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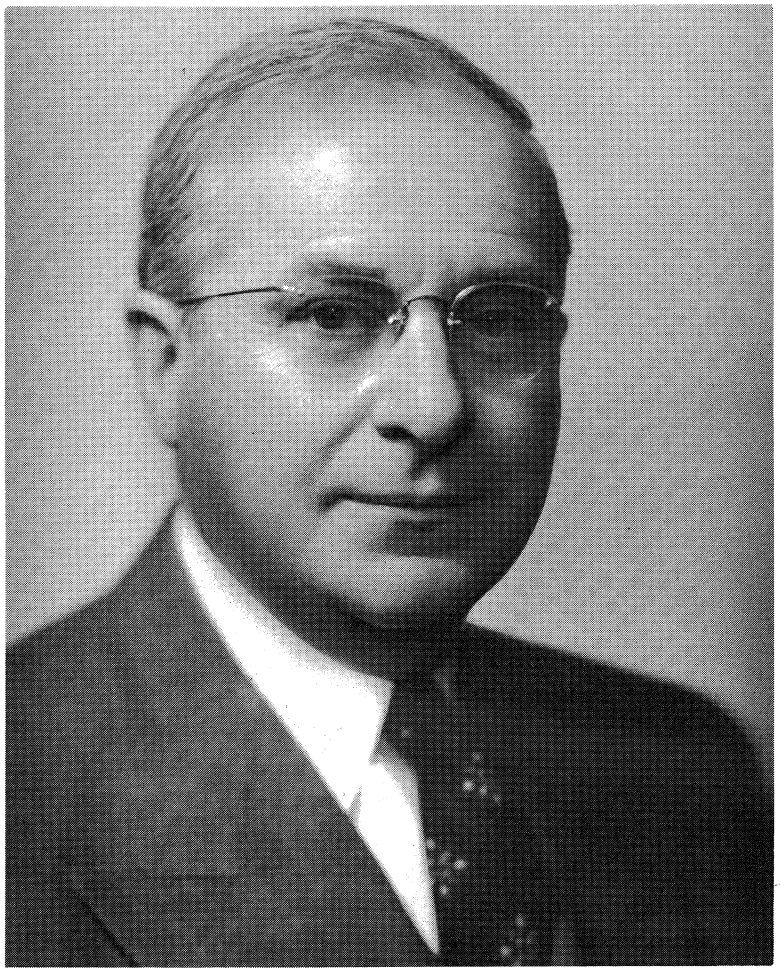

In Memoriam

HARRY W. HOUCK
1896 - 1989

Founded 1909, New York, U. S. A.

THE RADIO CLUB OF AMERICA, INC.

45 South Fifth Street, Park Ridge, NJ 07656

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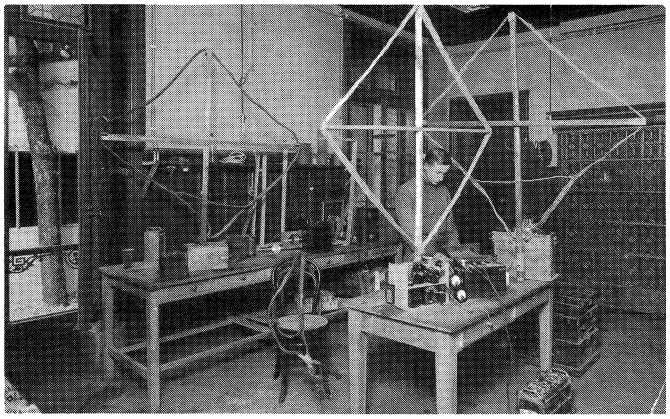
HARRY W. HOUCK - INVENTOR

Death took Harry Houck at the Indian River Memorial Hospital, Vero Beach, FL. on December 20, 1989. He was 93.

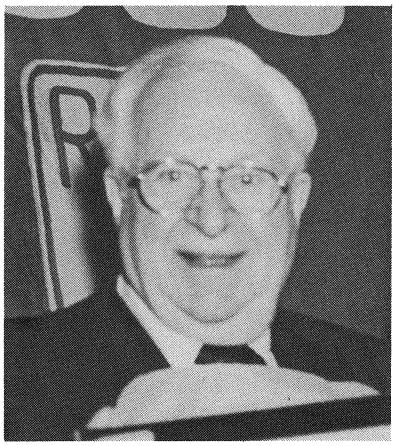
Lawrence Lessing in his book, *Man of High Fidelity, Edwin Howard Armstrong*, writes:

"Late in 1917, there appeared on his staff (Armstrong's), a belated recruit in the person of Sergeant Harry W. Houck, a Pennsylvania Dutch boy from New Cumberland, Pennsylvania, a tiny town just south of Harrisburg. He, too, was destined to be added to the long list of friends and associates whom Armstrong drew around him over the years. Houck had been an eager young wireless "bug" in the fastness of New Cumberland and had been assigned to report to Captain E. H. Armstrong at 140 Boulevard Montparnasse, Paris. He arrived there late, under fantastic circumstances. As he stood before Armstrong and snappily saluted, he was wearing a uniform half French and half American, and officially had been pronounced dead.



Armstrong's Paris Laboratory

"On landing in France, he had been taken violently ill and had been rushed into a base hospital where the ministrations were none too solicitous. In a delerium one night, Houck wandered away across the fields and woke up in a French hospital more to his liking, with two French doctors bending attentatively over him. When he was released two weeks later, he gave the base hospital a wide berth and hopped a truck to report for duty, per orders. There he discovered that the base hospital, in one of those mix-ups peculiar to armies, had reported him dead and had so notified his family and Captain Armstrong.



Harry W. Houck
1967

"Armstrong was charmed by all this and by the perseverence that had carried Houck to Paris, and began questioning the new recruit to find out how much he knew about wireless. Asked to draw a crystal circuit, Houck quickly complied. Then, anxious to show off his knowledge, he volunteered that there was a new and better one than that, and he swiftly sketched in a feedback circuit. Armstrong gravely watched, quickly switched two lines about which Houck had reversed in his excitement, and asked where he had heard about it.

" "In *Wireless World,*" said Houck, "and d'you know, Captain, the feller who invented this has the same name as you !" "

The new sergeant turned out to be a craftsman in the building of apparatus meticulous enough to suit even Armstrong who was a stickler for cleanliness and compactness of design. Moreover, he had the patience, enthusiasm and stamina to match Armstrong's disregard for time when in pursuit of a problem. In after years, Armstrong would allow no one else to build his transformers, maintaining that Houck had a "touch" with trasnsformers superior to anyone he knew. In addition to this, Houck had a sound streak of originality, capable of

Early in 1918 in France, the two were soon in pursuit of the problem which, through all the pressures of other work, Armstrong had been turning over in his mind ever since his talk with Round." (the super-heterodyne.)

Harry Houck was waiting for Armstrong when he returned to New York in 1919, with Houck having decided to forego a visit to New Cumberland in view of the greater excitement. Together they set about pushing the superheterodyne method of reception. With great care, they built an improved five-tube set. News of their feat with the superheterodyne had preceded the return of Armstrong and, later that year, he delivered a paper on the receiver before The Radio Club of America, which officially launched the new circuit on the radio world.

Four years of development were necessary before the superheterodyne was ready for general use. The first task was to reduce the many controls to two, then the circuit had to be simplified by making tubes do a double duty instead of one, in order to bring the set within range of economic manufacture. Houck carried on this development alone and was given full credit for it. He shared with Armstrong an important improvement patent on the superheterodyne which covered a method for greatly simplifying the tuning of the set to the proper intermediate frequency.

