ideas out of his research organization and wondered whether I could come to St. Paul and make some suggestions in the magnetics and graphics field for consumer products and systems. Here was serendipity at work. I flew out and had a long discussion with executives of the Scotch tape company, particularly with William McNight, the legendary chairman of the company, who had devised wet and dry sandpaper and who had helped the company achieve its eminent position in industrial research. I proposed several ideas, including the idea of a tape-cassette system for the home and automobile. After that, we held meeting after meeting. Although I was an employe of CBS, I began to enjoy the role of a private independent entrepreneur; it was the way I had learned to survive at CBS.

Finally, the 3M Company agreed to support some of my ideas. They would put our laboratory on a no-cost-to-CBS basis if we continued to do research in the field of magnetics, especially magnetic recording, and give 3M the results of what we produced. It was agreed that 3M would give us 250,000 dollars a year to underwrite our activity.

The color of the 3M money turned the trick. Now at last I felt strength coming into the laboratory. Even Paley phoned from Europe to tell Stanton he'd changed his mind about the lab. I talked boldly to Stanton about a new lab out of the city. We obviously needed the extra space to expand, and somebody else was paying for it. When we raised another half a million dollars a year in military contracts, there was

no stopping the decision to put CBS into the research and development business on a major scale.

Our hand was further strengthened by an arrangement with Mergenthaler Linotype Company to pay for development of an electronic-typesetting system, which resulted from a proposal of Ken Moore, a CBS engineer then working on improved electronic display devices for the Department of Defense. Moore's idea excited the interest of the president of the old linotype firm, and he agreed to fund a project with CBS. However, we worried about undertaking it because we could agree only on a fixed-price contract to cover our development costs as well as delivery of the product, and we weren't sure whether we'd lose money on the deal. Stanton in this case fought hard for the labs to go ahead because he agreed with me that the new technology we would establish would be worthwhile, even if we didn't make it on the black side of the ledger.

The project culminated a few years later in the delivery of the world's fastest and most accurate typesetting system, which is now being used by the U.S. Government Printing Office and the Air Force. The machine, known as a Linotron, typesets an entire page at once instead of line by line. One Linotron replaced a hundred hand-operated linotype machines, thus contributing to a revolution in the stodgy printing business. We got tremendous know-how from the job which we applied to television and to a system known as Vidifont, a device that inserts news items or titles into a program, which subsequently paid back in sales all the development costs.

When the books were balanced for the year, however, the labs had lost money on the contract, and the inevitable hap-

pened. At this time a new division was being formed that would include the labs and would remove my direct line of contact to Stanton and dislodge his protective arm from the labs; so Stanton suggested I become chief scientist of the corporation at the time the new division was formed; both announcements would be made at the same time. The new division was announced—it was called Comtec—but there was no mention of chief scientist. Stanton later told me why. "Bill changed his mind about you," Stanton said, "because you lost money on the Linotron."

Despite the Paleyesque reaction Stanton told me that the 3M deal was so impressive he had managed to get me my lab in the country, and John Christensen and I soon were dealing with architects in Stamford, Connecticut, the city I recommended as the home of the labs because it had the kind of facilities we needed. Other concerns were also discovering this city forty miles north of New York, and giving it the name of "Research City of the East." Incidentally, the eleven-acre site we bought was that of a former insane asylum, which some critics may find meaningful. Stanton later said the lab was the best investment he ever made. I think as far as the real estate value was concerned, he was right.

In November, 1957, we made an official announcement that we were going ahead with the lab. Construction started a month later.

In those days I traveled a great deal between our lab and St. Paul, carrying new ideas and the results of our work at the lab. At the end of the first year we learned that the NASA program required a miniaturized voice recorder for the astronauts, just the kind of thing we had been working on. CBS got the contract.

The recorder proved to be highly successful and became

the basis of astronaut conversation in space in the Mercury and Gemini programs. Thinking beyond space application, I suggested that 3M might now consider using the magnetic tape for recorded music. They liked the idea and established a three-year project. Much of this work was done by Ben Bauer and Emil Torick, both leading audio and acoustic engineers who later led the development of the first quadrophonic audio system, called the Columbia SQ.

We developed a tiny, single-reel cassette, which played an hour of high-fidelity music at a speed of $1\frac{7}{8}$ inches per second. To develop this took long hours, day after day. For me it was the LP days all over again. We had to make new magnetic heads, new tapes, new drives, new cassette forms and technology, so that all cassettes could be played by the same apparatus. CBS took little interest in this work; they didn't think taped programs would displace the LP. At best CBS hoped it would provide the masters for 3M to make the taped programs.

As the time went on the 3M projects grew to a million dollars a year, and we applied for patent after patent on our recording system, which laid the groundwork of the audio cassette that is familiar to almost everyone. At one point 3M went so far as to purchase a company, Revere Camera, to make the new instrument.

We gave demonstrations to industry, and 3M issued licenses to manufacture cassettes. The climax of our operation came one day when representatives of Philips, the giant Dutch firm from Eindhoven, came to CBS to look up the new wonder in miniaturized tape recording and to negotiate with 3M to put it on the European market. I introduced Philips representatives to 3M, and they went into negotiation.

The final meeting to lead to signing a contract between the

two firms took place in a suite at the Lexington Hotel in New York. It was an unforgettable meeting. American businessmen frequently negotiate with drinks in hand, and with lots of smoke and noise, so the room was soon filled with bleary-eyed people (having a good inebriated time). The Philips people, used to European reserve and formal meetings, looked uneasy. They told me at one point that they couldn't understand what the "drunks" were saying. I know Columbia Records was saying that they wouldn't come aboard even though Stanton wanted them to. They didn't like making an investment in a new product that might take years to return a profit. They didn't want to make their current product obsolete. Records to them were clearly synonymous with immediate success or failure.

The meeting grew hotter. At the request of Philips I remained in the lobby as the critical moment drew near, waiting for final word. But the negotiators were finding it hard to talk above the noise, and I heard that they were led into a closet where they could carry on business without the noise and interruption. Then the 3M management joined them with drinks and cigars. The closet was tight, airless, smoky, and hot. Every few minutes somebody had to come out gasping for breath. It had the appearance of a Groucho Marx comedy. The 3M people were so pleasantly tight that they made less and less sense.

Finally, it became too much for the people from the Netherlands. They walked out and met me in the lobby. "Peter," one of them said, "we're going back to Holland. We believe in your development, but we'll have to do it on our own."

And they did. On a trip to Holland I visited the Philips plant and saw the device they came up with. It was a transistorized cassette just like mine, which they called the Pocket

Recorder. It was small enough to hold in the palm of one's hand. They made a point of giving CBS Labs credit for the basic work. They even adopted our standards and made them worldwide.

Although the recorder was not an immediate success, recording companies began to issue cassettes of prerecorded music, and they caught on. Cassettes have also found uses in texts for visitors to the New York Stock Exchange and other institutions, for tourists on cruise, for language courses, and for dictaphones, among other things.

The combination of audio cassette and LP has brought a new dimension to entertainment and culture. All the world's music is now available, and the time barrier is gone. With tape, the ancient Chinese folk music is instantly retrievable, as is the latest version of Great-Uncle Karl Goldmark's *Rustic Wedding*. Today, as I indicated earlier, CBS has a substantial audio-cassette business.

I got something out of all this, too—my laboratory in the country was finally ready. It was a magnificent building, designed by Gordon Bunshaft of the famous architectural firm of Skidmore, Owings & Merrill, who did Lever House in New York. The million-dollar building, though paid for by others, made me feel that I was really in the forefront of scientific research for a while.

# 10

# The Great EVR Sleigh Ride: Part I

WHOEVER said that necessity is the mother of invention never endured my experience with electronic video recording (EVR), which was my last inventive development for CBS and which convinced me that invention is sometimes the mother of necessity.

I should have realized that EVR, which is a device that enables you to play a prerecorded program through your own TV set, was jinxed from the start. It began in a curious way on the very day that the CBS Laboratories building was being dedicated in Stamford. That day in April, 1958, was, as I remember it, a warm, spring day. Everything was out—the flags, the sun, and even the politicians, who were ably led by the then Governor Abraham Ribicoff—to make our gala opening a day to remember. A number of distinguished people were in the audience to welcome us, and to look over the flat, ranch-style glass-and-brick building that would be our own new hilltop research home.

When my turn came to speak, I decided to touch on the theme of technology in the service of man. I remember saying, among other things, that television could be a great boon to education because it would bring the great educators into classrooms that normally would be unable to attract such eminent and busy people. Because of this I offered the city's teachers a gift—a three-camera, closed-circuit TV system, with experts to install it. I thought it was a most appropriate gift, and that as a leader in communications CBS was doing its bit to show Stamford that private enterprise was gracious, loving, and out to do good in the community.

The trouble was that nobody else seemed to think much of my gift. For three months the TV system remained in the lab's storeroom, nicely dusted, polished, and unclaimed. Finally, unable to contain my curiosity, I phoned Reg Neuwein, superintendent of schools in Stamford, and asked him point-blank why no one had come around to pick up the system. After a long pause he said, "Well, Peter, remember that dedication speech of yours? You blew it. The teachers are afraid of you. Maybe you'd better talk to some of them."

I did speak to them and quickly discovered that the teachers felt TV would interfere with teacher control of the classroom. They told me they could dominate such audio-visual equipment as slide projectors and 16mm film, but television was something different. It meant that a brilliant teacher coming through the tube might make their own efforts seem less impressive to the youngsters. Some thought they might even lose their jobs. It seems amazing that this attitude to TV prevailed only a short time ago among a sensible professional group. How could teachers believe this when children were growing up on TV? McLuhan calls this generation the TV children. Where did this superstition come from? How could

I prove that television was not a monster but an aid to the teacher?

To gain some perspective on these questions, a group of us, including Reg Neuwein, visited Hagerstown, Maryland, where the Ford Foundation was in the process of sponsoring the largest closed-circuit educational television experiment in the country. The Hagerstown experiment showed me how dull subjects could come alive by imaginative handling of TV. In a history class, for instance, important events were taught by acting them out on the screen. Teachers and students prepared printed programs of each sequence; costumes and stage settings were made to conform to the life of the time. Both students and teachers had a chance to participate in the preparation and the show. It was done with gaiety, noise, and a great deal of determination. TV in this case was the leavening agent that made the entire cake rise. When the show was on, the children in the audience sat on the edges of their seats, their eyes glued to the screen. The teacher made comments while the show was in progress and never lost control of the situation. Moreover, the students learned something of the excitement of the historic period and will probably never forget the importance of the event being shown.

We returned to Stamford, and reported our observations of this new form of participatory teaching to several teachers' groups. Evidently my enthusiasm was catching. The schools eventually sent additional teachers to see the Hagerstown experiments for themselves, and they came back as missionaries for television as a tool, rather than as a threat. Later, with teacher backing, Neuwein phoned me to say he would now be in a position to accept my equipment and to set it up in the school system. But at the very last moment he accepted a new position and left Stamford. Although I called the new

superintendent and a few others in the school system, nobody seemed interested in my TV system. So the ill-fated gift remained in the storeroom. After a while I began to think I would never be able to place the system in a good home.

Some months later, however, an unexpected development occurred. I had been invited to Riverbank Elementary School in Stamford to attend a talk on new audio-visual methods of teaching. As head of CBS Labs I was interested in exploring this technology for our company. I saw slides, films—the usual thing. Finally I felt compelled to pipe up. "How would you like something different, a closed-circuit television system?"

Margaret Toner, the principal, who was conducting the session, turned around and fastened her eyes on me. "Who are you?"

I said I was the president of CBS Laboratories and I would be happy to donate such a television system to Riverbank School. I think Miss Toner was stunned at this unexpected largesse. But she recovered charmingly, and without looking the gift horse in the usual spot, she agreed to accept it. When I got back to the lab, I quickly pulled out the system from storage, and before Miss Toner could think twice about it, I had it installed at the Riverbank School, the first such installation in Stamford and one of the few in the country.

Under Miss Toner's direction the children were trained in writing, acting, and production for television. Boys and girls aged seven to eleven learned to make their own news broadcasts, and they appeared on the tube every morning on the school's newly created channel. Not only did they learn about TV and its functions, but also their curriculum programs were affected; map reading, for instance, once taken for granted, took on a new excitement on TV. Kids were en-

couraged to suggest controversial programs—such as whether there is too much homework—and the youngsters interviewed parents who were local celebrities. The setup drew visitors from many parts of the country and I think it contributed much to the use of TV in school systems.

While the development was heartwarming, the frustrating, almost comic experience of trying to donate a television system to a school led me to think hard about the role of television and other visual aids in the educational process. The familiar film and projector seemed limited. I can always remember how the teachers of my youngsters tried to thread film and ended up utterly defeated. What was needed, I felt, was a simple, inexpensive device that didn't dominate or frighten the teacher and moreover didn't limit the student.

Television's advantages were obvious. You didn't have to darken the room; in darkness kids often get out of control. Children grow up with television in the home, and in normally lighted rooms, so it's an environment they know (some critics think they know it too well). Large screens are alien to them. Moreover, television is easy to handle. It doesn't break down like a movie projector and frustrate the teacher while the children grow impatient.

The disadvantage of most closed-circuit television setups is that they are piped into classrooms from a central office. The system depends almost entirely on outside timing and control. Could we shift the control to the teacher without sacrificing the advantages of television?

Then an idea struck me. Why not turn a television set into a miniature movie theater in which a viewer can see whatever film he wants at any time he likes? He can stop it, go back, start again, as though he were setting up his own puppets. He

would be free of scheduled programming of the network or local channel or, in the case of the school, of the principal. This new dimension for television would create a revolution as deep as TV itself.

I immediately thought of video tape but quickly discarded it because it would cost too much. It seemed to me that the answer had to lie in film, which could hold more information per frame than a similar square of video tape and hence would be cheaper to make. However, I knew we would have to develop the tiniest frames ever produced.

In that instant I saw the outlines of a system in which miniaturized film could be played through the TV set. I also saw that every home could use this miniaturized film cassette. Great libraries of special film containing much of the world's information would be available to anyone, just as library books are now available across the country. It didn't make any difference in my way of thinking that no such type of film yet existed, the largest film in use being 8mm, or that the technological obstacles looked horrendous. The idea was worth pursuing, and I knew I would do it. I talked it over with Ren McMann, then V.P. of Engineering at the labs, and he agreed. In that moment EVR was born.

Before presenting the idea to CBS management for backing, I decided it would help my cause if I picked up advance support from industry. As I've said before, CBS Laboratories is essentially an independent entity with just one mandate from Paley—go forth and make money. So I donned my salesman's hat and visited Eastman Kodak, which I thought would join me in partnership because of their interest in selling film. But it turned out that Kodak was faithful to the movie projector and didn't want to get into anything having

to do with the television screen. (Interestingly, Kodak later announced they were working on a Super-8 system that could be played on television through an attachment.)

In June, 1961, I approached several publishers. McGraw-Hill Book Company, which has a school-film division, was then looking into electronic education. They thought my idea had merit but that our type of player would be too costly to produce for educational purposes. Of course they said once we got started they would be happy to sell us filmed programs. Encyclopaedia Britannica also praised the idea but was equally discouraging about entering into the business.

After a few months all I could show for my salesmanship was a growing file of letters and a memory of some pleasant visits, but nothing tangible in the way of support. On the simple though illogical theory that where everyone else is wrong CBS may be right, I figured that the only recourse left was to work on my own management.

I targeted the next CBS annual budget meeting as the occasion for presenting my proposition to management. CBS corporate practice makes it necessary for each of the divisions—Columbia Records, CBS News, etc.—to get approval from management to develop a new device, or start a new project, even if the division funds such developments out of the profits it has made from its own activities.

One day in the fall of 1960 I arrived at the twentieth floor of 485 armed with a sheaf of charts, plans, and a high degree of optimism. Paley was presiding, as usual, with Stanton in attendance, along with Ned Pugh, the chief finance officer. It was customary at the annual corporate ceremony for me first to present the record of our year's progress at the labs, propose a budget, and then to introduce new ideas for possible investment.

I can recall Paley sitting at one end of the long, shiny table in the paneled boardroom, smiling debonairly and, as always, doodling on a pad of paper. At the appropriate time I described my idea about EVR and gave what I thought was a clear, impassioned plea for funds. I asked for a relatively small $75,000—about the cost of a minute of commercial network time—and stressed that the EVR system was not "blue sky," a region of the universe corporations shun, but was perfectly feasible. I brought out facts and figures. I quoted excerpts from McGraw-Hill and others and suggested that we might be able to deal with these companies if our own organization was behind the development of EVR. I concluded on what I thought was a high note, saying that if we started at once, we had a good chance to become a leader in a new form of educational television.

Paley looked up from his doodling and asked Stanton what he thought. Carefully choosing his words, Stanton said it sounded like a tough thing to pull off, though he agreed with me it might be a good idea for education. There was extra emphasis on the word *education.* We all knew the word was a good one at the time. With lots of reserve cash in the bank, CBS was in the process of thinking about diversification into educational areas. As I look back on it, this was a more plausible zone of acquisition for the company than the New York Yankees, which they purchased later and which promptly responded by ending up at the bottom of the league. (In 1972 CBS finally sold the Yankees for $10 million, a bit less than what they'd paid for the team. Paley's timing was interesting. In 1973 the Yankees turned around and landed in first place.)