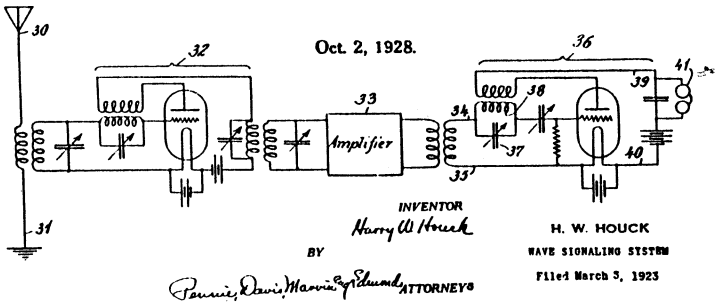
Houck settled in New Jersey, married, and set himself up in a small way in the electronics business. At one time, he ran into some trouble on the superheterodyne, so brought the gear to Armstrong. After toiling over it for some hours, Armstrong suggested that they take it to his home laboratory in Yonkers. Houck stayed that night and the next. Late in the second day, the problem was solved and the set blared forth with a crisp report from the Missing Persons Bureau. Armstrong moved to switch it off.

"Leave it on, Major," said Houck with dry Dutch humor, "I want to see if my name's on it. I've been missing for two days and my wife probably has the police on it by now."

Edwin Howard Armstrong, in a paper presented March 5, 1924 before The Institute of Radio Engineers, said: "To determine just what could be accomplished along these lines (the simplifying of the adjustments necessary to operate a superheterodyne receiver) the writer, working in conjunction with Mr. Harry Houck, constructed during the spring of 1922, a set designed for the maximum usable senstitiveness and selectivity. The set-up consisted of one radio-frequency stage (non-tuned transformer), a rectfier tube, an oscillator tube (used as a separate heterodyne), a three-stage iron-core transformer-coupled intermediate frequency amplifier designed to cover a band of 20,000 to 30,000 cycles, a second detector tube, and two stages of audio-frequency amplification.

"It had been apparent ever since the question of the application of the superheterodyne to broadcasting had been considered, that there were too many tubes performing a single function which were quite capable of performing a double one. The most outstanding case is that of separate heterodyne oscillator. In view of our knowledge of self-heterodyne, it appears quite obvious to perform the first rectification by means of a self-heterodyne oscillator and thereby save a tube.

"As a matter of fact, this was one of the very first things tried in France but, except for very short wave lengths, it was never very successful when a high intermediate frequency was necessary. The reason was this: if a single tuned oscillating circuit was used, the mistuning to produce the proper beat caused a loss of signal strength which offset the gain of the tube. If two tuned circuits were used on the oscillator, one tuned to the signal frequency and the other arranged to oscillate at the heterodyne frequency then, on account of the relatively small percentage difference in frequency, a change in the tuning of one circuit changed the tuning of the other.



"The solution of this problem was made by Houck who proposed an arrangement so simple and so effective that it completely solved the problem. Houck proposed to connect two tuned circuits to the oscillator -- a simple circuit to the frequency of the incoming signal and a regenerative circuit adjusted to oscillate at such a frequency that the second harmonic of this frequency, beating with the incoming frequency, produced the desired intermediate frequency."

Armstrong's recognition of Houck's contributions to the success of the superheterodyne has a sequel. In February 1923, Armstrong walked into the office of David Sarnoff with the simplified model. It would take further work to adapt it for commercial production and Sarnoff decided to take the gamble, hoping to scoop the industry with a model that no one else could match.

RCA's receiver line then was being manufactured by GE and Westinghouse; Westinghouse declined to undertake the development work, and GE ran into numerous difficulties. In desperation, Sarnoff called for Armstrong's help and together with Hull and Langmuir of the GE Research Laboratory, solved the problem of hiss in the mixer tube while Houck solved the oscillator-pulling with his "second harmonic" invention. For this assistance, the two received an additional 18,900 shares of RCA stock making Armstrong the company's largest stockholder.

In 1920, Harry William Houck joined The Radio Club of America during Armstrong's tenure as president. Houck became a president in 1934 and again in 1967. He served also as Vice President, Recording Secretary, and Director, was elevated to the grade of Fellow in 1926, became a Life Member in 1970, was elected a Director Emeritus in 1978, and an Honorary Member in 1983.

In 1941, the prestigious Armstrong Medal was bestowed up Houck with the citation:

The Armstrong Medal of The Radio Club of America is awarded to Harry William Houck for his outstanding contributions to the radio art.

.After assisting at the birth of the Superheterodyne in Armstrong's wartime laboratory in Paris, he designed the second harmonic superheterodyne, the first type to be placed in large commercial production.

Radio receivers operating from alternating current power lines, from their very inception, leaned heavily on the technique, the designs and the inventions of the medalist. His researches on capacitors -- paper, mica and electrolytic -- made practical the filter systems used in all modern radio receivers.

His studious, detailed, careful experimental attack on any radio problem, with results always worthwhile, should be an inspiration to younger men.

Upon the occasion of the 50th Anniversary of The Radio Club, a recording of the sounds of radio history was distributed to those attending the anniversary banquet. Messages in the International Morse Code were keyed in 1909-style by Harry Houck on his original fifty-year old transmitter.

Harry Houck at the Key of His Original 1909 Transmitter

Honors continued to come to Houck. He became a Fellow of The Institute of Radio Engineers in 1957, and was former manager of that organization. He was a member of the Engineer's Club of New York, a Life Fellow of the Institute of Electrical and Electronics Engineers, was awarded the Institute's Morris E. Leeds Award in 1969, and was a recipient of the Marconi Medal awarded in 1955 by the Veteran Wireless Operators Association.

Following his military service, Houck joined the Engineering Department of the International Radio Telegraph Company in 1919 and was assigned to special receiver design problems. In 1921, he took up a private practice as a consulting engineer until 1923 when he joined the Engineering Department of the Dubilier Condenser & Radio Corporation, later becoming its Chief Engineer. Here, he did pioneer development work on the development of capacitors that made possible power supplies for broadcast receivers, operating from AC power sources. In 1931, he accepted a position with the Federal Telegraph Company doing research and development work. In 1934, he joined Measurements Corporation as President and Chief Operating Officer. When that company was acquired by The Thomas Edison Company (later a part of McGraw-Edison) he continued to manage the Measurements Division until his retirement on December 31, 1966. During his career, he had been granted over 80 U.S. patents.

Houck was elected an Honorary Member of the Antique Radio Club of America on October 5, 1974 in recognition of his significant services to the art of radio communications. In 1988, he made a generous contribution to ARCA to establish the *Harry Houck Award Fund* to provide annual recognition to a member of the club in recognition of that member's contributions toward the preservation of radio artifacts or the history of wireless communications. The Antique Wireless Association also established two awards: one for historical documentation and the second for preservation of historical equipments; the AWA Houck Awards honor Houck as a pioneer AWA member.

It has been written that great men do not require a long story about their virtues.