As it turned out, sometime after our meeting CBS embarked on a voyage into education and publishing by ac-

quiring the publishing house of Holt, Rinehart & Winston (at an incredibly high price). Later they picked up the firm of Creative Playthings, a manufacturer and merchandiser of imaginative children's games and toys, and W. B. Saunders, a publisher of medical books and audio-visual aids, and a string of correspondence schools.

With this fairly amiable interest on the part of Paley and Stanton, I continued with a bit more confidence to expand on the possibilities of EVR. I drew a picture of EVR as the "video long-playing record of the future," an analogy that later was to grip the imagination here and abroad. I suggested that in time the EVR system might be tied in with our own Columbia Records Division and used in the home. As I made the last statement, I caught a look of displeasure on the chairman's face. It quickly struck me that I might have said too much.

Paley dropped his pencil, looked up, and flatly said no to the EVR proposal. His tone was edged with so much finality that everybody present became suddenly still. The meeting soon adjourned.

I returned to Stamford bitterly disappointed. My vision had seemed so clear; the idea was blazingly simple; the cash outlay was relatively small for its ultimate potential. But in my enthusiasm for EVR I had marched into forbidden ground, the home. Paley would not allow any of us to produce a device that posed a potential threat to broadcasting, even though ironically CBS was constantly embroiled in a battle to break through the limitations of its franchise from the government—and, EVR would help release some of its programming from government regulation.

Despite Paley's response I was determined to figure some way to carry my idea forward. It occurred to me that many

of our large projects at the labs were government-sponsored, mainly for the Air Force and NASA. Why shouldn't the federal government be interested in EVR as an aid to weapons training? Washington has a way of supporting research-and-development projects by raising the overhead fee on old projects and allowing the increase to be pumped into the new projects. Such a system, tricky at first glance, is good both for the government and for industry because the government becomes the instrument of innovation—something I am afraid industry often is not.

I asked John Maniello, the lab's vice president of marketing and a former Air Force captain, to contact the Air Force, which runs one of the world's largest correspondence schools, and state the proposition that they would be able to provide EVR video cassettes in correspondence courses and initiate a new kind of education through electronics. The Air Force representatives liked the idea and agreed to allow us $37,000, a modest amount—in fact, it was half of what I had asked of CBS. I would just have to make it do.

In 1961 we set up our operation in a far corner of the labs, where it would be out of sight of prying eyes. The hush-hush project began with two engineers, John Hollywood and Harvey Schwartz. Their job was to solve the problem of developing a miniaturized film system of high resolution and the associated optics so as to make the EVR idea workable. I checked the progress from time to time and when nobody was around enjoyed sneaking into their quarters to watch them make each tiny frame individually.

Much as I would have liked to throw all my energies into this new project, as head of the labs, I couldn't. For one thing I had to take care of the overall day-to-day problems. Also, I couldn't overexpose myself to one project, or the laboratory

would be thrown off its delicate balance. Morale might suffer if word got around that the president of the organization was favoring one research project or one group over another, particularly one in which I was personally involved.

Still, I must admit that I did emotionally favor EVR, although the only time I could add my own thoughts to the technical solution of its problems was during my vacation, when I would be unimpeded by the affairs of the labs. One of the knottier problems was the nature of the film movement through the optical system and its tie-in with the scanning process. So I flew with my wife, Diane, to the island of Eleuthera in the Bahamas, where I could lie in the sun and think and scribble in a notebook.

By the end of 1962 I felt it was time for Stanton to take a look at what we had done. Our group had solved the problem of the miniature film for black-and-white and we had a working system on a breadboard. We could run the film through the electronic guts of a TV set and produce clear pictures. Stanton came to the lab, took a good hard look, and emerged enthusiastic. He said he wished he could get equally good clarity on his own ordinary television set.

Paley's original turndown of the idea never came up in our conversations—that was yesterday's show, yesterday's rating. At my suggestion Stanton agreed to let me demonstrate our pilot model to the 3M Company. This company had pulled the labs out of despair once before in the years after the color-TV fiasco; they had invested several million dollars in our research, and we believed they had gotten a great deal from it. I thought they might just see that we now had something even more exciting for them.

Thus began my entrance into a kind of yo-yo of intrigue. Stanton's office made the arrangements with 3M, and shortly

thereafter he and I flew to St. Paul and showed blown-up photos of the device to a group of high-level executives from the 3M Company. The group included the President, Herbert Butow, and my old friend Carl Barnes, director of research. Two other men present were Bert Cross, the executive vice-president, and Robert Westbee, head of the photo and magnetics section. The group listened attentively to our presentation. They asked some questions; then, after a short deliberation, they turned it down. No reason was given.

However, Barnes, who had watched our presentation with great eagerness, could not forget EVR. When he left 3M for a position with FMC Corp. of San Jose, California, he persuaded his new management to invite me there to make a presentation of EVR. FMC's top management—Jim Hait, the president, and Paul Davis, chairman of the board—were impressed. They appointed a team to look into the market possibilities. They reported back favorably and began negotiations in 1963. FMC would pay the cost of further development of the system at CBS Labs, and CBS would receive a royalty when the development was completed and the device went on the market. FMC was so excited about the deal that they said that if CBS were ever to sell the labs, then an unlikely thought, they would like to have the right of first refusal. Everything seemed neatly settled. All that was needed was ratification by FMC's board of directors.

With events moving along smoothly and optimistically, I felt I could use a vacation, so I went to Europe with my family. On my return the first sign of trouble arose in the form of a phone call from Barnes. Something was wrong, he hinted, and he was coming east to see me; no more, no less. He arrived in Stamford a day later and sadly told me that the FMC board had met and everyone had voted for EVR ex-

cept one man, the chairman of the board, Paul Davis. Nobody could explain why after his original approval he now had second thoughts and had voted against EVR. An explanation given me was that as a self-made man with a strong ego, he didn't believe in supporting a project or acquisition unless he himself had thought of it. According to Barnes, there was considerable uproar during that ill-fated board meeting, with threats of resignation ringing across the table. But Davis's vote was decisive. Finally, he sent Jim Hait as his goodwill ambassador to apologize to Stanton and me and to try to undo the damage as gracefully as possible. FMC gave us the reports they had prepared for the marketing of EVR and said we could use them as we saw fit.

So there we stood, with no FMC backing, no money, no interest from 3M, and no CBS support. And in my hands, I felt, was one of the world's most intriguing little inventions; ironically, it was getting better all the time. The staff had contributed heroically to its improvement. My feeling at this point was that the world was mad and there was nothing to do but continue without support until the world lost its madness. A veteran of other forms of insanity, Stanton felt the same way and suggested that we approach Monsanto, whose nuclear-chemist head, Charles Thomas, was an old friend of his and had indicated he wanted to move the giant chemical company into new fields.

When the Monsanto chairman and his colleagues saw the device demonstrated, I knew Frank's choice was a wise one. They could hardly restrain their excitement. A joint task force was immediately set up, headed by the able Franklin J. Cornwell, director of advertising and market development, and then vice-president in charge of Monsanto's New York office, with the idea of pursuing a practical marketing pro-

gram and strategy. In the meanwhile Monsanto agreed to pay us a fee of $50,000 a month for six months to continue development of EVR. If at the end of that time the task-force decision was negative, the development would be ours. If they came up with something positive, we were bound to go into a deal with Monsanto out of which CBS would earn a royalty. Monsanto would also underwrite further development if needed and would contract for the manufacture of the players with other firms. Monsanto would make its money through marketing the entire system. It was a wonderful deal for CBS, one I felt sure would gladden Paley's heart, for it actually meant we could develop a moneymaking system without paying a cent for it.

How long would it take to develop such a system? I gave myself and my team a three-month deadline, and we worked on it day and night. In the spring of 1964 we agreed to hold a meeting in St. Louis at which Cornwell would make his report and at the same time one of our models would be shown to Paley. We had integrated the system into an ordinary television set and had recorded a popular television show, "Gunsmoke," on EVR film. Our first run-through worked beautifully, and we celebrated at a dinner at which Stanton was present. It was a memorable affair because I recall that Stanton was interrupted during the meal to be told by an awestruck page that President Lyndon Johnson was on the telephone. Stanton took the call and later confided that Johnson simply wanted to know how he had looked on television during a speech the night before.

Cornwell made the arrangements with Paley and reported back to us that the chairman was looking forward to our preview. He even suggested that Dick Lewine, producer of programming of CBS on the West Coast, join the task force and

handle the television shows for the new medium. According to my informants Paley was in one of his enthusiastic moods and was apparently now interested in the possibilities of novel home programming. Lewine in fact looked into opera, musical groups, and off-network comedy programs with enough exclusivity to avoid making EVR a handmaiden of other media.

I should have suspected something right there, but I was too excited over the turn of events. A few days before the intended meeting, as we were all sweating to get the system into perfect condition and with apparent victory in sight, I received a phone call from Stanton. "Peter," he said, "we're in trouble. You better come in and see me."

As soon as I arrived at 485, I could tell from Stanton's expression that something was indeed wrong. He came directly to the point. "The chairman took one look at the program plan and decided to call off the meeting," he said mournfully. "He further said that EVR would never work in the home. It would be too costly." What about Lewine? Paley said Lewine didn't know what he was doing in looking at home uses for EVR.

It was a crushing blow. Paley, who had gone so far as to pick his own programming man, would not even come to St. Louis to see the demonstration of EVR. How could the head of a large, responsible organization behave this way? How could he throw away an innovation that could do nothing but public good and would make money as well, because of a feeling, which I could believe was just short of irrational, against anything that appeared to threaten home television?

The outcome was a shattering experience for all the participants in the brave new world of EVR communications. Lewine soon left the company. Cornwell, who had labored so

hard and long with us, returned to other duties in Monsanto. I tried bravely to interest Cornwell and other Monsanto people in the educational possibilities of EVR, but they felt that it was much too limited. Only the home use would provide the volume of sales and profits that would justify the risk. So they too bowed out of the picture. Government funds had also stopped, so the only thing to do was to disband the project. Nothing was left.

# 11

# The Great EVR Sleigh Ride: Part II

WHAT do you do when you think you have one of the world's greatest innovations and nobody in high places seems to want it? Well, you don't succumb to the thought that perhaps your invention is no good after all. That is fatal. You console yourself with philosophy. Popularity, you say to yourself, is a fickle woman, and one must be prepared to lose her quickly to another bed.

In the case of EVR I felt I had not tried hard enough. If the chairman was unwilling to support EVR for entertainment in the home, he might still support it for other purposes like education. This was worth looking into. A consulting firm was hired to study the market. Their results indicated that there was a strong market in the educational area. Armed with this information, I met with Stanton and appealed to him to let the labs continue in a modest way to develop EVR. After all, I pointed out, Monsanto had supplied the bulk of the money, and we had gotten ahead on it. Stan-

ton cautiously agreed to let me continue. "But remember," he said in OK'ing my proposal, "don't sell it, or design it, as a gadget for the home."

"No home," I said. "Absolutely not."

So EVR fluttered back to life again, like a cat with the proverbial nine lives—this time not for home entertainment use but for education. One day, after we had been working on the project for some time, Stanton suggested that we might be ready to sit down with Paley for a new discussion of the project, but strictly, mind you, in the educational field. Stanton eventually arranged a summit meeting with Paley to see the device for the first time. We set it up for him in the boardroom. The program we showed was indeed educational—it was "Gunsmoke." The chairman watched the operation and the show closely. When it was over, he turned to Stanton and amazed us all.

"It's marvelous," he said. "Frank, I want the best man on it."

In the CBS world that usually meant a tough-minded station manager, and so Norman Walt, the tall, good-looking, intense manager of Station WCBS-TV in New York, was summoned to headquarters and asked by Stanton to take over the internal exploitation of EVR. Walt's station in New York was subsequently run by Jack Schneider, who moved in from Philadelphia.

Walt was impressed with the system, which was important for a nontechnical man who was in a position to sell EVR to the world. Walt even borrowed a computer to find a new name for EVR, but after some 2,600 combinations he gave up. EVR stayed simply EVR.

Walt also called in IBM, whose subsidiary, Science Research Associates of Chicago, was strongly involved in edu-

cational technology. IBM felt it was right for them to manufacture EVR and for SRA to program it in line with their other educational activities, and engineers came to the labs in waves to see the system that provided movies on demand on a home television set.

With IBM's solid initial interest as a spur, Walt holed up in a secret rendezvous place on 53rd Street, where he and his crew worked day and night, drawing up a plan for IBM's participation in the future of EVR. What he finally came up with was a proposal in which CBS would commit itself to a processing plant and IBM would manufacture the players, market the cassettes, and produce the programs. We also agreed to develop EVR in color. It was a fair arrangement, we all thought. But in the summer of 1965 CBS turned it down—stopped it dead in its tracks five feet from the goal line.

Looking back, I don't know exactly how it happened. Corporations are sometimes propelled into strange behavior by forces that are not easy to measure and delineate. The correspondence of the period shows only that Walt notified Stanton that it was not possible for the labs to deliver a color system for education at this time. I in turn pointed out that it was because we were diverted to "broadcast EVR," a system derived from EVR technology for broadcasting color via black-and-white, which was being pushed at the same time by management. I felt sure it wouldn't make any difference because IBM spokesmen had hinted to me that they would in any case move forward with black-and-white, with color following later. Stanton and Paley felt, however, that it would hurt our image if CBS didn't first go into color. We were in the process of switching from black-and-white to color broadcasting, and the CBS executives felt it was the wrong

time for the company to come up with a new medium in black-and-white, so they wanted IBM to delay until color was developed. I myself had hints that the contract with IBM (I never actually saw it) called for exploiting the home market as well as the education market, and that Stanton might have suddenly become concerned as to what would happen with the chairman if the contract were continued. The net result was that IBM executives joined Monsanto in thinking CBS was erratic. But CBS's decision was final. IBM tried to show interest and to proceed with black-and-white, but it was no go.

So once again EVR was dead. My dream was trapped somewhere in the tangled bush of the corporate jungle. EVR became a dirty word in the company.

It was ironic that just at this time Professor Albert Hill of MIT, a physicist who was a consultant to the Carnegie Commission on Educational Television, an agency set up to study and suggest ways of improving noncommercial television, came to see me about the new system we were developing. He had heard a rumor about it. With Stanton's approval I gave Dr. Hill and several members of the commission a private showing, after eliciting a promise from them not to disclose the invention. I felt it was important for a prestigious group of educators to know about a communications invention that I regarded as one of the most important since the invention of television itself. The commission later included a brief mention of the principle of EVR in their final report issued in January, 1967, hinting that it was a revolutionary development, in which the public could pick tapes from a library in the same way records or books are selected today. They also indicated EVR was only five years from completion.

But before this report was published, the EVR story was taken out of my hands and out of the hands of CBS management in a dramatic way.

The first I became aware that there was a new element in the picture occurred when I was awakened in the middle of the night by a phone call from Stanton. He sounded almost breathless.

"Did you see *The New York Times*?"

"I usually see it in the morning," I replied sleepily.

"This is too important to wait until morning," he said sharply. "Jack Gould has a front-page story about a video disc developed by us that can be slipped into a television set. I'd like to know how he got the story."

That woke me up. "Frank, I don't know," I said.

"All right, Peter. Don't say a word to anyone. If you're asked questions by the press, just say that you weren't working on a disc."

Stanton hung up, and the phone rang again. It was from London. A thoroughly British voice from Reuters was asking me about the "disc." I hesitated. I am not good at outright lying, but I did manage to say that we had no *record*, with emphasis on that word. This was, of course, literally true. What we had was a reel of film.

The next morning Stanton publicly denied Gould's story in a carefully worded statement. I knew Stanton was worried about the reaction at the SEC. Stockholders are supposed to be advised of new developments, and premature exposure in the press might result in embarrassing questions. As a matter of fact, the day Gould's news item broke CBS stock stopped trading on the New York Stock Exchange because of an influx of buy orders.

The official CBS denial embarrassed Jack Gould, and I

was personally sorry for that. Gould's reputation as a reporter was solid and well earned over the years. I myself determined not to indulge in direct statements that would call anyone a liar, and my information man at the labs, Joe Dine, worked hard on developing just the thing to say without letting Gould down. However, I am afraid the damage was done; the *Times* printed CBS's denial.

I was greatly puzzled as to how Gould got the story of the disc. Later I found out that while traveling on a train to a convention in Bilagio, Italy, Gould fell to talking to a visitor who had actually seen the "disc." In fact, Gould discovered that even the Italians knew about it. He called our development a disc because everyone else used that term, including the man (it turned out to be someone from the Carnegie Commission) who had first told Gould that he'd seen the device. It was described as seven inches in diameter and quite thin, a perfect description of the EVR cassette.

While CBS was busily denying the story to the press, CBS management was being shaken out of its lethargy. "If it's in the *Times*," said one executive revealingly, "it must be important." CBS decided then and there to take a closer look at what was going on in Stamford.

Meanwhile the Europeans discovered EVR and brought an even more exciting dimension to the story. The European participation in EVR began innocently enough when Jim Dalgleish, a former colleague of mine in London, called to tell me that a friend of his named Curt Swinton, a consultant to Borg Warner, wanted to help the firm get into educational technology. What he wanted, it turned out, was a low-cost teaching machine based on slides and sound. Jim thought our labs might be able to assist.

I saw Swinton, who in turn led me to a London publisher

of Viennese birth named Wolfgang Fogus, a stocky, forceful bear of a man, who puffed continuously on large smelly cigars. Fogus's claim to notoriety was that he had once roomed with Wernher von Braun, and remembers that von Braun wet his bed, thus complicating Fogus's boarding-school life. Fogus, who headed a small, prestigious English book firm he had sold to Doubleday, eventually finished telling me all about Fogus. Then, after listening briefly to me, he looked at a "phono book" (an album of recordings) for the blind that I had developed during my various inventing activities in suburbia.

Subsequently, as we met to discuss invention, I told Fogus about EVR. It so fascinated him that he nearly dropped his cigar. I even invited him to Stamford and showed him "Gunsmoke" on EVR, the first demonstration after the IBM fiasco. In virtually no time at all Fogus had rounded up publishers from Germany, France, Britain, Italy, and even from Yugoslavia. His own parent firm, Doubleday, was also interested; they saw the possibility of joining print to electronics and participating in a new world of publishing. The European publishers were interested in video cassettes in the home because they felt that would be the answer to breaking down state control of European television, a constant burr in the side of many European publications executives.

Interest in EVR abroad continued at so high a pitch that I felt impelled to tell management about it. Stanton said cautiously to go ahead but not to make any final commitments for CBS. However, the Europeans felt that CBS should do more to show their faith than send me abroad. Nonetheless, we were able to work out what I thought was a nice deal without CBS putting up money. A consortium was to be formed that would pay development costs. After the mem-

bers were paid off, CBS Labs as a partner would get a 20-percent cut on everything that came in as profit. I felt that Paley would love the deal.

The consortium came into existence slowly but interestingly. The members wanted confirmation from an independent electronics company as to the practicality, quality, and competitiveness of EVR with other contemplated video systems. Through a friend we got Philips, the leading electronics firm in Holland, to take a look at EVR. Philips representatives wrote an opinion for their management in which they declared that EVR was at least ten years ahead of other potential video-cassette systems, even those under development in their own laboratories. Philips soon asked to join the consortium, which at this time included one publisher, CBS Laboratories, Imperial Chemical Industries, Ltd. (the world's second largest chemical firm, which had been brought in by Fogus), and CIBA, the great Swiss pharmaceutical house.

Meanwhile we had discovered that a British photographic company called Ilford, Ltd., had a stock of silver halide film with better characteristics than the type of film we were using. Since high-quality silver film was scarce, we thought the best thing to do was approach Ilford to join the group in order to use their film. (We were so euphoric we were willing to cut everyone in.) While we did this, ICI and CIBA took over Ilford, thus pleasantly simplifying things. The consortium was shaping up with two giant companies in England and with little CBS Laboratories in America holding the key to the enterprise. I began to travel back and forth across the Atlantic.

On the way back from Europe after a final meeting, I phoned Stanton from the airport and told him about the business arrangement we had finally worked out. Stanton

thought it was wonderful, and when I arrived in New York, he called Paley into his office so I could report to him directly. I repeated my story of the arrangement. Paley thought it was great, too. "EVR must be good," he said. "Why should we be just a minority partner, with only 20 percent?"

"Well, we're not putting in a penny," I said, looking at Stanton.

"Okay," said Paley, smelling profit for the first time. "Let's do something about that."

That startled me. Paley was actually suggesting putting money into EVR. I found myself in a new role. I objected.

"We have a good deal right now," I said. "We have all the U.S. rights at no cost, and 20 percent of the world rights. Why change it?"

"Why not?" said Paley.

"We've been in and out of EVR," I said doggedly. "We've blown hot and cold. It will take a lot of money, and it will be a long time for the investment to pay off. I don't believe you will have the patience to wait."

Stanton interrupted mildly. "Bill, Peter may have a point."

"No," Paley said. Then he turned to me. "You may be a great scientist, Peter, but you're not a businessman. We need a businessman to conduct the negotiations—and CBS must have 50 percent of the partnership."

So Felix Kalinski, a handsome, youthful former Air Force colonel and West Point graduate, who was then CBS vice-president for planning and obviously a businessman, was given the job of handling the delicate international financial negotiations between CBS and the Europeans. Kalinski quickly announced that CBS would increase its participation in the partnership. The partners were delighted.

Secretly I was uneasy. I didn't think that Paley, a man who

had objected to his company's putting programming into EVR, would give the EVR business abroad the long-term support it required.

But the first source of trouble was not from Paley. Philips decided it wanted a bigger piece of the pie than the one-fourth they had agreed to earlier. Indeed, they now wanted to control selling and manufacture of the machines, leaving the software to us intellectuals. This behavior, I thought, was typical of a good deal of the businessmen in small countries. Unable to stand up to bigger countries on their own, they had the urge to achieve power through control of international consortia. In this way they could counteract the powerful influence of American technology abroad. The Swiss have had similar impulses.

Now ICI and CIBA became unhappy with Philips because they didn't want Philips to have a monopoly over the EVR manufacture. The rest of us became restless at this turn of events. I myself was getting tired of commuting to London, and believe it or not, delightfully plush though it was, I was getting bored with eating in the Savoy Hotel dining room.

In New York Kalinski played the EVR international game close to his vest, and I was discovering that I didn't always know what was going on in my own corner. The next thing I heard, for instance, was that Kalinski refused Philips's demands and that they were leaving the partnership. I thought that was a mistake. Even though Philips had grand ambitions and its representatives were abrasive, I felt we should have sought ways to keep them in the organization. Philips, moreover, was an old associate of CBS and a friend of mine. As things turned out, the company that could have helped make EVR a sensational success in Europe went into magnetic tape recording rather successfully on its own. When Philips

left, we were without a manufacturer. Disenchanted at the turn of events, Doubleday opted out, too.

The consortium was finally formed without a player manufacturer and with CIBA-ICI and CBS fifty-fifty partners. CBS would have all the rights for North America. Back at CBS headquarters, now the formidable, dark stone and glass skyscraper called "Black Rock" to which the company had moved in 1965, a new group was created known as Comtec, with Kalinski as group president and serving as chairman of the partnership. An EVR division was formed and put in care of Robert Brockway, whose job was basically to market EVR and manage the processing plants. This took the entire matter out of my hands.

The first job of the EVR division was to locate a manufacturer, and in 1968 Brockway worked out an arrangement with Motorola, which would manufacture EVR under exclusive license for a number of years. At no time would Paley countenance putting money into software. I raised the issue a number of times at management meetings, as did Kalinski and Brockway, but Paley still saw EVR as competition for television broadcasting and said he would not support programming for EVR. "Let everyone who wants to produce a program bring his goods to our processing plant, and we'll make money on all of them," he declared.

In September, 1967, we finally felt we were ready to make a public announcement on EVR, mainly because of the European interest. When the release came out, Jack Gould made the most of it in his *New York Times* column the following day, pointing out quite clearly that despite CBS's denials, his earlier story had been basically correct.

The debut of EVR in 1968 at the New York Hilton was marked by all the terrors of opening night. The sets sent to us

by Motorola didn't work as well as I thought they should, and I had to send for those in the lab. The equipment was taken to an electrically hostile environment, where it was plagued by the wrong voltage, by outlets in the wrong places, and by unfavorable lighting. Russ Dupree and Don Rigley, engineers, spent the night in the lab to process cassettes and make sure we had the best version, which was rushed down to the Hilton. The films actually had come in the day before. At the Hilton, two of my associates, Al Goldberg and Robert Castrignano, and I worked through the night.

That evening before the debut, a corporate team that included sparrowlike Bob Brockway and ruddy-faced Kidder Meade came to inspect the entire operation. They kept asking whether everything was working. We kept responding that nothing worked. People ran in and out with tools, sets, equipment. A constant stream of people marched from CBS headquarters across the street to the Hilton, occasionally by way of the bar. To top it off a science writer, Earl Ubell, sneaked in with camera, cable, and an air of harassed indifference to photograph the entire event for CBS. His wires and equipment got in the way.

At one point one of the machines failed to work because a spring had fallen out, and ever-ready John Christensen stuck a fat finger into the equipment and couldn't get it out. We pulled and pulled and finally dislodged his finger; then we found the spring. While I was consoling Christensen, the second machine was brought in from the lab. Brockway flipped on the lights; I thought they reflected too much on the equipment and flipped them off. Pulling rank, Brockway flipped them on again. I flipped them off.

The following day, after a sleepless night, we prepared the showing, "Mission Impossible," followed by a marvelous ed-

ucational film made in Britain, "Sex Life of a Grasshopper." In introducing it I made the offhand remark that after seeing two grasshoppers together, the audience might regard life in grasshopperland as dull indeed. The remark was greeted with laughter, and afterward the press people there said that the presentation livened up the conference. Next morning, after a night flight across the Atlantic, we gave a similar demonstration in England. In both cases I thought we were positive hits.

Imagine my surprise, therefore, when Felix and I found ourselves together on the flight home from England, that he suddenly mentioned to me that Stanton liked everything about the debut except one thing—the film. And it was not "Mission Impossible." Stanton, Felix said, was incensed over "Sex Life of the Grasshopper," saying it was lewd and immoral, hardly worthy of CBS. In fact, Felix chewed me out. I couldn't believe it. The film had been highly thought of in England as an educational movie. I couldn't be sure what anyone could read into the behavior of the grasshoppers; I wasn't even sure by looking at the film that the grasshoppers were actually producing other grasshoppers.

In view of CBS programs that I was familiar with, I am afraid it told me something about the taste and the myopic morality of those in high places. Management punished me over this film by not permitting me to show EVR at the upcoming stockholders meeting.

Time went by. In 1969 it seemed as if EVR was still not ready for the big time. I had brought in Ted Conant, the son of the famous educator, James Conant, to help in selling the educational potential of EVR. Unfortunately, Ted's abilities in this area were never fully utilized because the corporation went in another direction.

At this time my personal relationship with the company was playing a role in my thinking about the future. In 1969 I was approaching my sixty-third birthday, and I knew that according to a law laid down by the corporation, retirement was mandatory at sixty-five for everyone except Paley, who in a dramatic moment one day announced that he, the founder, would not leave the company at sixty-five. He was now almost seventy. (By the same corporate illogic, Frank Stanton, who came to CBS ahead of me, retired at sixty-five to become the president of the Red Cross.)

I come from a long-lived family. My mother was then eighty-six, and my grandmother died at the ripe old age of ninety-two. I felt more vigorous at sixty-three than I had felt before and worth more professionally. Surgeons, conductors, and painters go on working until they can no longer produce. Why not research scientists? So I decided to ask the company to let me know what I should do. I discussed it with Stanton and Kalinski. Our conversations were generally amicable and gave no hint of what I would face later in the company.

A CBS executive and a member of the board whom I knew before (I shall call him Radford Byrne) came to Stamford one day and told me that the company was obliged to enforce the personnel rules so that they applied to everyone. He urged me to withdraw from the labs, rather than wait for the inevitable day of retirement two years hence. Then very calmly he asked me whether I would like to go into business with him.

Over the years I had been approached to go into private business and had always decided against it, preferring to build a reputation within the company. But this approach

was somewhat of a shock. It had an air of corporate Machiavellianism about it. At the time I didn't respond.

In September Byrne broached the subject of my post-retirement future once again. He told me he had discussed it further with Stanton and Jack Schneider, who was now a member of the board. They had agreed that I would relinquish presidency of the labs and become a consultant to CBS. This would be technically in keeping with Paley's law.

"What would I do as consultant?"

"All sorts of things."

"How about EVR?"

"It's over the hump now. It will go on without you."

I sat quietly, watching Byrne. Finally, he asked me for my reaction.

"No," I said. "I continue in the same way, or I build something new on the outside."

Byrne looked visibly relieved. "That's what I figured you'd say," he said. "Now I can tell you that I am leaving CBS at the end of the year. I have financing of some $5 million and I would like you to join me. I'll put some front money in it. You'll have the same salary and be in charge of technical development, just as you are here. The company doesn't need me, so I see no reason why I shouldn't leave CBS."

For lack of anything else to say, I said I would think about it.

All the way home I wondered what this highly placed executive was up to. I called Stanton and asked him about the plan for me to become consultant.

"What?" Stanton yelled. "I never heard of such a plan. I think we better meet with the chairman."

At the meeting my corporate associate produced charts showing his plans for the future of his group at CBS. He had

hired Arthur D. Little, a management consulting firm in Boston, to look into the future of electro-optics. He had also checked it out with several people in my lab without telling me. His chart showed how the labs would prosper in the field, worked out over the next five years. On the chart was the movement of the finger of fate for me. I was to leave the labs and become consultant to the company by the end of the year.

I looked around me at the board table. Paley's secretary was coming in every fifteen minutes with a pill and a glass of water. The chairman gulped it down. (Later I heard he had a sore tooth.) Schneider, in his usual neat entertainer's suit, was drowsing. My associate John Christensen was with me. Radford was talking about obscure technical items, and I wasn't really sure he understood them fully. Stanton was absolutely silent. The atmosphere trembled with unreality.

"What about EVR?" I heard the chairman ask. "Won't we need Peter for that?" So Paley had not been in on the consultant plan. The entire idea was apparently Byrne's.

"Anyone can now run EVR," said Radford diffidently.

Christensen couldn't restrain himself. "It is asinine, Mr. Chairman, to let Peter out of the labs," he blurted. Stanton kicked Christensen under the table.

"Well, John," said Paley. "We do have strict rules. I've made only one change in them for myself as founder."

John shook his head pluckily. "It's asinine," he repeated. "Why not sell the labs?"

At this point Schneider roused himself. Suddenly everyone was alert.

Paley said he hadn't thought of that. "It's worth examining," he added.

Thereafter the name Goldmark hardly came up. In fact,

the meeting shortly came to an end. "Let's meet again," someone said. "Right?" "Right."

Meeting adjourned.

The next day I was on the way to London to talk to members of the international partnership. At Kennedy Airport I received a phone call from Byrne. He talked about a few minor matters and then asked if there was anything else. I guess he meant whether I had made up my mind on his proposition. "Have you thought further about what we discussed the other day?" I said no. There was a pause.

"OK, call me when you get back," he said.

In London, however, there was a new bombshell. Fogus told me that he had met with Byrne earlier. In utmost confidence, said Fogus, Byrne had revealed to him that he and I were in agreement, that I would be leaving the company, and so would he. Fogus knew of my retirement problem but was shocked at this news. He had not thought I was going to leave CBS earlier, and certainly not in this way.

Suddenly I felt I was in the center of an international intrigue. Basic loyalties came back to me. I felt I had to alert management. On the way back home I composed a memo to Stanton, which I handed to him on my return.

Stanton read it and immediately phoned the chairman, who was at the St. Regis Hotel, where he keeps a suite so he doesn't have to commute to Manhasset, Long Island, from New York every day. Stanton told me not to talk to Byrne till I heard from him.

That night he called to ask whether I'd heard from the chairman, who he said is confused over the matter. I said no. On Tuesday Stanton had talked to the lawyers in the company. He told me to confront Byrne with the memo while Bob Evans, the company lawyer, was on hand. "I want you

to hand him the memo and tell him you want Evans in on the meeting," Stanton said. My heart was pounding as I went toward Radford. I handed him the memo. While he was reading it, Evans walked in. Byrne's face turned red.

"Every word is a lie," he said.

Evans interrupted. "I've known Peter for thirty years," he said. "He doesn't lie. There must be another explanation."

Then Byrne broke into a grin. "I'm just kidding, gentlemen," he said. "I heard rumors that Peter was planning to leave CBS to join another group, and I wanted to know whether it was true. So I prepared this little scheme to test him. I must say he came through with flying colors."

"What about Fogus?"

"Fogus is a liar," he said flatly.

The next day Evans was dispatched to London to check out Fogus's story. He looked at my notebook. He heard the story. The suspense was thick everywhere. But in the labs only Christensen knew what was happening.

Finally, Evans was back. He phoned and I couldn't restrain myself from asking, "Is it bad for me or for Radford?"

"For Radford," he said. The following day I learned that Byrne was leaving the company. Perhaps Byrne, a former military officer, didn't believe that the upper echelons would ever take the word of an underling over his own word, or perhaps he thought Paley's faith in him and in his background would be enough to sustain him. I am sure he felt it was a good gamble to approach me because he knew I wouldn't accept the position of consultant if it meant separation from the organization I had built up and nursed along for three decades.

By now video cassettes were appearing on the market. Secrets cannot be kept for long, as the U.S. Government experi-

ence with the nuclear bomb can testify. One of the first video cassettes was put out by Sony. Soon AVCO (Cartrivision) IVC, Panasonic, and Philips came along with their own system. Even RCA, our arch-competitor, got in the act with Selecta Vision, a proposed system based on using laser technology and holography. RCA announced a $50 million project devoted to programming. The entire field was growing—a lot of it on paper.

In Berlin in 1970 the Germans demonstrated the first TV recording on a gramophone record—the video-disc concept Gould had once reported as my invention. The video disc—a thin, plastic record like the familiar giveaway record—was developed by Teldec, a research-and-development organization owned jointly by Decca in the United Kingdom and AFG–Telefunken in Germany. I saw a demonstration in Germany when it came out and was impressed with the quality of the reproduction and with the fact that you can stop and start the mechanism to show individual pictures. It is also interesting to note that the video disc is not a twentieth-century idea. My old favorite inventor John Logie Baird was there first. He recorded video signals on a 78-rpm wax disc back in July, 1928, and actually sold records for play into the Baird television systems.

We had created our own Frankensteinian competition. Some companies stressed the home recording possibilities of video tape and Super-8mm film, and the business press began to demean EVR because of what was termed the limitations of home recording, criticizing us and our system as a trick to force consumers to buy recorded programs. This was actually not an approach that concerned us; we never thought anyone cared about home recording. But stirred by the outcries of the critics, I had the idea that we could take home black-

and-white photographs, process them in the EVR plant, and play them back in the EVR player on the TV set in color. I asked for money from the corporation to try it out.