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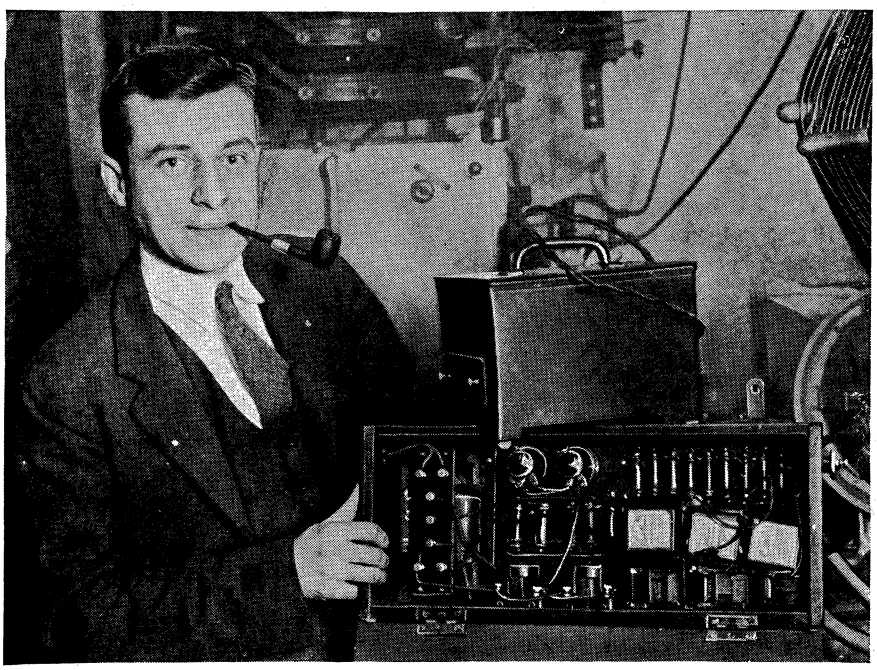
630 *Science and Invention* **November, 1929**

$20,000,000 for a Radio Patent!



A RADIO device that consists of little more than a few condensers, transformers, choke coils, and tubes was recently the cause of a $20,000,000 decision being won against radio manufacturers.

The inventor, Mr. Harry W. Houck, is shown in the photograph on the left, together with the apparatus on which he labored for a long period of time, before he finally perfected it. The device is a battery eliminator for radio sets and it makes possible the present-day all-electric radio sets. Fully 95 per cent of the radio manufacturers of this country are involved, it is said.

Such a decision gives hopes to many thousands of experimenters tinkering with new forms of radio apparatus. Just think of putting together a few simple radio parts and evolving a circuit worth $20,000,000! But this is not the whole story, for Mr. Houck had to spend many weary hours before he evolved this greatly needed device. The Dubilier Condenser Corporation owns the patent.

A Journey of Contrasts

Touring Science and Space Centers of the USSR

by **Jerry S. Stover, P.E., W5AE (F)**

These are exciting times in the Soviet Union. *Glasnost* or openness begun by President Gorbachev has opened Soviet culture and facilities to a degree not imagined three years ago.

In September 1989, my son, Bruce, and I joined a three-week tour of astronomical and space centers in the USSR. The trip was sponsored by *Sky & Telescope* magazine in cooperation with the Soviet Academy of Sciences. Traveling by plane, bus and train, we covered over 6,000 miles inside the Soviet Union. The group of nineteen was composed of engineers, scientists and amateur astronomers.

Ancient cities of Central Asia, an ultra-modern Space Center, the Himalayan foothills and canals of Leningrad all provided contrasts of cultures and scenery that became, at times, almost overwhelming.

PULKOVO OBSERVATORY -- LENINGRAD

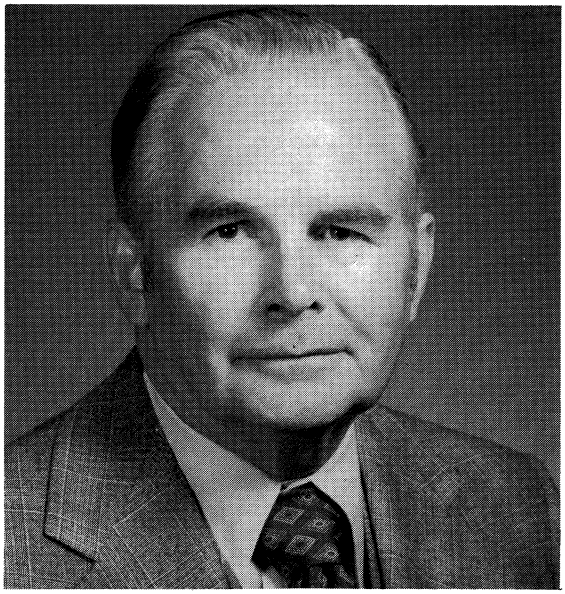
Following an overnight flight from New York by way of Helsinki, we began our tour of Leningrad with a visit to the 150 year old Pulkovo Observatory. Pulkovo is famous for its pioneering planetary work in the late 1800's, and its current work in solar physics.

The warm reception from Pulkovo's director, Dr. Abalakin and his staff, followed by wide ranging discussions, presaged the hospitality and candid interchanges that we would find at all subsequent stops.

During the 900 day siege of Leningrad during World War II when nearly one million people died of starvation and shelling, the twenty-six inch Pulkovo refractor was buried for protection. During its resurrection and installation the lens was damaged so the current unit is a replacement.

In addition to optical astronomy, Pulkovo has a large radio telescope for deep-sky work. We were told that when not used for radio astronomy the big "dish" is sometimes pointed across the Baltic Sea to pick up Swedish TV!

Trips to the Hermitage Museum and Summer Palace rounded out the Leningrad stay. There are over 1,000 fountains in operation at the Summer Palace, including a "surprise" fountain to shower passers-by. Considering that all of this was installed by Peter the Great nearly 300 years ago, using only gravity feed, makes it even more impressive.



Jerry S. Stover

SOVIET ASIA

From Leningrad, a four-hour flight southeast across the Kara-Kum desert to Tashkent and Samarkand, at the base of the Himalayas, carried us 2,000 miles in distance and over 2,000 years back in time. These ancient cities were on the old "Silk Road" that ran between the Roman Empire and China. History contributes greatly to the excitement and drama of the area.

Samarkand, called Maracanda at the time, was conquered by Alexander the Great in 330 BC. The Arabs brought in the Moslem religion in 800 AD and, in 1200, Genghis Kahn and his Mongol hordes laid waste to the entire area..

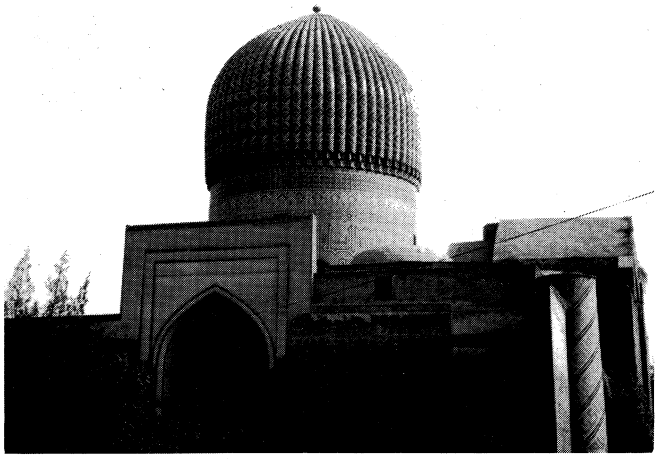
It was slowly rebuilt and reached its zenith under Tamerlane (Timur the Lame), a warrior even more fierce than Genghis Kahn. In the 14th century he ravaged all of Central Asia, slaughtering 50,000 in Delhi alone and bringing back thousands of women and children as slaves.

He was a ruthless destroyer and zealous builder all at the same time and made Samarkand the capital of his vast domain. He brought in artisans from the conquered countries to build "a capital of capitals" with beautiful azure stone gardens and buildings.

THE "CURSE OF TAMERLANE"

According to the guide, questions arose over the centuries as to whether Tamerlane was actually buried in his magnificent Samarkand tomb. To resolve this issue, Soviet scientists opened the crypt in June 1941.

The withered leg bone showed it was, indeed, the dreaded conqueror and the remains were carefully re-interred. A few days later, the Germans invaded Russia. To this day, local legend attributes the invasion, not to Hitler, but to the "curse of Tamerlane" for disturbing his grave!

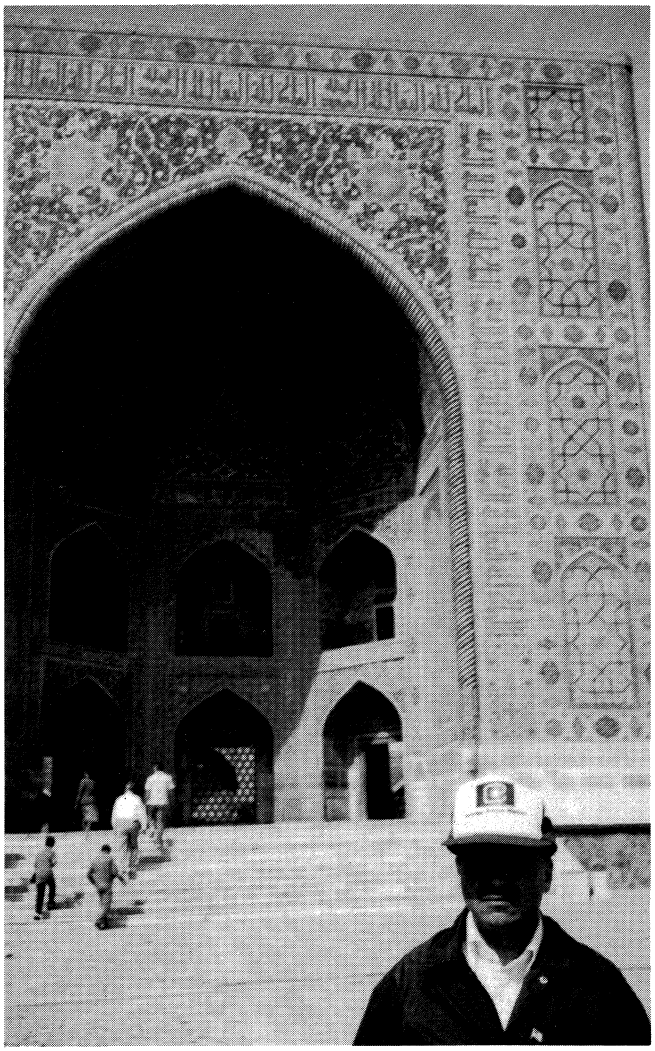


Tomb of Tamerlane

Tamerlane's grandson, Ulugbek, was more of a scientist than a ruler and this cost him his life. He built a large astronomical observatory with a 130 ft. meridian arc with which he calculated the angle of over 1,000 stars. These star charts -- prepared 150 years before Galileo invented the telescope -- were used by navigators for several hundred years!

Fanatical Moslem clergy who felt that science was threatening their theology, murdered Ulugbek and leveled his observatory. After years of searching, Soviet archaeologists found the site and excavated it early in this century. The below ground meridian arc, accurately aligned north and south even by today's surveying standards, is in good condition with the ancient markings still legible on its marble surface.

Ulugbek carried on the building program begun by Tamerlane and built, in 1420, the Ulugbek Madrassah, a Moslem school, containing some of the most beautiful inlay and mosaic work in Central Asia. The Soviets have done a good job restoring the ancient buildings. They have wisely not attempted to replace lost sections of the original tile.

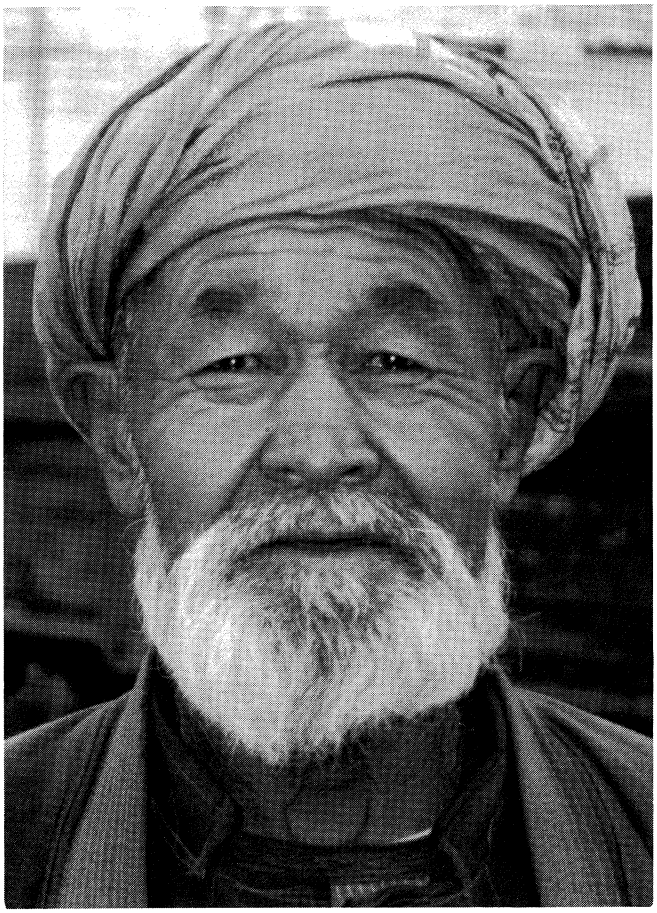


Registan Madrassah, Samarkand
Bruce Stover is at right of picture

In addition to the inherited Mongol features and cultures that characterize the principal tribes -- Tatars and Uzbeks -- Samarkand's proximity (less than 300 miles) to China, Afghanistan and Iran has caused an even greater mix in this crossroads of Central Asia. It is a true "melting pot" of races and culture.

Although about half the men wear western clothing the rest, and most of the women, wear native dress with ankle length pantaloons covered by a skirt. They are all beautifully and brightly colored. Many of the men wear turbans or a small flat cap. Although it is a Moslem area we saw few veils.

The Samarkand market place reminded us of "Arabian Nights" and we would not have been surprised to see Yul Brunner come out of an alley. We took many pictures, always after asking permission which was usually given with a smile.



Citizen of Samarkand
Descendant of Tamerlane (?)

Tashkent and Samarkand are both in the Republic of Uzbekistan, which produces 80% of Soviet cotton. The four-hour bus journey to Samarkand wound through many miles of irrigated land surrounded by barren hills, not unlike parts of Western Texas.

During the thirty-minute return flight to Tashkent, one could not help but visualize the plodding caravans or mighty armies that made their way along the same route thousands of years ago. Again, the contrasts!

Before leaving Tashkent, and with the aid of the Intourist guide, I finally met with a Russian ham operator. He was pleased to receive copies of *CQ* and *QST* and some ARRL caps for the Tashkent Radio Club.

ACCOMMODATIONS

Contrary to reports from friends who traveled the USSR in previous years, we found Intourist, the Soviet travel service, to be very efficient. The buses were comfortable and on time, the hotel rooms ready though often shabby, and the guides universally excellent. We first thought our good experience was because the Soviet Academy of Science helped arrange our trip but when we spoke to "non-hosted" groups in Moscow they also seemed pleased with Intourist.