The company said no, but once again I decided to follow my own instincts and to proceed anyway. I asked Bill Glenn, an outstanding physicist at the labs, now director of research, if he would be willing to be my "partner in crime." He enjoyed the thought, and in no time at all we were photographing still pictures on black-and-white film and playing them back on EVR color equipment, thus proving the principle that we could make home photography for EVR. Glenn and I received a patent on the process.

I thought this addition to EVR technology was worthwhile, and we got support from several firms abroad who wanted to put money in it. I got some flak from CBS management, which contended it was premature. Brockway, for instance, said it would ruin his marketing strategy, which was directed to educational institutions. People he dealt with, he said, were interested only in prerecorded programs.

Meanwhile, CBS built a processing plant in Rockleigh, New Jersey, and together with the partnership they built another plant in Basildon, England, outside London. In my opinion CBS made all the mistakes in the book in the course of equipping and running the plants. Among other things, the company went ahead with plans without consulting people at the labs, who had the expertise about EVR technology. This created catastrophic conditions and costly delays. They hired a movie film man who knew nothing about video techniques. He bought the wrong machine and hired the wrong crews. There were breakdowns and headaches because the operation was complicated both electronically and photographically. I had to call an emergency meeting at one point

to establish some kind of direction for the plant and urge hiring of a video man to take charge of the operation. The company finally did. On top of that sales predictions were not met, and Motorola delayed production of players. We lost time, while the competition caught up. In 1970 CBS posted a loss of $14 million, and Paley, it was rumored, was hopping mad.

The biggest mistake in my view was that CBS was willing to take on the role of duplicating the work of others, putting programs on a master and pressing them into copies at a fee, but they wouldn't go into their own programming. Time and again I urged the company, as did others, to sell cassettes with content, so the company could obtain income not only from duplication but from the use of its own storehouse of talent. With programming we could make up for any losses during the startup period, before we reached the break-even point of 500,000 cassettes a year. On one occasion Ted Conant, the labs' educational director, went to New York to try to sell a series of Black America programs, but nobody listened.

Paley insisted we couldn't program the medium, which is a bit like a newspaper staff with lots of editorial talent deciding only to print other people's papers and not its own. I must say that other companies also kept away from programming, but these companies were essentially manufacturers. The CBS situation, with its own library and its own talent bank, was somewhat unique.

As CBS policy grew clearer, various groups that initially liked EVR began to back away. *The New York Times*, one of the first major educational program customers, pulled out. Rumors began to fly that only pornography would survive on EVR.

I plugged for EVR in education and developed something I named "knowledge EVR"—a video reference book. I felt that the written word—rooted in a 500-year-old invention—could in our unique age use the help of electronics, a medium more suitable for a fast-moving world. EVR technology included all the elements to make learning effective and fun. I do not hold with those critics who see in this arrangement a kind of electronic guruism, which will cause the written word to die out. The written word, the perfect expression of the abstract in civilization and the reflection of the highest attribute of the brain, will survive, I am sure, no matter how hypnotically primitive the television set behaves. To use a homely comparison, bringing a dog as a pet into a home does not displace the child. It simply widens and enriches the household experience.

In my view EVR was on the brink of spawning a new series of industries, but Paley fought it, almost as though possessed of a death wish. Instead of opening a new world, Paley closed it in 1972, when he announced that CBS was abandoning EVR. CBS's share in the potential of EVR was sold to the European partnership, which now was joined with five powerful Japanese firms to continue producing these cassettes. And after leaving CBS I became, ironically, the partnership's consultant.

# 12

# Spies in the Sky

SOMETIMES invention brings its richest satisfactions when the inventor least expects it—often after he's quite dead. But not always. For instance, I remember that day in April, 1969, in Houston, the manned space flight center of the U.S., when George Low, now the associate administrator of NASA but then the chief of the Apollo spacecraft project, announced proudly that NASA had achieved a major technological breakthrough. That's a word I enjoy, and I wanted to know more. Low went on to explain, as I heard the story, that the breakthrough was a new color camera that was to be used by the astronauts to beam pictures of the moon's surface back to earth. This was the camera that eventually brought into millions of homes the wonderfully clear color shots of the moon exploration.

Low's description of the camera was clear, precise, and familiar. Too familiar. Here was my twenty-eight-year-old television camera, reduced in size for space usage, but containing the basic color wheel and field-sequential system that I had left sadly on the Boot Hill of invention back in 1950, when the RCA "compatible" system came into vogue. The

space camera was credited to Westinghouse, a subcontractor of the Apollo project.

What galled me even more was that shortly before, CBS Labs had shown NASA how black-and-white could be converted to color and had demonstrated our small color camera from our medical work. The astronauts loved it and insisted they use it on the flight to the moon. NASA asked Westinghouse to look into it, and Westinghouse representatives approached me. When we didn't agree on price, they decided to build the camera themselves, using the field-sequential idea.

The day after Low's talk I mentioned to Leo Murray, my PR adviser, how a funny thing had happened in Houston. As I told him about the camera, Murray, alert and press-wise, immediately sensed a story. In minutes his phone began to sizzle. Two days later, on April 5, Jack Gould broke the story in *The New York Times*, leading with:

> One of the classic controversies in the evolution of electronics—the fight over the introduction of color television—has come full circle, not on earth but on the moon. In an ironic footnote to the history of visual communications a color TV system once deemed too crude for use on the ground has now been adopted as the sophisticated tool for the relaying of tinted images from space.

Gould then went on to tell his readers how we at CBS Labs first broadcast color TV and won federal approval for the field-sequential system, only to lose it to RCA after a long battle through the courts.

After the unnerving problems of EVR, it was uplifting to one's flagging spirits to read Gould's story and the headlines that sprouted tall and straight from its seed: "The magnificent failure became the hero of space." "Moon TV owes much to Stamford genius." "His camera gave color to Apollo

10." The Westinghouse staff, which had been annoyed at first at being upstaged, eventually included mention of our early work in their news releases. To top it off Walter Cronkite, who administered the great space extravaganzas from a desk piled high with heavy looseleaf notebooks and surrounded by the trappings of artificial space technology, was persuaded to reach into the outlying territory of his company and interview me, somewhere between astronaut Wally Schirra and science-fictioneer Arthur C. Clarke. It was gratifying to know that we had at last made a noticeable contribution to television. I could only hope that Paley was watching.

The chairman's view of space, from all I could determine, was nothing more than a larger stage for show business. Yet by a curious set of circumstances it was Paley who first launched the labs into the space business and sent CBS on a new trail of exploration. In 1955 Paley called me to relay a message from General Elwood Quesada, former head of the Air Tactical Command, who had just joined Lockheed to start what was to become the company's missiles and space systems division. Quesada told Paley he had something exciting in the works and he wanted to talk to me in private about it. I knew nothing more.

Talking to the general in private was no simple matter. First, I had to obtain clearance from Air Force intelligence, a process that involved several days. When I was finally cleansed and certified as suitable to handle classified information, we arranged to meet at his office in a corner of a large loft, which by the way is now the keystone of the entire company. There a short, dark, stocky man greeted me and got right to the point. Lockheed, he said, was organizing a team of engineers and scientists to develop a "space camera system"—the modern version of the aerial spy camera of

World War II. The press later melodramatically and improperly nicknamed this spaceship camera the "spy satellite," because it would pass in cold silence several hundred miles over the earth, with its eye fixed on the earth below.

The proposal had been made before Sputnik and demonstrated the advanced thinking in technology that was going on in some quarters of the Pentagon at the time of the cold war.

It also indicated that we were not above a bit of spying in the national interest. Space photography seemed to have strong advantages over aerial reconnaissance, even over the Lockheed U-2 plane, whose very existence was then being denied by the government. In space it was clear that the camera was out of range of antiaircraft weapons and even out of the atmosphere of the country over which it was flying. The space camera also could provide clearer and fuller coverage over a larger area than could any of our planes. In fact, depending on the period of the space camera's orbit, it could take pictures continuously over the same site a number of times, every twenty-four hours, day after day, until the system died.

According to Quesada, the problem was not the rocket itself. He was using an Atlas ICBM as the first stage; the camera payload was in the second stage. Quesada's main concern was to find a photographic system with such high resolution that it could be flown as high and as fast as planned and still transmit accurate pictures of what was going on in parts of the earth we were interested in.

Quesada had provided me with only general details, but I gathered that the Pentagon had been in the process of examining several alternatives. One idea was to use a television camera and a means to store the television pictures until the

system passed over a friendly ground station. Then it could link up by radio and pass on the secret pictures. This idea had been recommended by RCA; unfortunately, the pictures lost detail in the process.

Another possibility, though somewhat difficult to carry out, was to trigger the vehicle to drop its film package into the ocean at a selected spot where it could be retrieved. The third suggestion was to take the pictures on special film, process it within the system, and send the finished product immediately back to earth by radio. The advantage would be that the high resolution would be maintained. The big question that Quesada asked was whether I, being in the communications business, could design such equipment, and would I care to do so?

Here was an opportunity to lift the laboratory out of the precarious position into which it had fallen only two years earlier in 1953, when the color TV fight had been lost. Lockheed could be the angel we were looking for. It might mean a second life for CBS Labs.

Before I could say yes, I spent some time thinking of the technical problems involved in the matter of transmitting and receiving high-resolution pictures from space. To transmit pictures, the device had to generate what is known in the TV business as a "flying spot"—an intense beam of light that rapidly scans a film or image from point to point. As the reader may remember, each picture on film is made up of thousands of light and dark areas. When the light spot strikes either area on the film, it triggers an electrical signal in a tube behind the film; the strength of the signal depends on the amount of dark or light in the film. When the spot hits either on the film, it produces little or no signal. A light area generates a signal. These signals are then collected elec-

tronically and reconstructed into the picture on a TV screen.

The problem of scanning in space is that the great distances involved require packing into the film more information than you do ordinarily, so you need a system that is able to distinguish among the greater number of changes in the dark and light areas. This requires a narrow beam for scanning, a higher intensity light, and a greater degree of screen brightness—not too bright, of course, or the transmission will burn the phosphor and spoil the picture.

Suddenly I remembered an article I had written in 1935 and published in a British magazine. The article revealed how to get more visual information out of a beam of light by focusing it on a tiny rotating drum (whose surface is covered with phosphor) instead of a flat screen. On the drum the dot of light can be used to get more brightness out of the phosphor because you distribute the bombardment over a larger area, as the drum rotates. The greater light intensity represents more information. I applied this rotating drum idea to the space tube and proposed what later was to become known in the trade as the "line scan tube." This tube became a new tool in high-resolution readout, that is, the ability to clearly distinguish objects on the film, and is used mainly in military systems.

A few weeks later I felt ready and called Quesada to say we had a solution. I met with Lockheed representatives in a Washington restaurant and told them I thought I had worked out the answer to the high-resolution reconnaissance system—a method to read out the information and reconstruct it for evaluation. They seemed to like the idea. In fact, as the meeting drew to a close, the Lockheed representatives felt optimistic that we would win the government contract to develop the system. If it came to pass, it would be the largest

contract our labs ever had, perhaps $200 million, involving camera, processor, scanners, transmitters, and their counterparts on the ground. I saw CBS Labs becoming a leading force in space communications. And there was a fitting touch to the story. RCA would have to drop its bid for the first reconnaissance space camera system in the U.S.

However, an unexpected development placed a stumbling block in the way of our consummating the contractual nirvana. The obstacle turned up in the form of an efficiency expert named Byron Cherry, who was hired by CBS management to examine the internal workings of the company and make suggestions to improve its profits. At the time CBS had six division heads—from CBS News to Columbia Records—but lacked a financial vice-president and planner who could guide the company into the most profitable routes. Stanton told me at one of our monthly dinner meetings that he had found a "fantastic" guy for this position, recommended by no less a personage than the president of General Electric. "I was lucky to get him," admitted Stanton.

At my first meeting with Cherry we shook hands, and he looked at me speculatively. "I heard about you, Dr. Goldmark," he said, emphasizing the "you." "One of the first things I want to do is look into your operation."

He did, and from that moment things rapidly went downhill. Cherry poked around my lab as happy as a seagull in the wake of a trawler. He asked hundreds of questions and collected lots of information and opinions. When he had finished, he told me with all the triumph in his voice of one who had uncovered the secret of life that my operation was no good. Moreover, he was going to recommend disbanding the lab. I am afraid that my Hungarian temper rose up. I told

him if he didn't get the hell out of my laboratory, I'd call the guard.

"You wouldn't dare," he said.

"Try me," I said.

Cherry didn't take the challenge. But the upshot of the investigation was that he immediately reported to Stanton that CBS didn't need the lab, and if the company decided to keep it, I shouldn't be the one to run it. I think Stanton was deeply concerned. He had a feeling for research, and I flatter myself that he had a feeling for my contributions as well. It was hard for him to accept Cherry's cold recommendation with its potential body blow to the future of CBS's role in technology. I revealed these feelings in continuing meetings with Frank and told him bluntly at one point that Cherry couldn't be a big man or he wouldn't be spending so much time on so small a segment of CBS's growing empire.

Stanton decided to do nothing about the Cherry recommendation. But with Cherry boring from within and with RCA on the competitive flanks, I was in nervous turmoil. More than ever I needed the stabilizing influence of a Lockheed contract.

It was Cherry's irascible nature that contributed to his own demise. Among other things, on one occasion he arrived at CBS and got into a brawl with a bus driver when he insisted that the driver let him off in front of the CBS building at a point that was not an authorized bus stop. The driver refused, and there was a near fist fight. The incident made colorful copy for several newspapers.

Eventually complaints about Cherry began to mount. At one of our management dinners Goddard Lieberson, the president of Columbia Records, inquired gently whether

Cherry's role in the company was more than that of a financial expert. He then went on to say that Cherry was poking around his domain, at which point I couldn't restrain myself from telling my experience. Others piped up and said he had been on similar escapades in their areas. In the face of this unanimous uproar Stanton said he wouldn't tolerate anyone like Cherry on the staff. We all broke into a cheer. Stanton told me later that he had to personally escort Cherry from the premises.

Cherry's passing through CBS left his imprint on the Lockheed negotiations. He had recommended that the $200 million Lockheed contract was too much for us to handle because, he pointed out, the company didn't have the funds to assume the huge financial responsibility of ensuring delivery of the entire system. This argument held some weight with management, though it was unfounded because the innovative nature of the project put it on a cost-plus-fixed-fee basis in which the contractor couldn't lose. I argued that we could certainly handle it and that the contract would make us grow into one of the most formidable research organizations in the country in the space-communications area. But to no avail. I don't recall that Paley and Stanton ever formally turned down the offer from Lockheed, but they did nothing to advance it either—a characteristic that my associate Christensen aptly called "conscious indecision." The result was that the Air Force awarded the prime contract to Eastman Kodak, and we were left with just the subcontract to develop electronic scanning in the vehicle and on the ground, which amounted to about a million dollars a year for several years. This was our debut in the space business.

The engineering development of the scanner, a mixture of

artistry and logic, involved a number of steps by several groups. A team comprising engineers Bob Azud and Ray Heck began work in New York. Later my able colleague, physicist Bob Rutherford, a distant relation of the famous Lord Rutherford of Cambridge, whose work I had questioned in Vienna in my bachelor's degree thesis, orchestrated much of the work and brought into practical utility for scanning the idea of the rotating phosphor drum, which I had suggested to Lockheed. With this new type of electron tube we began to make progress.

Unfortunately, the first drum we designed spun erratically in its evacuated container and fouled up our images. To eliminate this trouble we had to improve the vacuum lubricant. This proved to be tricky because the usual wet lubricant available spoiled the vacuum; as for dry lubricants in vacuum, we studied them for a year or so and found that they didn't work either. NASA's multimillion-dollar space-reconnaissance project in effect awaited the discovery of a dry lubricant that worked—a modern case of a kingdom going down to defeat for want of a nail, or worse, for want of a bit of oil.

I would like to say the solution came to me cerebrally, but it didn't—it was resolved because of coincidence. One day, while I was in Europe on business, I heard there was a lubrication physicist in Switzerland who understood the process. I immediately flew over to see him. His name was Fred Kaspaul, and he proved to be a quick-talking man with white, flowing hair and a thick Swiss accent. An individualist, he operated from the basement of his home, where he and his wife literally slept and ate vacuum pumps. In fact, the Kaspauls' bedroom led to the vacuum lab, which was in the base-

ment where the children played. At the age of six the youngsters knew more about vacuum seals and chambers than they did about lollipops.

Here was a situation that I instinctively admired—a free-wheeling technologist operating from the traditional place of genius, the basement. The Kaspaul family looked quite happy living in a neutral country with their vacuum world, and I felt a bit guilty in acting as the agent to remove them from this idyllic setup and transfer them to the sterile, controlled, junglelike atmosphere of the corporation. They seemed quite enchanted over my proposal, however, possibly because it was attached to a reasonably attractive salary, and they packed up and came to America. Or, to put it more accurately, we packed and moved Kaspaul, his wife and vacuum-knowledgeable children, and his entire laboratory to the United States. We also had to get Kaspaul a special visa, and since as an alien he couldn't get clearance to work on a classified military project, we moved to declassify the lubricant. Who ever heard of a secret grease anyway? When we finally got to work, Kaspaul solved the problem and we finished the system, which went into the reconnaissance camera. On some night or day while nobody was looking it was lofted, and I suppose it carried out its duties and made an important contribution to our military-intelligence operation. As for the lubricant, it became important in its own right and today has many uses, not quite as romantic as reconnaissance but equally significant in certain quarters.