It took us awhile to appreciate the hotels and food that seemed second or third rate by Western standards, but were in fact the best the Soviets had to offer. Most annoying was the lack of even rudimentary maintenance, especially in the bathrooms. Faucets dripped, cabinet knobs came loose and carpets were torn.

At the hotel dining room in Samarkand, the sheets of fly paper were completely unable to make up for torn screens. It was somewhat reminiscent of a Boy Scout Camp so, as former Scouters, we soon adapted. Food was usually attractively prepared but with a very limited menu. The bread was excellent and the jar of peanut butter I brought from home came in handy. We were cautioned to use bottled water, even in Moscow. Unhappily, the bottled water is highly carbonated so cokes and German beer, bought at the Beryozka, or "hard currency shops," soon became beverages of choice, even for brushing teeth. It seems almost paradoxical that the country that put the first man in space cannot purify its water!

Political discussions were common with much criticism about Gorbachev and his failure to help the economy, especially as regards the housing shortages. However, when we asked if they wanted it back like before, the answer came immediately and forcefully, "No!"

A three week tour hardly qualifies one as a "Russian Expert" but, from conversations with guides, etc., it would appear that long standing economic problems have been exacerbated by removing old strictures without putting in new ones to keep things moving. It is almost as if they do not know how to handle the new freedoms.

They can, for the first time, complain publicly but are frustrated by the fact that complaints do not bring relief. We Americans, especially those in big cities, have known for years that complaints do not necessarily begat action. Perhaps they used up their patience before they could go public with their complaints.

THE CAUCASUS

It was with some reluctance that we left the drama of Soviet Asia and flew back west to Mineralnye Vody (Mineral Water), the airport for Pyatigorsk in the heart of the Soviet Spa country. However, we had no time to visit the many mineral baths or to climb nearby Mt. Elbrus, Europe's highest peak.

Instead, a full day's journey into the beautiful Caucasus Mountains of the Ukraine took us first to the Zelenchukskaya Observatory at an altitude of 7,000 feet. Again, the cordiality and openness of the Soviet scientists was typified by our visit to the world's largest optical telescope, the giant six meter (20 foot) reflector.

Instead of a perfunctory briefing and photo session, Dr. Lipovetsky and the observatory staff took the entire group down into the "pit" to see the unique method by which the 100 ton behemoth is floated on oil-film bearings.

The size of the giant mirror precludes sending it off for the recoating that must be done every year or two. To accomplish this they have a giant vacuum chamber in the basement. To demonstrate its capability, they sealed it off and pumped a high vacuum.

World's Largest Radio Telescope, RATAN 600.

At a lower elevation but still in the Caucasus mountains, we stopped at the "RATAN 600," a radio telescope. The young astronomer who showed us through, Oleg Verkhodanov, jokingly complained that they were in the *Guiness Book of Records* as the world's largest radio telescope but Guiness had the diameter as 600 feet instead of 600 meters (1900 ft.!)

Radiations from the outer limits of the Universe are collected by the reflectors and focused on the receiving cab. Various centimeter receivers, cooled by liquid nitrogen, feed the recording equipment. The enormous cab mounted on rail tracks can be moved to different azimuths for study of different sections of the sky.

One of the staff of the RATAN 600 was a ham but was off the day of our visit. I left him radio magazines, an ARRL cap and solar-powered pocket calculator. The calculators were the principal "thank you" gift we presented to our hosts. Solar-powered units are highly prized as batteries are scarce.

ARMENIA

We were scheduled to go by bus to the Byurakan Observatory in Armenia. However, Azerbaijan was blockading Armenia in a dispute about the Armenian enclave, Norgorno-Karabakh, so we went by "overnight" train.

The 200 mile journey to the Armenian capital, Yerevan, took 15 hours and was one of the few unpleasant parts of the entire tour. The staff gave us clean sheets for the rolled up mattresses but the rest of the train was dirty and in bad repair with broken windows and filthy toilets.

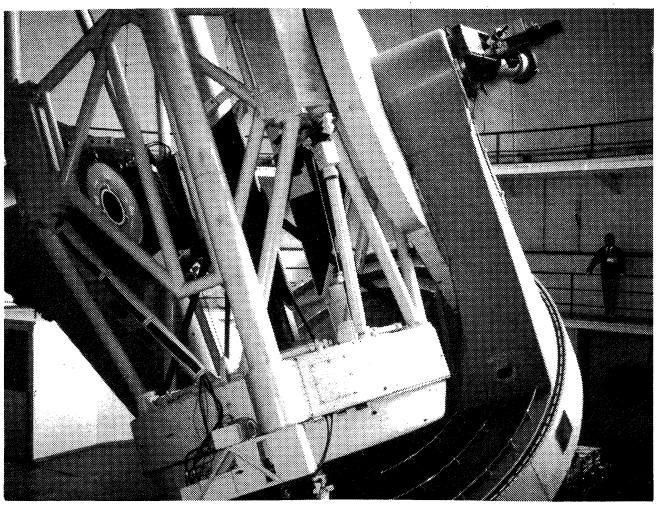
Yerevan is a beautiful city and is the center for the reconstruction aid to victims of the 1988 earthquake. There were several International Red Cross vans from Italy, France and other countries but all were stranded for lack of petrol due to the blockade.

The Byurakan Observatory is on Mt. Aragatz, just north of Noah's snow-covered Mt. Ararat which looms up 17,000 ft. on the Turkish side of the border. The pine forest and mountain springs made it one of the more picturesque locations of any of the sites visited.

Because of its relative isolation, heightened by the blockade, Dr. Khachikian and the staff seemed especially glad to have us. They readily opened the domes and moved the telescopes around so that we could get the best photographic angles.

The principal instruments are a 102 inch reflector and one of the world's largest Schmidt telescopes with a 52 inch mirror. For

non-astronomers, a Schmidt is an astronomical camera used for sky mapping and finding comets.



Byurakan Observatory, Armenia

We were able to get a plane out of Armenia but,. for a time, we were almost ready to try the train again. On our flights in the USSR, security and safety precautions were not up to Western standards (seat belts seldom checked and often not working) but the thirty-minute flight from Yerevan to Tblisi took the "white knuckle" prize.

Our 30 passenger plane -- a YAK 40 -- took off full, plus eight stowaways with six sitting on the baggage in the tail! It took the entire runway to get off and, after going through the edge of a storm, we finally arrived in Tblisi.

Tblisi, the capital of Soviet Georgia, is in the heart of the Soviet breadbasket. Unlike cities in the north, we saw no lines for food, clothing or soap. The people are well dressed and appear more cordial and easy-going than in Leningrad or Moscow.

This is not to say that the Leningrad or Moscow people were not helpful, especially as we tried to find our way on the subway, but there was a certain abruptness not evident in other areas.

No doubt the shortages and economic conditions of the northern cities creates a more serious mien. Also, those two cities have been tourist centers for years, causing their locals, like New Yorkers, to be more blase' about visitors.

While in Tblisi we visited an Orthodox church and a Jewish synagogue, both very beautiful. The church was fairly crowded with worshipers of all ages, mostly women, lighting candles, etc. The synagogue was empty at the time but the Rabbi who welcomed us said it was an active congregation and that they had few problems other than money.

THE CRIMEA

Not far from Yalta on the Crimean Peninsula is one of the Soviet's major observatories. In addition to 48 inch and 102 inch reflectors, it has one of Europe's largest solar telescopes. A large heliostat tracks the Sun, reflecting its rays down a 100 foot tower to laboratories where spectrum studies can be made.

The observatory was also engaged in some of the Soviet unmanned lunar-landing activities, including the return of samples. Dr. Petrov explained that they had brought back only a small amount but that we had shared some of the samples from the "hundreds of kilos" that our Appolo missions returned.

The Crimea site also has a radio telescope with a 70 foot dish for observations at millimeter wavelengths. While in the Crimea we had planned to visit the 230 foot dish at Evpatoryia, used by Soviet scientists to track their interplanetary spacecraft. However, since it is also used for military work, we were not entirely surprised when our clearances did not come through. This was the only place during our entire tour where we encountered any restrictions on where we could go.

As is common in many foreign countries, the hotels kept our passports and gave us a hotel card to carry. It was written in Cyrillic so in addition to serving as an identification card, it was useful to show cab drivers or others to get us back to the hotel.

Our hotel at Yalta was the finest of the entire trip. Somehow, perhaps because of my gray hair, Bruce and I were assigned the Presidential suite, containing an office, dining room and kitchen with a balcony overlooking the Black Sea! Of course, the refrigerator was not working, but Bruce named our suite "The Texas Embassy" and we hosted the only social event for which we had time on the entire trip.

Also, at Yalta we were finally able to telephone home. Everywhere else it was "Not possible" or "Twelve hour delay." In addition to home news we obtained brief up-dates on world news.

The Russian TV often carried excerpts from CNN but only with Russian commentary. Bruce saw an English language newspaper on the newsstand and quickly bought it only to find it was from New Delhi and a month old!

On most overseas trips I take a small short-wave radio to pick up the VOA and BBC but decided against it on this trip. However, it would have presented no problem. The important thing is to register money, watches, radios, etc., when you enter and be sure to have them when you leave. Otherwise,

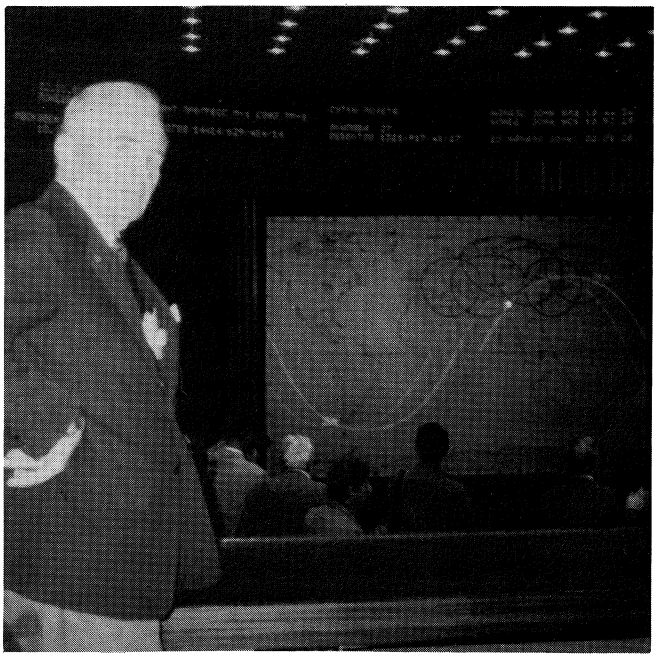
you might be accused of black market dealings.

The black market is very pervasive with young men on nearly every corner trying to sell rubles for dollars at one-tenth the official rate or wanting to buy Bruce's *Walkman,* our watches, etc. with rubles. Since there was nothing to buy with rubles and no one wanted to risk falling for a police "plant", they got few takers.

Again, due to our full schedule I was unable to meet with any Yalta hams but our guide's husband had a friend who was a ham. I gave her the rest of the ham publications and, since returning home, have received a nice "thank you" letter from the Yalta ham club.

MOSCOW AND THE SPACE CENTER

The final stop on our journey, Moscow, was a busy one. The Mission Control Center at Kalingrad on the outskirts of the city was a highlight.



Mission Control Center, Moscow
The Author is at left of picture

Our hosts scheduled us to be at the Center when the Soviet Space Station, MIR, was passing over. The communicators were giving the three Cosmonauts the morning news after their sleep period. These were the first Cosmonauts back on the MIR after several months of unmanned activity. They had been up about 2 weeks when we were at the Control Center.

The Soviets have had several long-duration missions with one Cosmonaut staying up over one year. At the Control Center we were shown a small TV room that had some toys in the corner. We were told that this is where families could come and talk to, and see, their husbands and fathers more or less privately.

Adjacent to the MIR control center is a large all-new control room built specifically for the Russian shuttle, BURAN. BURAN has made one unmanned flight and, because of "budget limitations," it is not clear when the next flight will take place. Meanwhile, the large, new control room sits vacant with banks of brand new computer consoles, projection screens, etc. The same comment about funds being cut "by the Supreme Soviet" was heard at nearly all observatories and centers we visited.

We ran out of time to visit the cosmonaut training center at Star City where I had hoped to meet one of the cosmonaut hams that operate from the MIR space station. However, I gave the chief PR man the last of the ARRL caps and other ham gifts and he promised to deliver them to the hams.

Our schedule included a visit to the Space Research Institute, Russia's equivalent to NASA and the organization responsible for several highly-successful unmanned probes to Venus, Halley's Comet, etc.

The Institute's most recent probe was sent to Mars to study its moon, Phobos, but it failed after a couple of weeks of exciting picture taking. The Director, Dr. Galeev, candidly reviewed their analysis of the failure and the proposed corrective measures for the next probe "when we get funds for another."

The Cosmos pavilion, Moscow's equivalent to Washington's Smithsonian Air and Space Museum, houses test models and replicas of many of the Soviet spacecraft. SPUTNIK, the first of the artificial satellite, occupies a central spot, along with full-scale models of the U.S. Apollo and Soyuz vehicles that linked up in space.

The late Yuri Gagarin, the first man in space, is honored not only in the Museum but throughout the Soviet Union. Next to Lenin, there are probably more statues and pictures of Gagarin than any one else.

In addition to the science stops we worked in some sightseeing, including the famed Moscow Circus. The Circus is able to draw on the very best talent from the entire country and, in its new building, it is truly outstanding. They have many more acts than can be shown so they are rotated in road companies that make national and international tours. One company recently toured the U.S.A.

We were under no restrictions as to travel and ventured out on our own, including using the subways, whenever we had free time. The subways are all that they are reputed to be. The stations are clean with hanging chandeliers, art work and digital readouts telling when the nexty train will arrive. We changed stations twice going from the Circus to our hotel and were able to see that the trains did arrive within seconds of the predicted time!

Some of us were surprised to learn that Red Square, with St. Basil's onion-domed cathedral -- reputed to be the most photographed object in the Soviet Union -- and the Kremlin are not one and the same. Red Square is adjacent to, but outside the Kremlin walls. Both are quite colorful -- not the menacing grays of spy movies.

Inside the Kremlin we toured the Armory where the Czars' crowns, jewels, clothing, etc. are kept much as in the Tower of London in England. In some ways the Armory does a better job of display than the much larger Hermitage Museum in Leningrad. The period groupings seem better organized.

Our final scientific stop was at the Soviet Astrophysics Institute. There, in some rather dilapidated quarters, they are doing some very original and outstanding research, according to the scientists on our tour. It demonstrated that fancy new quarters are not always necessary for good research.

Most of the discussion was over my head but at one point when they said a Cray supercomputer was being used to reduce the data, I broke in and said, "Excuse me, did you say Cray?" The researcher laughed and said, "Yes, in Canada. This is a joint project with Canada. Your government has not yet let us buy a Cray!"