As I said, I do not know what our space camera has done, but in general I think remote surveillance is a good thing because it contributes to international stability. This may seem odd to some people such as pacifists and other idealists. But

the truth is that spies neutralize one another, and each side knows what the other is doing. When one side knocks off the other's intelligence sources, then real trouble begins. One day I heard that the Russians had responded to our reconnaissance camera system by lofting one of their own. It meant that the Russian and American cameras would be passing each other as they circled the earth, each smugly loaded with its own film. I had the irreverent idea, which I suggested at a luncheon with my colleagues and Pentagon representatives, that we could save money by exchanging photographs in space. "Let's put the billion in the kitty and spend it on important things in science," I said. But the world is much too serious to see itself in this kind of perspective, and I didn't get any response. Interestingly enough, RCA's proposed reconnaissance satellite, which was abandoned when our system was chosen, was rescued by the Army, who nursed it into becoming Tiros I, the nation's first weather satellite. It was launched on April 1, 1960.

It was around this time, with the beginning of the Kennedy era, that a new life dawned for those of us in science. We had been doing bits and pieces without seeing the entire picture. Kennedy showed us we were embarked on a national adventure. The key to it was space. The sudden illumination reminded me of the philosopher who compared life to a weaver who weaves one side without knowing what the threads are arranging themselves into. Only when he comes to weave the other side does he begin to realize there is a pattern.

As a part of the long-range planning preparatory to conquering the moon NASA put out a request for mapping the lunar orb, placing stringent requirements for resolution. It seemed to me that our reconnaissance system was just the

thing, and suddenly a device that had a limited usage for the military became a key part of the pattern being woven by technology.

In early 1966 NASA gave us the contract for what became known as the Lunar Orbiter, a satellite that orbited the moon and took pictures as it flew. We had to build a new breed of line-scan system to withstand a higher "g" in liftoff than the one for the reconnaissance camera. But when we were through, we had a television studio that traveled around the moon, twenty-two miles above the surface, taking pictures of the valleys and peaks that had tantalized telescope observers for centuries. The Lunar Orbiter automatically processed the film and triggered the line-scan tube, which scanned the film and radioed the signals back to earth, where they were reconstituted into images of the lunar surface.

The pictures were marvelous. In 1966 *The New York Times* in a burst of eloquence called it "the picture of the century." In a few minutes we had seen more on the moon than had been seen by generations of red-eyed astronomers since the time of Galileo. Some five Lunar Orbiters were launched to provide the data for selecting the sites used for the actual landings on the moon, which the *Times*, adding euphoria to eloquence, now called the "greatest discovery of mankind since Galileo." I was sorry to see no mention of those fine astronomers in between who had extended the bounds of our universe to the far-out regions of the quasar.

At the height of this success, with the space effort enjoying immense support in Congress and in the country at large, we at the labs became interested in going into business as a manufacturer of microcircuits, those enormously clever miniaturized circuits that could do jobs once handled by much larger and more complex equipment. We had established, thanks to

government largesse, a solid-state research organization at CBS Labs, equipped with a suite of clean rooms and necessary instrumentation, all because of the many contracts that involved expertise in this new area. One minor but intriguing contract, for instance, was to develop protective glasses for pilots to use in case they fly in the region of an atomic bomb blast. The glasses Kaspaul and his associates designed would darken instantly when a flash occurred and thus preserve the wearer's eyes. The lenses were, of course, made from a solid-state material, which is affected by strong light. I do not think their original purpose was fulfilled, but I found these glasses useful elsewhere. Stanton called me to say that President Truman was having trouble reading a script over television. "Something about the glare," Frank reported. "Peter, you must do something."

I presented Stanton with a pair of our atomic flash glasses, and he passed them on to the President, who was delighted. I felt that the higher purposes of research were served.

It was NASA that encouraged us to concentrate on developing special transistor circuits, known as integrated circuits, which operate on extremely low power. These circuits, it seemed, would be vital for many space applications, especially in satellites, where power was at a premium. We could sell them, we thought, to a growing market. To head this operation my associate John Christensen found an engineer in the Signal Corps at Fort Monmouth, a man named Gaertner who was an expert on tiny machines that worked on a billionth of a watt. I thought here was a new business for CBS and recommended to Stanton that we go into production.

This was one case where I would have done better had I stayed at home. Our microcircuits were lovely in conception and design but too expensive to produce, and the market was

more limited than we realized or had been led to believe. While we were gearing up, the space program was heading toward devices requiring higher power sources. All NASA could say to us was, "Sorry, we made a mistake."

To make matters worse Paley would not invest money in the future of integrated circuits. He had no faith in the field's long-term promise, and thus he passed up one of the most significant developments of the century. I must admit he wasn't alone. Other large corporations also failed to recognize the importance of the solid-state "chip" and left this extraordinary business to be developed by the Young Turks of electronics, who came from Bell Labs, Stanford, and elsewhere and turned semiconducting devices into one of the most spectacular growth industries of the 1950s.

Eventually, out of a sense of uselessness both Kaspaul and Gaertner left the company, and we went back to specialized tubes. Our losses on this deal amounted to $200,000, a third of the cost of Jackie Gleason's home in Westchester, which CBS bought to keep him under contract and which afterward became a loss to the company. But while show business losses are taken in stride, management has no such benevolent attitude to engineering losses, and CBS top echelons did not forgive me so easily.

Space having been sold as gee-whiz entertainment nationally—"see it live from the moon"—started to drift from public interest after the first few moon shots, just like any short-lived spectacular. In fact, the notion that space exploration is a waste of time and money, a big boondoggle, has gotten more and more public support, especially among young people and others with special cases to plead, such as ecology. My son Chris, who isn't sure whether I sold out to the military-industrial complex, thinks space is a clear choice be-

tween pride and priority, and he is firmly on the side of priority—priority for what he considers to be important social projects. I think the growth of this either-or attitude is a shame. The greatest utility of space will occur in later years, in terms of greater insight into the universe and into ourselves. Even if it were not so, a generation destined to make an approach to the greatest of all mysteries—the origins of the universe—should not be denied.

Although the fine spirit of adventure of the Kennedy days has dissipated, the current administration has shown some interest in enhancing the utility of space technology for the public. In line with this I was invited one day to join a panel set up by vice president Spiro Agnew and chaired by former Caltech president Lee DuBridge, then Nixon's scientific adviser. DuBridge asked us all to come up with ideas for using the space organization for the "benefit of mankind," a piece of phraseology that itself has spun off from the space effort.

It was an interesting and broad-based panel, including such diverse personalities as Frank Stanton and the attractive Shirley Temple Black, who was then a U.S. delegate-at-large to the UN. I took DuBridge's request seriously and suggested that NASA's greatest "leap forward" was not the visit to the moon per se, but the fabulous organization it had created. Here was a blending of industry and government and the talents of many university disciplines, all directed and managed to a proposed goal. I said it was a splendid national resource, the greatest systems-engineering problem-solving organization since that which built the pyramids. Out of it could come great things for mankind.

Why, for example, not turn it to such uses as creating a better transportation system at home? I said that having gotten efficiently to the moon we might now figure out how to

get around the corner. DuBridge said it was a good idea, but he felt NASA should continue in space, regardless of popular pressures.

When it came to a show of hands, Stanton agreed with me and so did the president of Rand, and Keith Glennan, the first head of NASA, and most pleasantly so did Shirley Temple Black. However, my proposal didn't prevail with the majority of the group. So the greatest outcome of the panel meeting was a thick report, containing grandiose phraseology, available for any scholar to pursue in the year 2000, if we reach it, but doing little to further the use of space technology. I am sorry to say that this was the forerunner of the negativism that began to set in about science in high government places.

At the last countdown the space age, despite cutbacks of budget, is still reasonably healthy, with new plans afoot following manned experimentation in space via America's first space station known as Skylab and back-burner thinking of new automated journeys among the planets. Obviously the space age will live longer than its detractors. Reconnaissance is also very much alive. CBS Laboratories paved the way once again with a system that uses lasers to carry even more information than was carried on electronic beams. We also had a successful run of a system known as Compass Link, which allowed for photographs taken in Vietnam to appear instantly by satellite at the White House.

While these improved pieces of technology keep appearing, the broadcast world of CBS is still busy shuffling rate cards, arranging mergers, analyzing population shifts, dealing with unions and talent agencies, with color conversions and network feeds and automatic switching and other broadcast paraphernalia.

Suffice it to say that we've been to the moon and back home again. The world of technology has expanded our communications horizons. It is not yet clear what that will do to each of us in the future.

# 13

# Doing One's Thing

IT was my son Peter who taught me the real meaning of communications, that it was not just an electric wave on a coaxial cable, or a spot of information on a film, but a meeting of minds and hearts, a touching of souls. I was fifty-three and Peter was twenty. I had reached the point in time when I was old enough to listen to youth but young enough at least to start thinking of going forward into new and uncharted domains.

It was the summer of 1960. Peter was attending Harvard, and I used to drive up frequently from Stamford to visit him. For me the meetings were exhilarating. My son's mind was crammed full of such weighty subjects as arms control, foreign policy, race, and other social issues. Like most young people, he felt he knew more than I did about such subjects; I suspect he was right. But what impressed me about my own son at that time, and had a profound effect on my life, occurred one day when he announced calmly that he was going off to Tanganyika, of all places.

Peter's urge to go to such a remote country at this time was startling but understandable. He had arrived at a transition

point in his life—graduation. He was restless, pondering his own future as well as social and political conditions; there may also have been the lingerings of emotional tension that had persisted since Frances and I were divorced in 1954. The original decision to part did not make for a happy environment for four sensitive youngsters, although by 1960 we had managed through hard work to establish a sense of equilibrium in the family relationship.

In any case I could well understand Peter's interest in accepting a new challenge. He told me he wanted to organize a group of students who would go to Africa to try to combine two things that hitherto had been done separately: one to try and meet some of the social and educational needs of the developing country, and the other to do it with young volunteers not associated with the government. This was in the pre-Peace Corps days.

Peter told me he had chosen Tanganyika (which is now called Tanzania) because the country had political stability, with first-class national leadership, and was managing to survive without American or other foreign aid. A rational way to decide, I thought. We discussed his idea of helping the country with the Tanganyikan ministers of education and finance, who were then visiting Harvard, and they liked the idea. We found that, among other things, the country was in great need of teachers of English in the secondary schools. Peter and his group could meet this need without sending themselves through three years of graduate school.

My son started the operation by sending out inquiries for participants. In the fall of 1960 he was swamped with hundreds of applicants; he narrowed this group down to twenty.

The next move was to raise money. I suggested he write to the chairman of the 3M Company, who was a donor to many

international projects, telling of his plan and asking for support. This simple appeal wasn't persuasive enough, and he had to follow it up with another letter explaining, as Peter put it, that he was really "stemming the advance of the Communist tide and Russian hordes and bringing religion to the savages." To this appeal the Midwesterners responded with both alacrity and money.

Then Peter went one better. He personally contacted Eleanor Roosevelt, a great performer in such matters, and much to his surprise she promptly invited him to lunch. By the time the dessert was served she knew exactly whom to approach for money and for how much. Lansdell Christie, a businessman who had made several million dollars out of African rubber, donated $5,000. A drug company contributed $60,000 worth of antibiotics, which was important because Africa was afflicted at the time with a good deal of disease.

Peter moved ahead with other ideas. He approached the Harvard administration to set up the first accredited course in Swahili, but they turned down the request, so the students set up the course themselves and hired their own teacher. Before leaving for Tanganyika Peter tipped off *Life* magazine to the project, and they wrote up the story. Interestingly, the Peace Corps, a brainchild of President Kennedy, went into business shortly thereafter, quite independently. I have heard, however, that this earlier student effort had some influence on the Kennedy thinking.

After Peter came back from Africa in the fall of 1961, he wrote a thesis on his experience for his A.B. degree and graduated with honors. He spent two years teaching at Putney School in Vermont and then went to work for the newly formed Office of Economic Opportunity in Washington, which was designed to do something about poverty in the

United States and eventually became responsible for setting up community-action programs to help the underprivileged in cities around the country, including Stamford, where it was called the Committee on Training and Employment, or CTE. This is where my son's experience and involvement suddenly had a profound effect on me. Like so many other middle-class professionals and executives involved in the growth of America during the fifties, I had only a sketchy idea of the dire poverty in many parts of the country. It was President Johnson's highly publicized trip to Appalachia that triggered my interest in this problem. Peter kept repeating that I hardly knew what was going on in my own backyard in Stamford.

Eventually Peter's idealistic excitement over social reform got to me, and I decided to take a long look at Stamford, where I had been living for twenty years. Here was a middle-class city of 100,000, predominantly Catholic and conservative, with a northern section that was fairly affluent and with stately old Connecticut homes along the Sound still occupied by people of substantial inherited wealth. Stamford is probably the first town north of New York City that has a personality of its own.

I knew there was a black section downtown but little more, so one day I decided to ask Henry Crawford, a black policeman who was an acquaintance, to take me through it. I met him on a Saturday morning, and we toured one section of the ghetto after another. I was shocked at what I saw—decay, poverty, hopelessness—in the heart of one of the wealthiest counties of the United States. As I wandered up and down one block, I saw buildings rotting away, broken windows, ceilings in some places propped up by poles. A recreation center for the young was ironically called the Sunrise Center,

but I could see little sun in it. There was no equipment, no means for organized play. The two floors in the dilapidated building were actually in danger of collapsing. I myself almost fell through a hole in the floor. Suddenly I realized I was in a part of the world that defied my sense of humor. This was a serious matter, too long neglected by the rest of us. Peter was right. What I didn't know was how involved I would become and how difficult it is to try to help others.

However, on the first tour I must admit I did see something heartwarming. One young man was supplying hot dogs for small kids out of meager earnings. He taught the smaller boys how to play billiards on an old makeshift table with wobbly legs. If this kind of devotion could exist in such impoverished surroundings, I knew I had to do something to fan it and keep it alive. My son's enthusiasm for his efforts in the OEO was indeed contagious. I was suddenly inspired to do my share to improve conditions in Stamford.

When I got back to the labs, I started to phone friends for assistance in rebuilding Sunrise Center. I managed to tease a new table and chairs out of one industrial concern, games from another, a sound system out of our own labs. One businessman donated some money toward the purchase of sporting equipment. It was amazing for me to discover how much one person could do if he asked others to help. Of course my position in the community helped, but it seemed to me that many men in higher positions had similar opportunities and either didn't take advantage of them or simply didn't radiate enough sincerity to accomplish what they wanted. At the same time I appeared before the board of CTE and asked them to contribute. In almost no time at all I had $2,400 and soon learned the excitement and pleasure of actually doing something for the community. I couldn't help but compare

these efforts with those of the federal government and realized that Washington did not have the proper approach to the real needs of the people. Such needs are visible only when you see them at first hand, not through a reporting agency or through special pressure groups. Washington is a funnel with a tiny opening at the end, and a trickle may go into the wrong places.

Here was involvement in the human side of communications, a departure for me from the electronic communications that had dominated my life so far. But it didn't reach some sort of fruition until I came into contact with the Stamford Urban Coalition, a group that had just been set up by the mayor in line with President Johnson's ideas to improve conditions in the black ghetto. As an initial move the coalition decided to hold a giant gripe session of the poor.

On April 25, 1968, several hundred people showed up. From the front of the auditorium on a makeshift stage the members of the Urban Coalition made their statements. I will never forget the meeting as long as I live.

The chairman, Bruno Giordano, then mayor of Stamford, had thrown the meeting open to questions. After a few moments of awkward silence a black man in the back of the auditorium stood up and hesitantly asked to be heard. The chairman waved him to proceed. At first he complained about living conditions in Southfield Village, an area in which many of Stamford's black citizens live. He cited the lack of plumbing, the fire hazards, and then, warming to the topic, he brought up many other problems—the filth and disease, the hungry children running barefoot in the streets, the overcharging landlords. Something should be done, he concluded. Then he sat down to applause.

Immediately a woman rose and asked to be heard. Iden-

tifying herself as a tenant of Southfield, she complained of the inadequacy of maintenance, the impossibility of a complaint being heeded by the city housing authority, of molestation and lack of police protection. Gathering momentum, other tenants rose one by one and aired their own complaints. One tenant mentioned the failure of valves to work on steam radiators. On the upper floors of the high-rises in Southfield doors had to remain open in the dead of winter to let out the hot air. The building is a sauna bath, said this tenant. Southfield is the only place in Stamford, one inhabitant told me, where you buy summer clothes in winter.

It went on and on. Slowly and painfully one poor citizen after another spoke out on his plight. It became abundantly clear that the communities of the poor were not so much troubled by a future of hard-core unemployment as they were by the day-to-day misery of living conditions. Like so many others, I had thought the only problem of the ghetto was lack of jobs. I suggested that we immediately form a committee to study Southfield in depth and come up with a program of action. The mayor agreed and promptly made me chairman.

A few days later I met with a group of tenants and others from the Urban Coalition, and we proceeded to conduct a fact-finding session. I recall that some tenants bitterly condemned white do-gooders who made promises and never kept them. My younger children, incidentally, were a bit nonplussed about my sudden joining of ghetto meetings and my shifting the dinner conversations at home from the stresses of television technology to those of the lives of the poor.