After nearly three weeks of checking in and out of hotels, getting on and off buses, and going through dreary airports, fatigue really began to set in and we were ready for home.

As we waited at Moscow's International Airport for our flight there was time to reflect on the kaleidoscope of scenes, people and events we had observed in the world's largest country.

The one universal thread was the cordiality and helpfulness of the people, whether it was Samarkand or Moscow. The few phrases of Russian we had practiced before the trip never failed to bring a wide smile and often a handshake.

They were genuinely glad to see us and we were glad we came. All of us left fervently hoping that they will solve their economic and political problems. It will be a new era for them and for the entire world.

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Jerry S. Stover, W5AE **(F)**, is a native of Dallas. He received this B.S. degree in Electrical Engineering from Southern Methodist University (SMU). A major in World War II, he was awarded the Bronze Star medal for establishing communications on the Omaha Beachhead during the invasion of Europe in 1944. In 1946, He and **Tom McMullin**, ex-W8CBG **(F)**, established Communication Industries (CI) a mobile radio firm and Decibel Products, an antenna manufacturer.

Since his retirement as Chairman of CI in 1980, Stover has served as a volunteer assistant to the Dean of Engineering at SMU. He is also a member of the Radio Engineering Advisory Committee (REAC) for the Voice of America. He is a Registered Professional Engineer, a member of the IEEE and a Fellow of The Radio Club of America. In 1981, he was awarded The Radio Club's Sarnoff Citation and, in 1984, the IEEE Centennial Medal for outstanding contributions to mobile communications. He is an amateur astronomer and active radio ham, having been licensed for over 50 years.

PHILLIPS CODE REBORN

by **Kaye Weedon (M)**

Sooner or later, the venerable *PHILLIPS* code had to be revived.

The following appeared in a "New Products" notice in *Newsweek* magazine, issue of May 9, 1988:

> "...the Panasonic Industrial Company...has developed a new software program for certain Panasonic electric typewriters that could improve the accuracy of typists. The program, called *FasType,* automatically converts Gregg shorthand abbreviations... into full typed text. If, for example, a secretary types the abbreviation 'asap' on the keyboard, the system will automatically type out the words "as soon as possible." Panasonic claims the program increases productivity in two ways: by reducing the number of keystrokes needed for data entry, and by eliminating some potential spelling errors. *FasType*...has a 1,400 word standard glossary that includes days of the week, months, salutations, common nouns and standard business terms. A separate 'user glossary' allows operators to store abbreviations unique to their job..."

It is interesting to quote an example[1] of the abbreviations used in the Phillips code era which lasted, in the U.S. circa 1879 - 1919. The Phillips code was used only by commercial high-speed operators and almost entirely for press work. Speed of message handling was their bread-and-butter -- unlike Europe where bonus pay was unknown, telegraphers were offered no incentives and, in the German Post Office, higher speed was seen as a possibility for reducing staff.

Phillips code enabled U.S. operators to send for hours at 45 - 50 words per minute and, at times, even more but it also transferred a burden to the receiving operator.

> Example: **"Mems o cx Cgs rptg und cv cmns o eno cap wo knp xgn ifo thr adhts wi cmb aga ay emt to t crpns, bt cujx es dtmd efo qpt peo f stas wi efy dmz ay osn."** Which translates as: "Members of Congress representing under cover combinations of enormous capital corrupt legislation in favor of their adherents will combine against any embarrassment to the corporations, but courageous and determined effort on the part of the people of the separate states will effectively demoralize any opposition."

In the Phillips code, the computer was the human brain of the telegraph operator whose functions are described thusly:[2, 3, 4]

> "Working Phillips involves very remarkable brain work. First, both operators had to know the Phillips code by heart. The sender would automatically encode his abbreviated message in Morse. The receiving operator performed the almost incredible task of hearing the sounder in a noisy room, immediately decoding the message from Phillips into the readable language of the original message which his pen recorded on paper (and later written by typewriter.)
>
> "In press work, the use of the Phillips code... materially lightened the burden of the telegraph operators, some of whom now could handle 50 to 55 w.p.m. for hours...using their privately owned typewriters."

The burden is now taken over by the computer and its software but the 'operator', now the "*FasType*" secretary, has to master the Gregg shorthand abbreviations, duplicating the Morse operator's initial learning process of 111 years ago.

Where the old-time operators stored the abbreviations in their minds but could look them up in the Phillips code book, the modern secretary has them stored in the computer program for instant reference if the human memory is not adequate.

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[3] Weedon: "Faster Manual Morse", Morsum Magnificat Nr 11 Spring 1989, p.45.

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TELEGRAPHIC SPEED & SHORTCUTS

by Donald K. deNeuf (F)

Around the turn of the century, the semiautomatic key (or "bug") and the typewriter made the movement of traffic by the American Morse Telegraph Code considerably faster then the older method of sending with a straight key and copying by hand writing. The urge was always present to "move copy" faster -- especially in the press field.

Walter Phillips, a crack operator for the Associated Press, devised a set of abbreviations even before the advent of the "bug" and typewriter, which went a long way in accomplishing greater speed. He published his "Phillips Code" as early as 1879 and it became the standard abbreviation code in the U.S.A. and Canada for press message transmissions. "AB" stood for "about". "BC" stood for "because" and "CCN" for "conclusion". "WIT" meant witness, "RKZ" meant recognize, and so on.

There were nearly 6,000 such abbreviations. Skilled receiving operators using a typewriter could easily type-out the abbreviated word in full and keep-up with the sender as fast as he could go. But they couldn't let their minds wander. "POX" was the code for "police". A news dispatch once referred to a breakout of smallpox. One absent-minded operator copied it as "a breakout of small police."

While many operators became familiar with his abbreviation code, few knew that in 1914, Phillips designed a modified Morse telegraph code which he felt would not violate the prevailing sentiment attached to the existing code and, at the same time, would dispose of the drawbacks of the "spaced-dots" used in the letters C, O, R, Y, and Z, and the extra-long dash signifying the letter L. His proposed code was:

A .—
B —...
C ...—. (instead of .. .)
D —..
E .
F ..—.
G ——.
H ....
I ..
J .———
K —.—
L ...—
M ——
N —.
O ——— (instead of . .)
P ..——.
Q ..—.
R ——.. (instead of . ..)
S ...
T —
U ..—
V ...—
W .——
X .—..
Y —.... (instead of .. ..)
Z —...— (instead of ... .)

Despite occasional Morse telegraph errors caused by careless senders (as "seen" for "son", "sheep" for "shop", "tease" for "lease", etc.) Phillips' proposal never caught on -- habit is difficult to change and some operators felt strongly that the spaced-dot letters provided somewhat faster transmission than would the proposed code.

If Phillips had been able to present his proposed code somewhat earlier, it might have been the one eventually adopted internationally to replace Morse's original code which was not satisfactory to many European countries for two principal reasons. The spaced-dots were not practical on sluggish "swinging needle" type circuits and submarine cable telegraphy. The other reason was that the code made no provisions for diacritically marked letters used in Europe.

Because of these problems, an International Telegraph Conference held in Berlin in 1851 devised and adopted the present-day "International" code which utilizes some of Morse's original signals but eliminates the spaced-dots and the long-L, and it provides for the accented letters.

Morse's original code remained the standard for landline telegraphy in North America despite the use of the International Code on overseas cable and radio circuits and in maritime wireless communication until the 1930's when it began to be phased out with the introduction of teleprinters which replaced manual Morse telegraphy.