Is poverty a great complaint due to the poverty itself, or is it the living conditions associated with poverty, the poor

services, filth, neglect, and listlessness that constitute the problem? I submit that the answer to this question is more important than one realizes. For instance, many Swiss villages are steeped in poverty, as were the settlements of the American pioneers, but somehow the environment is lifted from depression, perhaps because there is no constant reminder of minority status and inability to share equally in community resources. More livable environment and more opportunity—these are the two items that are most important to people, and they don't cost much money. Indeed, it is not a question of money but of concern.

The biggest obstacle to the solution of poverty, in my opinion, is hopelessness. I think any family would be able to live in poverty with a more optimistic spirit if its members could look forward to a better future for their children. To brighten the future, I began to realize one must somehow break the chain of hopelessness that shackles one generation to the next.

So I gave a great deal of thought to the Village. Being an engineer, I once again thought in terms of systems, the components in this case being people and available resources. What was the objective of the system? Obviously, to clean up the Village, provide better living conditions for the residents, and improve their state of mind by creating hope for the future. How do you do all this from within? Outside crews and aid were expensive; their work would be transitory. So I thought of the strength of the Village—its human elements. Why not get the youngsters, the boys and girls from fourteen to nineteen, and make them the channel of communication? To spruce up the surroundings, they would need to know some carpentry, electrical work, plumbing, as well as ordinary maintenance. Well, why not train them in these trades

for pay and have them exercise their newfound skills right in their own backyard? How? Who would teach the kids? As far as possible, the craft specialists in the Village, who would also be paid. When a youngster learned enough, he could take over the teaching. In this way the operation would be self-perpetuating, guaranteeing a combination of training, necessary maintenance, and community participation.

In a week a plan was worked out with the tenants, and we presented the working blueprint for this approach to the Urban Coalition. Everyone was enthusiastic. Now the immediate question was how to get the money? My thirty years at CBS had convinced me that a good idea will always find financing, if you are persistent enough in seeking it out. I called LeRoy Jones, then the director of the Connecticut Department of Community Affairs at Hartford. I told him that he could accomplish three things at once for $500 a family per year—a total of $250,000, a small sum in those days of social experimentation. Jones listened and said, "It's a great plan, Peter. We've never had one that does so much for so little. If the tenants approve, and you can do it at so little cost, you'll have the money."

Armed with this assurance, we presented the plan to the rest of the tenants at a special meeting. They quickly approved, and an association called the Southfield Neighborhood Coop. came into being, with offices in one of the ground-floor apartments in the Village. The word spread quickly. I called Hartford to say we were a going concern. We submitted a detailed plan, and, believe it or not, six days later an okay and a check arrived. I couldn't believe anything involving the government could occur so quickly. The residents of Southfield had seen this thing grow in front of their

eyes; they had come to believe that such things were possible. Here was hope that you could get good results not from above but from within.

The key to success was to obtain a program director. In June, 1968, Leonard Rivers, a husky black high school teacher, football coach, and ex-wrestler was appointed. Fliers were distributed to announce the plan, and at the beginning of July the program took off.

The first trade classes were greeted with enormous enthusiasm. They consisted of painting, plumbing, and carpentry for the boys and secretarial work and typing for the girls. The basement was compartmentalized into shops, and saws, hammers, lathes, and other equipment were moved in. Every day for two hours after school the youngsters came to the basement academy, as it was known. Afterward they moved out in the Village to paint, repair window screens, or replace broken windows. The gutted-looking laundry room in the basement, which had been a notorious site of molestations, was brought into working condition. A group of boys under the direction of Len Rogers organized a patrol to see that the laundry room was properly used.

The youngsters earned from $1.25 to $2.00 an hour, depending on age. When they weren't learning a trade, they were improving their education in such subjects as elementary math and reading. Three nuns of the Notre Dame Congregation in nearby Ridgefield heard of our efforts and offered to help as teachers and guidance counselors. They agreed to live in the Village and spend full time tutoring anyone who wanted special education. The nuns soon reported that some 250 boys and girls and twenty-five adults, mostly women, attended classes. "Our first pupil," recalls Sister Ger-

aldine Hacker, "was a sixty-year-old woman who wanted to learn geometry. What she will do with it she doesn't know, but she feels it's important."

One of the most interesting spinoffs for me was that my children suddenly started to react strongly to my community efforts. "Imagine," said Chris, "a superscientist becoming involved in the community—cool!" Even Andy, my teen-ager who had been to private school and was interested only in writing songs, came to a poverty meeting while I was chairman to see what it was all about. I saw his white hand go up with a question—my son asking a question, and a good one at that. My daughter Didi also began to regard her father with new interest. Her own compassionate work with partially handicapped underprivileged children established a new bond between us, which I suspect was denied over the years of her childhood because of my apparent intense interest in things rather than people.

Of course, not everything came to us easily. I recall that one job we had to do at Southfield was to blacktop the playground, which was looking more and more like a dustbowl. It was actually the city's responsibility to do it, but city officials do not often act in accord with their responsibility. I called one official after another, but nothing happened. So that fall, when the United Fund came around to CBS Labs for the usual contribution, I decided to withhold the $6,000 we usually would have given until we could get some concrete action from the city on the playground. The United Fund representative said he had no power over the city. But it was interesting to see the connections between the city and a charitable agency. In a matter of hours the mayor phoned me and said he'd take care of the blacktop. And he did. So I gladly handed over the contribution to the United Fund.

Tenants were often a problem, of course, because of the high turnover. The tenant association discovered they had to indoctrinate newcomers with ground rules. When one newly arrived resident threw garbage from a window, a garbage patrol promptly visited him. I recall being told that the chastened tenant went downstairs, picked up the rubbish, and deposited it in the proper receptacle.

One day while I was chairman of the Committee on Training and Employment I received notification from the OEO that the auditors had uncovered mismanagement of funds in the operation of the program. Tens of thousands of dollars had allegedly been misspent. On investigation they found that the financial director seemed to be at fault, so I arranged a meeting with the executive committee. I pointed out the problem and, as chairman, asked the finance man to change jobs and become our public relations representative to preserve our good standing. He agreed eagerly.

I called a meeting at CBS Labs, and the next thing I knew I was involved in a "racial crisis." A faction of the black community rose up and accused me of unfairly firing the financial director, and they gathered around him as if he were a maligned saint. A huge crowd gathered outside the CBS Labs and started to press against the glass doors. The poor CBS guard, who had never had to deal with more than a tardy employe, got nervous and threatened to draw his gun. He called me, informed me of the crowd outside, and asked whether he should call the police. I left the meeting and arranged to let in as many as could be accommodated.

Fortunately, everyone quieted down and the meeting went ahead. They implored the financial director to rescind his resignation. This was too much for him. With tears in his eyes he bowed to his public and decided to withdraw his res-

ignation. Now a voice from the back of the room piped up demanding that the chairman, meaning me, should resign. I was about to open my mouth to agree when a chant arose, "Don't do it, don't do it." It was weird. The whole group suddenly faced the reality of the situation and was overcome by it. When the chants subsided, I concluded the meeting. At the next session of the board of directors a representative of OEO appeared and asked the financial director to resign. The board agreed. I looked for a new director and was able to interest the then district chairman of the Stamford Human Rights Commission, John Brown, who came in and gave the organization professional leadership.

In the spring of 1969 the Southfield program was going so well that we decided to present our progress both in Hartford and Washington. LeRoy Jones regarded Southfield as one of the remarkable success stories in the antipoverty campaign, and the Department of Housing and Urban Development's Assistant Secretary Harry Finger looked at Southfield as an example of what can be done with community participation.

Southfield was called a renaissance, but I am afraid that the renaissance was short-lived. When I left the program and others backed off, the Village more or less retreated to its old habits. It is really too early to tell whether any program can change the lot of the poor, much less their behavior. Poverty is a way of life. In Southfield people feel trapped even if they come up in the world financially; there is simply no place for the blacks to go. They have to pay higher rent to the Housing Authority whenever they make more money—rent is pegged at 25 percent of income—so many of them feel as if they're in a prison with no hope of parole.

The biggest obstacle to racial progress, I believe, is still the structure of American society, which limits opportunities for

blacks, even for skilled blacks. As one youngster put it in one of the basement classes, "It's fun to study this plumbing, but man, what do you do with it when you finish the course?" I have made some inroads with the unions, but I must admit that the lad has a point.

My own vision for the future is not simply to make poverty more tolerable. I don't like low-cost housing as it is now handled because I think it becomes a slum too soon. Urban renewal is really a form of residential genocide. It demolishes homes without making suitable interim housing for the displaced tenants. Rehabilitation is much more important. I believe in bringing in opportunities for black business, to give blacks more chance of building their own towns.

And I must go back to the children. Start with them, so the gains can be transmitted to the next generation. Transfer the hope and the opportunity. I still think that this is the best way to break the chain of helplessness that created the conditions in Southfield and every public-housing ghetto in America.

# 14

# Communications in the City

NOW it became clear to me in the late sixties that Southfield Village was merely a local symptom of something more insidious and widespread: the general deterioration of living patterns throughout America. My youngsters kept me aware that the decade of the sixties was an age of national self-discovery. For many of my children's peers it meant a strong rejection of the past and some testing of new approaches to marriage, education, and politics via drugs, communes, religious impulse, violence, dirty hair, wild dance and song. I became unhappily conscious of the fact that the American way of life was no longer following a familiar arrow upward into economic and social bliss, but was giving rise to a new series of turbulent self-adjustments, such as my generation hadn't encountered before. In fact, one of my sons revealed to me that he once had experimented with drugs in a desperate search to answer the questions, who am I and what are my capabilities? Fortunately, he gave it up without ill effects, but

the revelation still rings in my ears and makes me feel closer than ever to the problems of America in the upcoming years.

The environment was also changing visibly. The cities had grown into dense cores characterized all too often by pockets of poverty, poor housing, crime, and decadence. What's more, suburban areas grew faster than did available jobs in them and themselves became much too big. Indeed, the suburban population is now the largest population in the United States, and it is not only suffering from the psychological fatigue of commuting from home to office to keep a foot in both worlds, but it has imported the decadence of the city into local affairs. The mugger and pusher are as familiar in Palo Alto or White Plains as in New York or Detroit, and so are the growing areas of poverty.

Viewed from the perspective of human history, the deterioration of the environment in its broadest sense had become, I felt, the greatest issue we've ever faced—it is ominous, elusive and could be fatal to our civilization. The most obvious place to note the vast changes in the environment was in population. At the time America was discovered, the entire world population was 50 million more than the U.S. population is today. The world population today exceeds three billion.

The significant thing here is that with the rise of population—which is doubling every thirty-five years—there is an increase in the rate of change of many other things, including speed of travel, life expectancy, explosives, to name but a few. As I look at the exponential curves of this growth, I find, interestingly enough, that they started to rise rapidly beginning in 1455—just when Gutenberg invented the printing press. I think this is no accident. With the availability of print, science and technology took vast leaps forward, mainly because it was the first time scientists no longer had to talk to

one another but could communicate at a distance. Inventions, discoveries, and theories burst forth at an unprecedented rate, leading to modern science and technology and to an unplanned environment. I hate to sound like a victim of what John Maddox calls the "doomsday syndrome," but I cannot lightly pass over the works of Jay Forrester and Dennis Meadows at MIT, who showed by computer study that mankind can face disaster within 100 years if we continue our current life-style and industrial output. Unless we do something, the curves of growth will take a sudden dip in the year 2100, by which time pollution and the depletion of nonrenewable resources will probably bring about a rapid end to our civilization.

The obvious way to counteract these trends is to slow population growth as well as our insatiable appetite for material goods and growth. But short of that what about more specific problems in the decaying city? What could be done about crime and violence, the breakdown of technology-based services, the uncomfortable, noisy, and frustrating tangles of traffic, the impersonality of social relationships, the sense of unfriendliness, if not suspicion and open enmity, in the air? What could be done about the spillover of population into the suburbs, areas once thought to be refuges from the problems and difficulties of the cities, but now equally mangled?

These rather stirring questions were on my mind one day in 1968 during a flight from Los Angeles to New York. Flights are generally dull technological expressions of our haste to go somewhere, with no thought as to what's in between. But this time as I sat at the window watching the city and its environs turn to bare brown mountains, and the mountains in turn fall into endless stretches of desert, and then fade into flat, sparsely populated dairy and grain land, I

suddenly lost track of the questions in the awareness of the spreading bigness of America. Here, I found myself thinking, are the real assets of the country. They are not in New York, Los Angeles, Detroit, Washington, or Fort Knox. They are in the priceless land, some two billion acres of it, so much of it apparently unused and untrammeled.

I began to wonder whether the cure of the headaches in the growing cities might not lie in the proper use of this land —all the land. Most people in America live on only a fraction of the available land—a mere 10 percent, I discovered later, of America's habitable acreage. In sections of Harlem the density of population is so great that if given the same density the three largest boroughs of New York could hold the entire population of the United States. What if you could redistribute the population into the sparsely settled communities I was watching go by beneath the aircraft? Would you be able to relieve some of the tensions of the high-density city living and the problems that arise from them? Would you destroy the countryside in the process or enhance it?

How often had I started a train of thought with a "what if" question and allowed it to take me down the tortuous pathways of invention. Here the question was larger than any I had ever faced in the laboratory and it seemed also remote from my normal concerns. When I landed in New York, I became more sensitive to the congested traffic moving slowly out of Kennedy Airport, to the light smog that hung over the city, and to the haggard expressions on the faces of harried New Yorkers. These disturbing sights suddenly loomed more sharply in my consciousness and helped firm up my resolve to look further into how people settle in cities or anywhere else.

Migrations of all sorts occur because of economic, politi-

cal, and climatic reasons, sometimes freely, sometimes aided or pushed by government. In recent times the Soviet Union subsidized migration to central Asia and Siberia to build up sparsely settled lands with an abundance of natural resources. In the early history of the U.S. a great migration across the country occurred in the 1800s with the lure of gold and the subsequent opening of the West. The Homesteading Act underwrote the popular lust for carving a new world out of the raw land. During World War II thousands of people settled into new communities originally established for industrial purposes or as centers of military training. In addition, for climatic reasons, population shifted to the more desirable areas in the country, such as California, the Southwest, and Florida.

Throughout contemporary American history there has been an equally great migration, slow and steady, from the rural areas to the cities, where until very recently the general promise of more money, a higher quality of life, along with a touch of culture and a dash of adventure were the magnets. Until 1970 a formerly rural state like New Jersey had been steadily losing thousands of farm acres per year to the inroads of industrialization.

Was it possible to reverse the trend? And if you could reverse it, what would you do about the problems left behind in the cities? Obviously, the first thing to do was to look at the urban environment and see how it might be made more attractive for those in it, and secondly, how the rural environment might be sharpened by methods at our disposal to make the country as interesting as the city.

Of course, some minor reforms have been started in various cities. They include setting aside streets for pedestrians, traffic congestion being one of the major problems of the

modern city, just as lack of plumbing was the headache of life in the Elizabethan city. Redeveloping obsolescent and crumbling urban regions in downtown areas has been carried out for years throughout the country with spotty success.

My own approach was not so much to play the scientific do-gooder and poke into the difficult areas of the city to try to change them for the better, but to look at the entire city itself as a whole and its interaction with the surrounding country. No matter how I viewed it and how I weighed the interactions, I found that they all had one bond in common —communication. The city, as Lewis Mumford once put it, is in its bones a huge information-processing machine. From person to person, mailbox to mailbox, person to machine, and even from machine to machine, communications are the nerve system of the city, the dynamic, pulsing thread that binds it all together. As late as the nineteenth century communications were still a matter of word of mouth or a message delivered by fast horse. People had not yet learned to do things efficiently at a distance.

On the other hand, today the city that wants to can command advanced and sophisticated communications technology but remains in effect a primitive communications jungle. Devices such as the telephone, radio, and television, for all their apparent universality, are tom-toms compared to what can be developed right now to enhance our lives. The telephone, for instance, though extraordinarily refined in some respects, is still only a voice machine between certain discrete points, yet the technology is within reach to make long-distance telephone calls from an instrument hanging from a watch chain or attached to your wrist. Is this important? Enough so, I think, if you consider saving lives important. As an example, a victim of an accident or robbery in the city or

a vacationer trapped in the wilds could send an instant signal for help without the need for crawling to a telephone booth or to a rescuer. The late Congressman Hale Boggs and his colleagues who were lost last year on an Alaskan flight might have been found had they had such devices.

The telephone has other undeveloped potentials, and not just the well-advertised Picturephone. So far this device is a commercial failure. I think this is a case where technology ran away, because while it seemed glamorous, there was really no need to see the person you are phoning. On the other hand, the technology is within reach to allow the telephone to automatically re-ring a number and call you when the line is free if it is busy on the first go-around. Automatic transfers of calls to different points are possible without starting all over again with the operator. Indeed, the inroads of advancing technology make the telephone no longer a carrier of voice but of other kinds of information such as digital data and facsimile pictures. The telephone has yet to catch up with the infinite possibilities of computers.

Similarly, and more importantly, television technology is also ahead of public ability to use it. TV now has the opportunity to install the one item it was thought impossible to develop—feedback, or two-way conversation through the tube. This can be accomplished today through cable, potentially the most democratic and powerful offshoot of the communications revolution of the last decade. Cable was started in typical American fashion by entrepreneurs who saw a profit in sticking up an antenna and providing television to remote areas where the network television signal was blocked by natural obstacles such as high mountains. Thus CATV (Community Antenna Television), or cable TV, as it is now

called, was born; it plugged a good deal of small-town America into the television complex.

With the important promise of the two-way system, that is, talking back to whomever is on the screen, cable has become inherently the closest thing to an electronic servant. Among other things, it has the potential ability to poll the tastes and preferences of subscribers, both as to politicians and products. It now provides premium programming but it can provide much more, including courses in a variety of educational fields. Incidentally, I feel that with the right management cable can exert its most powerful influence in the educational field. It can even display supermarket specials of the day and take orders, along with complaints on high prices.

CATV, which is now available to about seven million subscribers in the U.S., is currently undergoing a metamorphosis from a complement to existing TV into a powerful medium on its own because of its ability to serve small communities. In fact, if it were not bogged down in the usual slowing-up processes in local communities, it could be achieving its often-stated objective of serving most of America, both city and country, much faster than it is, by providing services that could help diminish trips to stores and offices, thus cutting down on traffic jams, pollution, and crime. In view of the varying interests it is harder today to move ahead with a new medium than it was in the early radio days, but I look forward to the emergence of a strong figure who can lead cable out of the present mire of political bickering.

As my thoughts began to firm on how the new communications technology might help improve the quality of life in America, President Johnson's Office of Telecommunications

Policy, which then provided the ground rules for communications, asked the National Academy of Engineering—the prestigious counterpart of the National Academy of Sciences—for technical help in the task of coordinating national problems involving communications. A committee was formed with former Dean William Everitt of the University of Illinois as chairman. I was invited to become a member, and I accepted. We had fourteen other members, including chief scientists of IBM and ITT, and vice presidents of research of Zenith, GE, Hughes, RCA, and AT&T.

Everitt asked us all to submit memos on projects we thought important to pursue. I was a bit unhappy that so much high-powered talent was not being applied to problems of social need, and proposed that we look into ways of improving urban life through communications.

Everitt's response was swift. "Okay," he said. "Why don't you start a panel to look into it?"

I looked for members, but nobody volunteered to worry with me about urban needs; they were too busy with spectrum allocations, frequency distributions, and similar engineering matters involved in communications. So I became chairman of a one-man committee, and thinking big I unhesitatingly drew up a list of needs of the cities that could be satisfied by telecommunications in such areas as education, health, pollution, crime, and even the condition of the underprivileged. I seized the chance to write on how communications technology could help improve city life through working with current living patterns and then added something about using communications to help stem the population movements from rural to urban areas and thus relieve some of the pressure on the cities. The latter notion soon developed into a long-range idea that I called *Cities of the Future.*

In it I suggested, among other things, the need for carrying out a study that would show whether innovations in communications could provide 100 million people in the United States with an option they didn't then have of working in rural areas—which were diminishing in population as the price they paid to the growth of the metropolitan areas.

With this list of ideas I looked for members to join subpanels. Some did, but excitement on Cities of the Future was minimal. In fact, one leading figure on the committee thought the idea of redistributing population as a solution to the problem of the cities was not at all practical; the cities, he said, must find the answer to their own problems. I was resigned to become both chairman of a one-man panel and a one-man chairman of the future. However, Everitt suggested a compromise—closer application of communications technology to the present before we could examine the future. So a subpanel of the panel on urban communications was created on one aspect, namely, on crime prevention, which was as present as one can get. Crime perked up interest in some of my colleagues, and several excellent people joined the subpanel.

In the meanwhile the academy talked to HUD about my idea of Cities of the Future. HUD's budget includes funds for projects that are designed to improve urban life. Of course, there was some concern about my being too futuristic. I subsequently made a presentation of this concept, however, pointing out among other things that there has to be something on the way for the upcoming generation, or the people today will tend to despair. Our grandchildren should have the benefit of our thinking, I said. The HUD representatives were apparently intrigued. They accepted the proposal and gave us a substantial grant to establish models of the city

of the future. As is normal, as soon as we had financing, a number of people wanted to come aboard.

I was so delighted with this progress in social communications that I went to see the management at CBS. I thought the company, as a leading force in communications, could now make a major contribution to mankind by joining the Cities of the Future project, or at least taking pride in my role in it. But according to a colleague of mine, one CBS executive commented acidly that I was spending too much time saving America and not enough time at the labs on my job. It appeared that Stanton and Paley were not sympathetic either; they certainly ignored all my reports and never invited me to make a presentation on the subject.

So I pursued the work of the panel on my own. In line with the philosophy of one step at a time and of the present before the future, I spent a good deal of effort as chairman of the subpanel on crime, initially in examining the relationship of communications to criminal investigation and the prevention of crime. Historically, new communications devices have always been enlisted in the war against criminals. I recall that famous story of how a London murderer named Dr. Harley Crippen was caught in 1910 as a result of the then spectacular new communications device, the wireless telegraph. Crippen had murdered his wife, buried her in the cellar of their home, and fled the country with his secretary aboard the liner *Montrose.* The captain of the ship became suspicious of the pair, who were loosely disguised as father and son.

The ship was equipped with a new piece of technology of the day, Marconi's wireless, which the captain used to radio Scotland Yard concerning his suspicions. Acting quickly, the Yard sent an inspector on a faster ship to overtake the *Montrose* in mid-Atlantic. Dressed as a pilot, the inspector

boarded the ship and arrested the doctor and his mistress. Shortly afterward, the British Parliament passed a law making it compulsory for all ships to carry wireless.

Our study on crime dealt with advances in communications systems far more sophisticated than the telegraph, but not with such spectacular results. For instance, the 911 single-number emergency dial system in New York, which is tied to a computer network, is credited with contributing substantially to the safety of the community. The object here is to provide rapid service no matter what the nature of the emergency. Unfortunately, after analyzing 600 calls and 282 emergencies we concluded that the system was technologically very good but that it broke down in human terms. Many non-English-speaking people trying to explain an emergency to a police officer at headquarters are somewhat like an Englishman trying to explain British currency to an American. Not only are the accents often impossible to fathom, particularly under stress, but in many such instances the policeman taking the call cannot always obtain the location of the emergency. So we on the panel suggested a simple change—automatic location identification in the phone network by means of an electric signal. The phone company thought it was too expensive and objected, but after some pressure the cost miraculously came down to about one-tenth the original estimate, and the technique is currently under consideration for nationwide use.

Thinking of methods to counteract crime through communications technology led us naturally to consideration of deterrents. Night surveillance of streets and public areas with television was one specific approach. A number of cities have installed TV cameras in public places and have claimed some success against crime. In Stockholm TV cameras linked to

police headquarters are on high, inaccessible poles above railroad depots and other public places. Police say they have been able to spot robberies, drug pushing, and other illicit activities and insist that the probing TV camera has deterred criminal activity in that city. In New York City, on the other hand, despite the fact that there are 60,000 robberies reported a year and only 600 robbers are sent to jail, TV surveillance on the streets still has the aura of Big Brother spying, and officials are slow in accepting it. We found, however, that a survey of public attitudes showed that if the purpose is understood, and if the device is used for the good of all citizens, it would be accepted as it now is in stores, banks, and apartment complexes. The hitherto unheard-of baggage searches on airlines to deter hijacking have met with little protest.

To test the possibilities of twenty-four-hour surveillance in New York, we decided to try TV on several street corners. William Kanz, retired head of communications in the New York City Police Department, who served on our crime panel, picked a precinct in Queens with low illumination to set up the tests. The cameras were installed in an elevated bucket like those used by phone repairmen. The monitors and other equipment were contained in a police van parked on the street below. We used special low-light-level Department of Defense cameras, some of which were designed originally to monitor Vietnam battlefields in starlight, and were declassified for civilian use in 1969.

Through rain and shine we intrepidly manned the cameras and took turns at the monitors. In the daytime the results were good in terms of how large an area a camera could cover clearly, but at night our camera ran into trouble. A car that came along the street with headlights on, for instance,

was missed because the camera couldn't handle light and dark at the same time. We had the same problem with street signs and lights. On the other hand, our electronic vigilance did successfully pick up lots of dogs being escorted to trees.

During our long vigil we had some other humorous moments. Various people in the neighborhood became curious about our mysterious truck and they poked their heads inside the van. "Vat are you testing?" asked one elderly lady, and then, before we could answer, she added under her breath, "Vy don't you take the garbage away instead?" A smart-looking girl came up to ask what we were doing. When we told her, she shook her head and raised what must be the typical attitude of the American people toward science. "Wouldn't you like me to show you a good time instead?" she asked. Communications were never clearer.

In looking back, I think our experiments did not last long enough nor were they extensive enough to justify specific followthrough recommendations, except to point out that no known camera would give adequate nighttime service. However, we felt that with further engineering we could clear the "bugs" from the cameras and that the system could eventually be effective against the menace of crime in the streets. I would support a proposal to utilize a television surveillance system on the streets and in other public areas in large cities. The expense involved in such a system would be more than justified in terms of money saved in stopping crime and the eventual costs of bringing the criminal to justice.*

Out of these considerations I must confess that the war of electronic technology against crime is a two-way street, just as it was against the enemy in World War II. Every time we

* At this writing (June, 1973), I am pleased to see that the New York City Police Department has decided to provide TV surveillance of Times Square.

instituted a countermeasure against the Germans, as the reader will recall, they came back with counter-countermeasures. Criminals do the same thing, evidently because they follow the same textbooks. Criminals monitor police radio frequencies, for instance, so communications engineers have had to devise systems to scramble them. Criminals turn off obvious alarm systems, so their clandestine activity has to be detected by infrared or low-level-vision cameras. And so the war goes on.

Obviously, city problems involving communications go beyond crime prevention. Our urban communications panel looked into the ways of using technology to improve education, health, and transportation, but my experience with these approaches only convinced me after awhile that such palliative measures, while important, would not begin to touch the hard-core problems of the cities. I began to think once again that the basic solution to the cities problems lay outside their borders—thinning out the urban sprawl far beyond suburbia, and bringing the urban and rural areas into the kind of balance that Congress may have had in mind in 1970 when it announced that:

> the rapid growth of urban population and uneven expansion of urban development in the United States, together with a decline in farm population, slower growth in rural areas and migration to the cities has created an imbalance between the nation's needs and resources and seriously threatens our physical environment . . .

I am not so naïve as to believe that reversing the trend, even if it were to come about faultlessly, would result in a 100-percent solution to the urban dilemma, but the pressure on the city would surely lessen and the quality of life of the entire nation would improve. I wondered whether there was a workable plan—one that would take us beyond the wishful

thinking and dreaming that plague some authors who often merely state the problem without the solution. The basic answer, it seemed, lay in enlisting technology to provide a method that would give the population a choice between living in the country or the city.

My Cities of the Future concept, which had launched me into this mode of thinking, now broadened in my mind into the *New Rural Society*, with a focus not so much on urbia and suburbia, but on the livable land beyond.

# 15

# The New Rural Society

"IF only I had been elected President," Senator Hubert Humphrey told me in a moment of candor, "I would certainly throw my support to any good scheme to save rural America."

I was in the senator's office in Washington, a few months ago, not to discuss the vagaries of politics but to accept a post as adviser to his committee on rural development. I had briefly described for him my concept of the New Rural Society and how I felt communications technology might help both the city and the country by serving as a catalyst to reshape the distribution of population. Senator Humphrey listened intently and then laughed.

"That's the first refreshing view we've had for some time about doing something about the countryside," he said. "Everybody who has sat where you are sitting, Dr. Goldmark, usually expresses some kind of a political gimmick or provides a hackneyed pitch for funds. I don't know how your plan might work, but it's worth looking into."

As a private citizen and a relatively new practitioner in the art of world-saving, I felt possessed of no particular expertise on the subject. All my life I had eschewed politics, but in the concept of the New Rural Society I believed (and still believe) I had a plan that might utilize technology to do things in areas where politics and more conventional reforms had failed, and I felt compelled to share it with anyone who might listen and help, including U.S. senators.

How does one go about revitalizing an old society or inventing a new one? Since I spent all of my life with technology and saw it revolutionize the world power structure, it was natural for me to think that technology might be properly used to save the country and its life-style. There are tremendous problems involved of course in changing the quality of life of the city and the rural areas, and the irony is that in its present primitive state, social science can't really help by telling us exactly how to go about it.

Nonetheless, I felt we did have enough useful technology on hand to make some stirring changes, and I began to think about society in terms familiar to me—that is, when stripped to essentials society is no more than a system of interrelated communication parts. Poke one part and something happens down the line, like dominoes that fall when the lead domino is pushed. The problem for me was to focus on the right parts and make them fall together in the right places.

Long before I visited Humphrey, I had sized up the situation in the U.S. by spreading a map before me and isolating the urban centers making up what is known as the nation's "urban sprawl." There, like a spreading inkstain, is Boswash, the megalopolis extending from Boston to Washington; over to the midwest in Chicpitt, the Chicago–Pittsburgh complex; farther to the west was Sansan, the San Francisco–San Diego

complex. The increase in the U.S. population over the next ten years (at present birth rates) will be 50 million; even with some expected decline in births the rise in population will be close to that figure. If the present trend is followed, these people will fill the crevices of the urban-suburban complex. But what if you looked closely at the rest of the country, seeking out relatively deserted areas, and then found some way to turn peoples' sights not to north, east, west, or south, but to in-between? What would those areas have to offer to attract the new population? And how to go about it?

The first thing that comes to mind is simply to build new towns based on one's vision of the quality of communal life, rather than on the greed and lust for wealth and exploitation of natural resources that marked the historic birth of American cities.

This thought is, of course, not new. Architects, town planners, and indeed imaginative science-fictioneers have located their cities of the future under the sea, in the desert, on an island in space; for them imagination never has failed. They have designed new Atlantises and Shangri-Las where old age never appears; and on paper, they have moved entire populations into concentric rings, tunnels, squares, and whirling globes.

Even today architectural visions of the city of the future are being proposed with admirable fervor. At the University of Minnesota a project sparkplugged by Athelstan Spilhaus, former dean of the Institute of Technology, was aimed at working out the form and technology of an experimental city, which may have such innovations as a system for recycling pollutants for use in heat generation and the use of atomic power for distilling fresh water. An electric ground-transportation system, which substitutes for those horrid pol-

lution tanks we now use on the road, is one of the components of Spilhaus's dream.

"In fact," Spilhaus has stated, "there is no real need for automobiles to stay above ground for any length of time if you plan properly for underground thruways."

In the Arizona desert Paolo Soleri, the Italian-born artist, has devised something entirely different, a skyscraper structure of concrete and steel that may house as many as three thousand people. Soleri sees such structures—or arcologies, as he calls them—as places where people can live, work, and play in one compact area, leaving the rest of the land for natural vegetation and recreation. Another architectural solution, also modeled in Arizona, is being promulgated by the widow of the great architect, Frank Lloyd Wright, and comprises a rock and redwood commune in which the people share the joys and labors of living in a setting that is architecturally harmonious with nature. Finally, a Florida architect, Jacques Fresco, has devised a kind of self-contained, one-mile-in-diameter city arranged in the form of concentric rings of high-rise buildings interconnected by additional buildings, the whole project resembling the spokes of a wheel. Each ring is devoted to a different function such as working quarters, energy production, and recreation. In the dome-shaped center is a nucleus containing a giant computer that manages the automated facilities needed for inhabitants of the city. Dr. Fresco sees these complexes linked together like so many toadstools on a plain.

These ideas have a kind of fun-in-the-sun flair to them, and it's no accident that they arise in the warm resort territories of the U.S. A more practical step to alleviate congestion has been undertaken from time to time in the creation of new cities. The British, for instance, have explored the possibility

of decentralizing London ever since Dickens pointed out its evils. As early as 1880 proposals were made for new garden cities outside London, but basically little happened until 1946, when the Abercrombie Plan was adopted. As a result of this plan twenty-one towns were built outside the city, the first group being designed to absorb overspill from London's congested centers. But this bold move didn't stop the expansion of London. Evidently the rate of generating new towns in England wasn't fast enough to handle the increasing birthrate and the medical inroads on mortality.

Other countries have also undertaken building of towns from the bare earth. The USSR has built more than eight hundred new towns since the Communist revolution, opening eastern regions with new resources in order to foster industrial growth in uninhabited areas, but despite this initiative the big cities of Russia are still growing. Here in the United States several new towns were built in the 1930s for relocating population and providing employment. Green Hills, Ohio, Greenbelt, Md., and Radburn, N.J., are successful examples. In recent years private interests have built Reston, Virginia, Columbia, Maryland, and Clear Lake City, Texas.

Perhaps the most fascinating architectural adventure in new-town construction was that of Brasilia, the capital of Brazil, which was built in 1960 in the heart of the virgin wilderness of the Brazilian highlands, where headhunters occasionally make their presence known. According to historian Arnold Toynbee, an appreciative observer of the progress of this new city, the Brazilian architect Lucio Costa laid out the town along the lines of self-sufficient communities that could have the neighborliness of small towns and the roots of the larger ones. The town is organized in the form of a checker-

board of quadros, or square sections. Each quadro consists of at least one apartment house, a central shopping center, and a school. The children can go to school without crossing any streets (there is no need for busing, but then there is no problem of integration in the Portuguese-Indian-Negro country), and the women can make friends with one another while they go about their shopping. Traffic is smoother, and there is little noise or pollution. I understand this has helped make an urban complex more humane and harmonious than the sterile beehive of many American cities. Brasilia has certainly attracted a sizable population from all parts of the country who have made it bulge from zero in 1960, when the first ax was wielded, to over 400,000 at last count.

In my view both the architectural engineering and new-town solutions to the population problem won't work in the United States on a national basis at the present time. The high cost of building cities from scratch, or tearing down existing cities to make way for what must be colossal development projects, is somewhat difficult to support at a time of budget consciousness. I've estimated that to support 100 million people a new town would have to go up every third day. Even if the economics were plausible, I find these oversimplified constructions, so dear to the hearts of imaginative architects, somewhat cold and sterile and removed from the natural process of social growth. I had another reason for objecting. It would be turning one's back on the heritage and tradition of America.

My own thoughts were directed not to the form of the city but to the motivation of the people themselves and to an analysis of the natural movement of population from place to place. I felt that next to job opportunity, the environment was all-important, especially education, health, and the

chance to further social, recreational, and cultural pursuits. The sensible place to begin, it seemed to me, was with what we already had. Instead of building new structures and new towns, why not use America's existing small towns and build them up? Why not determine what must be done to them, if anything, to attract the population needed?

To demonstrate the possibilities inherent in small-town America, I proposed selecting a test site in my home state of Connecticut, where we could determine the elementary parameters of environmental attraction. Could we make this region appealing enough to businessmen, for example, so that they would tend to construct their headquarters or divisions and perhaps shift offices, equipment, and some staff there, drawing the balance of personnel from the local area? This would not be a suburban bedroom area with easy access to the city, but an area outside the commuting range, yet perfectly able to support the same kind of business as in the city. The businesses I had in mind were service-oriented, such as banks, insurance companies, electronics firms, as well as banches of large manufacturing industries, which wouldn't interfere with the attractions of the country.

There was some experimental basis for this thinking. In a recent series of studies based at University College in London it was reported that executives moving out of the English capital can use modern communications, such as conference television, to bring components in widespread areas together to such an extent that business can be carried out effectively. Thus the businessman has a wide range of choices as to where to set up branches. Once businessmen come into the town or its environs, my feeling was that the services needed to bring in the basic population were likely to follow. As the community grows affluent, it draws shops, restaurants, and

other service businesses that traditionally mark the charm and amenities of urban living. Of course, I wouldn't expect duplication of facilities to satisfy all the varieties of taste, but that may be little to give up for peace of mind, ease of living, and greater affinity with the outdoors.

I organized the New Rural Society project with Fairfield University and obtained funding from HUD. The governor of Connecticut suggested as the site for our first experiments the area of Windham County, a region of ten small townships in northeastern Connecticut, with two hundred people per square mile, under one-third the average density of the state as a whole. Here is a lovely pastoral area, with the typical town built around a green and dominated by a small, white church, just like the traditional Currier and Ives version of New England. The clapboard buildings with their gable overhangs go back to colonial days.

The main town, Willimantic, twenty-eight miles from the center of Hartford and with a population of 16,000, was once a thriving mill town, but in the fifties it began to decline. The area had a great many antiquated manufacturing facilities in such fields as leather and textiles, whose last infusion of capital occurred in the 1920s. These plants couldn't compete with the new sources of goods from Japan and elsewhere, and as jobs decreased the youth began to leave the towns. In two decades one of America's oldest industrial areas became an economically depressed corner of the nation. Yet the region was blessed with good natural resources able to support twice the population, and a number of the people in this region that my colleagues and I talked with at the start didn't seem to object to the possibility that our study might result in seeing new people and business move in. In fact, they already were considering various plans for growth. But I think it

would be fair to say they were somewhat indifferent to new federal studies, which end up as bound reports on the shelf. As one businessman put it, "We are waiting to be shown."

I sympathize with this point of view, and although studies are essential as a prelude to action, as a preliminary experiment we were happy to introduce in Willimantic this year the first public electronic transmission of mail, called Faxmail. In our setup a person was able to dial a phone number at a special site and at a signal could slip in the material to be transmitted. In Hartford, where it was received, the material was turned into the original form, whether written or pictorial. The experiment didn't last long enough to determine to what extent such a service can be valuable in bringing closer ties between the town and the larger city, but it did show promise as a tool for medicine. With further development such a method of transmission could be used to send X-ray pictures to the radiologists at a Hartford hospital, or indeed any hospital at a distance, using existing telephone lines, a medium of communication whose potential, as I said earlier, has not yet been realized. Records, graphs, and prescriptions are candidates for transmission through such a device. Other professional uses are likely to arise with further development.

Faxmail, of course, is only the early scratching of the technological dialogue between city and country that we hope to initiate through electronic means. We have found in our research of video, sound, and face-to-face conferences that knowing one another is the important element in the substitution of electronics for actual meetings. The use of video for conferences is helpful to people who have never met. The act of seeing one another's expressions contributes to communications. Once the first meeting has occurred, however, video is no longer necessary, and phone conversations become just

as revealing. Today we are working with highly sophisticated sound systems that allow identification of voices as they break into the conversation no matter how many are involved or how far apart they are.

Windham itself is not likely to be the sole target for such continuing studies, because it is not typical, as we've found, of the rest of rural America; nevertheless, it has given us some valuable insights. Our survey of this area and rural America in general convinces us that technology can mark the equalizer between the city and the country. Consider health, for instance. A recent nationwide study showed that twenty million people in the United States are too poor for private care and too rich for Medicaid. Increasing infant-mortality rates in rural areas have placed the U.S. position in infant mortality below that of a number of other countries. Statistics are none too reliable and may reflect social conditions rather than insufficient health care. But in any case there is no doubt that medical expenses have been mounting steadily and that there is a shortage of general practitioners in the rural areas. Many doctors don't want to practice in the small towns either because they feel they are overworked with minor complaints or, as one physician in Windham said, their wives want city-style shopping areas in which to spend their afternoons. Five thousand U.S. communities, the study showed, had no doctor at all. One way to recruit small-town doctors (which I cannot recommend) was suggested by a recent Phoenix court case in which a doctor caught selling amphetamines was given a choice of serving a jail term or serving six years as town physician in Tombstone, Arizona. He chose Tombstone.

Telecommunications can, I think, play an important part in helping to alleviate the problems of health delivery

throughout the U.S., simply by enhancing the productivity of each physician. For instance, instead of a patient going to the big-city hospital or the urban doctor, it is possible through mobile teleclinics to bring the hospital and the specialist to the patient. An experiment by Dr. Kenneth Bird at Massachusetts General Hospital in Boston showed that electrocardiograms can be made of people in a remote area by means of television and telephone linkage. In the West mobile teleclinics stop in remote areas to visit invalids and act like a friendly medical Welcome Wagon, bearing their video and voice linkage to the hospital. For space operations, where physicians are not present and are not likely to make house calls, Lockheed and NASA are currently examining a system of automatic health checks in which diagnosis and treatment can be made at a distance from the patient. Instant consultations even on difficult surgery have been made via television satellite. If this continues, we may have better care using satellites in remote areas than in nearby towns.

Telecommunications joined to the computer will probably also help rural-area patients avail themselves of big-city facilities. Computers are already handling the bills, patient records, and other data of the hospital. Several firms are working on minicomputer-controlled chemical analyses that in virtually no time at all can run through a dozen chemical tests of blood and urine and profile the results. Computers are also used in checking electrocardiograms and encephalograms. A computer scanning of brain waves recently turned up a rare formation of brain waves associated with a certain kind of epilepsy, thus helping a troubled patient. Computers can also exchange medical histories, which is more or less machinery gossiping about each other's clients.

I suppose the most compelling draw of a community out-

side of the availability of jobs is its educational facilities. I worry about them for my own children, and most people I talk with eventually move the conversation around to the sorry state of public education, including overcrowded classrooms, overstructured routines, lack of involvement of imaginative youngsters in the act of learning, and most especially inability of the school to move the child ahead at his or her own pace.

Telecommunications can't solve all the problems of education, and probably not even some of the major ones, but I submit that it can help in novel ways. One possibility of the new telecommunications in the service of the rural society is the "satellite college." Since the Windham region has at least two nearby colleges—Eastern Connecticut University and the University of Connecticut at Storrs—I felt that we might experiment with an electronic tie-in to these learning centers, transmitting some of the educational expertise of the distant colleges into the home or at some local point for those unable to attend the colleges themselves. It would follow that a small but capable faculty could combine local instruction with full participation in many of the activities of the distant university. We could also use cable television to bring courses into the homes—assuming, of course, that the talent now so splendidly devoted to the print media could with innovative techniques be used in the visual arts.

Some criticisms of electronic education have arisen over the years, and there have been spectacular failures, but I think experience, particularly abroad, has shown that some good things can be realized. For instance, one of the most interesting though limited experiments occurred in the underdeveloped African state of Niger, north of Nigeria. Niger decided as soon as it got its independence in 1960 to rise high in

literacy, as a cardinal tenet of democracy, and the Niger government approached France and UNESCO to teach French by television. The initial results, according to UNESCO, were spectacular. A major percentage of those who took the televised lessons learned to speak and write French and to do it much better than the national average.

The Niger experiment has been criticized as an expensive attempt to train a small fraction of the upper class, perhaps a thousand or so, but no such criticism can be leveled at Japan, where undoubtedly the use of television instruction has had its most spectacular popular success. According to reports of NHK, the Japan Broadcasting Corporation, some six million elementary school children along with a million high school students annually take courses by television. Substantial efforts have especially been made to bring high-school and college education by television into Japan's rural communities, with notable success. In fact, the use of TV in Japan is regarded as one of the major contributions toward making that nation preeminent as an industrial power since the end of World War II.

Finally, the most glamorous experiment of all is to repair the imbalance between city and country in the matter of culture, by utilizing a program of entertainment by satellite. The latest Broadway shows, operas, concerts, museum visits, sports events, and major dramatic sequences can be brought by satellite to ground receiving stations that are part of a cable system piped to houses or projected onto a theater or auditorium screen. Thus live cultural events could be shared by millions of people who ordinarily have no opportunity to see them and thus for the first time make such performances profitable. If a community has, or plans to have, a local cable-television operation, the holder of the cable franchise

could receive the satellite entertainment programs and distribute them to subscribers for a fee. A community can be inspired to develop its own cultural life through such programs. On a recent visit to Japan I saw a small, backward community virtually transformed by cable TV. The Japanese feature competitive artistic performances that involve both adults and children in the community, and they have become as accustomed to TV as possibly the old generation was accustomed to wandering minstrels.

I must admit that all people will not subscribe to the new way of rural life I've suggested. Arguments against the invasion of electronics into living have been heard since McLuhan brilliantly attacked the dire influence of ordinary television on men's souls. McLuhan is undoubtedly right in proclaiming that the media transforms the message, and indeed becomes the message, and that what one sees on a screen is not the same as what one sees or feels and smells in the originating theater and amphitheater. But I for one think this is a small tradeoff between the displeasures and dangers of the city in the age of congestion and crime and the comfort and serenity of the country.

The nice thing about the suggested solution to the American imbalance between rural and urban living is that it creates a new pastoral image of America without the citizen's giving up the comfortable technical devices that allowed him to beat back the terrors of nature and then shape it to his own ends. Here is the technological greening of America, on a sensible rational scale. Here is the solution of many problems that plague us now. Is there an oil shortage? The New Rural Society restores the bicycle and indeed the legs to their rightful places as transportation as well as exercise. In the city to go twenty blocks masses of people need a subway, an-

other great consumer of dwindling power resources. What about traffic congestion? Obviously, the New Rural Society will diminish it if not entirely eliminate this headache as people stay in the country because they can obtain all the recreation they want in their homes or in easily approachable community centers.

The New Rural Society will have profound effects on the economy in general. I see a nation of towns devoted more to service than to production. Production will remain in isolated regions carried on mainly by automated industrial robots. In time the cities will again become centers of fashion, art, and cultural exchange, but without the penalty paid to the dangers of urban deterioration.

If given a choice, would 100 million people migrate to a rural community? Would they stay there? I don't know. It is startling to see what people will do. I think in this case it is a question of doing something versus doing nothing. In the forties a movement sparked by the University of Montana (and later the University of Washington) to save the crumbling ghost towns of the West stirred considerable interest. The use of educational programs, seminars, self-study, and some old-fashioned rallies stirred the long dormant pride of the citizens in these towns and resulted in efforts to carry out a renaissance of small-town western America. Unfortunately, the new communications was not at hand to help draw business and in the end the powerful draw of the city and the lack of funds to continue the experience stopped the movement.

A more recent proposal in 1972 by David Rockefeller, head of the Chase Manhattan Bank, calls for building "satellite" communities outside the big cities and beyond the suburbs. The idea is to avoid confronting the tremendous resist-

ance that has arisen against low- and moderate-income housing programs in suburbia by simply bypassing it. To finance the development and settlement of beyond-suburban regions, Rockefeller has suggested that the federal government set up a land corporation to underwrite the private groups who would provide the actual financing. In this way, he says, there will be enough money to build the necessary roads, sewer and water facilities, and other amenities as well as the opportunity to provide a variety of housing that will attract black citizens who are currently confined to the central cores of big cities. Reviewers of the proposal suggest that these satellite communities need not be self-sufficient but actually can become a kind of new neighborhood to the big city and its suburbs—drawing its necessities from the city.

My own feeling is that this is a variation of new-town building. As I indicated earlier, I think such developments may well result in the same difficulties that now plague the urban housing complexes. They will extend megalopolis and simply spread the problems. Moreover, once the news that the federal government would underwrite such a huge development in vacant areas spreads, it is likely to raise the speculative value of the land and thus possibly defeat the aims of the plan long before the first bulldozer can carve a road.

People are asking to go to rural areas. A recent survey by Potomac Associates, a private research firm in Washington, D. C., shows that 50 percent of city white people and 70 percent of the blacks want to live in rural areas beyond the suburbs, as compared to 18 percent a year ago. They long for the good life of the city in the country if the areas offered what they needed, and they could move.

The public, it appears, is ahead of the government in this thinking, and I believe it is time for the government to recog-

nize this yearning for a new migration and take some initiative to satisfy it. I propose the following:

1. The President should create a new powerful post with authority to deal with all agencies that can contribute to the New Rural Society plan.
2. If a city business wants to expand significantly, it must not be allowed to do so in the metropolitan area, but must be influenced to go into the rural areas. Our studies show that communications technology can help business flourish as well outside the urban-suburban complex as it does within it. (Interestingly, in Japan, where living conditions have deteriorated since the end of World War II, Prime Minister Tonaka has adopted the decentralization of business as a national policy. New businesses can no longer build and operate in metropolitan areas, but must go outside.)
3. Provide substantial educational and health improvements in rural areas. State-administered loans to attractive rural communities are vital to provide the facilities needed by the influx of new population. The Rural Development Act, which President Nixon signed into law in 1972, is a small, hesitant step in the right direction.
4. The government should subsidize orbiting satellite systems, so that important cultural events can be made available to rural areas. This new communications network would be independent of commercial TV.

None of the best-selling (or nonbest-selling) books that have touched on the future of America have allowed themselves the luxury of putting forth a grass roots program. They have merely buried the problems in colorful semantics. The New Rural Society, I must admit, raises some questions that are not yet readily answerable in detail. Nonetheless, I do find that young people in particular who listen to me explain my vision of the future show the same enthusiastic light in their eyes that must have characterized the pioneers as they packed their covered wagons for the long, adventurous trek across America.

Support, once denied me when I pursued the New Rural Society for the first time, has begun to pick up. Senator Herman Talmadge of Georgia and his Committee on Forestry and Agriculture, together with Senator Humphrey, ranking member of the subcommittee on Rural Development, are among the political leaders who have indicated strong interest in the New Rural Society. Humphrey in fact has introduced a bill based in part on concepts of the New Rural Society. My calendar today is filled with appointments with university groups and private organizations to tell the story of what I think is nothing less than the survival of America. I have even been attacked editorially by one newspaper as a proponent of a 1984 kind of "big brother" society. This is not true—a proposal of options cannot be equated to regimentation—but it is the kind of response that demonstrates that my message may be getting through.

My own faith in the New Rural Society grows stronger all the time. It may take a national movement to bring the idea to fruition. Even the images must be changed so that people will feel that in moving to the country they are going where the action is. I feel that the time to begin this movement is now.

# Epilogue

AT the beginning of this book I said life begins at sixty-five. Now having reached the end of the book I am convinced that my first statement was correct.

When I left CBS on January 1, 1972, I had no firm prospects for a new career. I had been involved in many negotiations; some attempts were made to use me for promotional purposes; get-rich-quick schemers were on the telephone or appearing at my office. I had spent many sleepless, agonizing nights, and my family was distressed. All I knew—and they agreed—was that I could not emotionally afford to spend the rest of my life in a rocking-chair position, with a thick rug under my feet and a clean desk before me. No matter what the title or the salary.

Now all that is behind me. In January, 1973, I celebrated with my new staff the first birthday of my own company, Goldmark Communications Corporation, which is now a subsidiary of Warner Communications. In Warner I have found a company led ably by Steve Ross and a team of young people with interests and motivations that match my own. Here, too, I have found the freedom to gather together

a group of associates to join with me in opening up and exploring new directions in communications technology and hopefully to bring their benefits to the country. My technological hopper is brimful of new projects. We are also expanding the scope of the New Rural Society project to the point where we are seeing more clearly how it can fulfill the promise of telecommunications as the instrument for social change. It is interesting, too, to note in this connection that business can share with government in this process of developing a plan for nothing less than the survival of the quality of life of a nation.

Ideas are, as I said before, everywhere.

Just recently my son Jonathan, thirteen, and his sister Susan, nine, were playing together in the living room of our home while I was trying out a new LP on my built-in stereo. Suddenly Jonathan looked up at me dreamily and said, "Dad, what if . . ."

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