Prior to his death in 1988, Donald K. deNeuf was a frequent contributor of articles published in The Proceedings of The Radio Club of America, The Sparks Journal of The Society of Wireless Pioneers, and The Old Timer's Bulletin of The Antique Wireless Association. *His papers also have been reprinted by overseas publications such as* The Royal Naval Amateur Radio Society's News Letter. *He was recognized with the Ralph Batcher Memorial Award at The Radio Club's annual banquet in 1986.*

RADIO PIONEER - W. E. D. STOKES, JR.

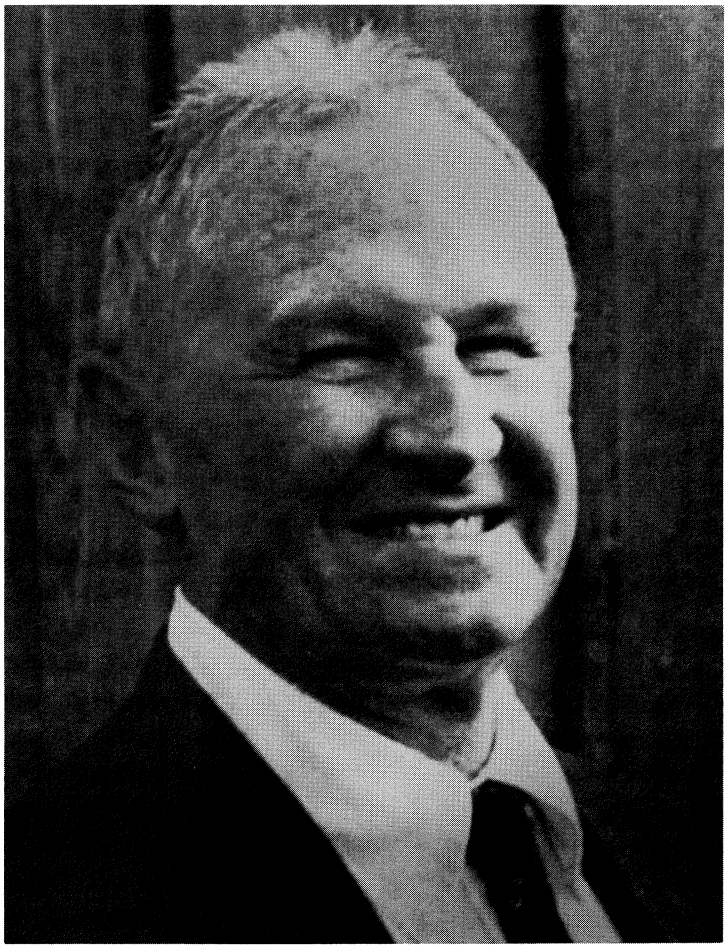
by **Houston H. Stokes, Ph.D.**
Professor of Economics
University of Illinois, Chicago

There is one member of The Radio Club having a tenure of 80 years: William Earl Dodge Stokes, Jr.

Born 5 January 1896, in New York City, he was educated at Browning School, Andover Academy, Sheffield Scientific School at Yale, the U.S. Naval Academy, and the University of Chicago Law School.

On 2 January 1909, W.E.D. Stokes, Jr. became the first president of the Junior Wireless Club, Limited.[1] The founding members' interests in radio arose as a result of a desire to control model airplanes in a New York armory, and Stokes' interest in aircraft has lasted throughout his lifetime. In 1985, he commented on the problems of controlling the models:

> "The problem was only to turn the model when you saw it about to strike the wall and rest content that the motive power would let it fade out as it began to circle. For this purpose, I had two springs attached on either side of the rudder. When I saw the plane getting close to the wall all I had to do was to unlatch one spring so that the other spring was free to pull the plane around into a turn.
>
> "As luck would have it, the head carpenter at the Hotel Ansonia, who was terribly interested in my extensive workshop, was able to produce an electric front-door latch for unlocking doors by remote control. This very small piece of equipment was fitted into the large model plane that I had put together and along with the said springs was able to release one spring when hooked up to the decoherer and battery carried on board. This was a great idea for saving the plane from damage but did not solve the problem of returning the model to straight flight.'
>
> "Various ideas were suggested to produce a system for latching up the spring that had been unlatched in the above way. This required more heavy batteries and use of a small motor to wind up the spring instead of unlatching it.



W. E. D. Stokes, Jr.

> "A scheme was concocted to do this after allowing the plane to turn, say 15 seconds, and then to flip a switch and reactivate the spring to produce straight flight. It all seemed so simple but never worked. It took one whole month in the summer at my father's summer estate at Little Silver, New Jersey, to put the material together into a very heavy box kite. The end came quickly when the box kite made a sudden flip to one side and never recovered, and dove into the river never to be seen again."[2]

The organizational meeting of the Junior Wireless Club, Limited held at the Hotel Ansonia, established the club on a firm foundation with the help of W.E.D. Stokes, Sr. who provided legal guidance and encouragement. Meeting on Saturday afternoons, the members built their "wireless" transmitters and receivers, and commenced operations. The first radio call book listed Stokes as X, King as FK, and Eltz as GZ.

Although Stokes secured four U.S. patents on radio, his most lasting contribution to the future of amateur radio came, at age 14, from his participation in the Club's organized opposition to the Depew bill introduced in 1910. The Depew bill (S. 7243), as originally written, would have practically outlawed any amateur experimentation. The Junior Wireless Club was contacted by Senator Depew. Their reply, which requested to be heard at hearings on the bill, was signed by Eltz, Munn, King, Seymour and Hardinge and was dated 19 March 1910. The Junior Wireless Club, consisting of mere boys, was well organized and represented by able legal counsel in the form of Frederick Seymour. It was able to react in a timely and appropriate fashion. A committee consisting of W.E.D. Stokes,Jr., Chairman, Frank King, George Eltz and Ernest Amy attended the hearing on 28 April 1910. As a witness, W.E.D. Stokes, Jr. made a speech against S. 7243 before the Committee on Commerce of the Senate of the United States. Key aspects of his testimony had long-run implications for the development of amateur radio and included:

- agreeing "...to the importance of licensing all professional as well as amateur wireless operators..."

- stating the principle "...that such a license should be revoked forthwith for malpractice at any time such as in case of war or intentional interference in important messages, and the sending out of false calls for aid, or refusal to answer calls for aid, or to send along such messages..."

- calling for license qualifications "...we believe that every person who takes out a license should be either a born citizen of the United States, or should declare himself to be a citizen, and he must understand the Morse code..."

- protesting that the Depew bill would discriminate heavily against the amateur and in favor of the commercial wireless companies and that, if passed, it would stifle the ambition and really great inventive genius of American boys."

The Committee killed the measure. A discussion of the whole episode is reported in the 25th, 50th, and 75th Anniversary Yearbooks in George Burghard's excellent history of the Club.

The membership soon increased from the original five charter members and, by April 1911, had more than doubled. Due to this increase, it was decided to hold the meetings at the home of Frank King where, on 21 October 1911, the name of the club was changed to The Radio Club of America.

W.E.D. Stokes, Jr. left for boarding school, and this hampered his radio experimentation. Further disruption was provided by the war. In 1915, he entered Yale Scientific School. In 1916, he served in the 10th Militia Field Artillery with "Black Jack" Pershing during the Mexican Border War. In 1917, he left Yale and entered Annapolis for a short training course. He later served as Assistant Communications Officer on the USS Delaware in the North Sea with the 6th Battle Squadron of the British Grand Fleet. After the war, he served on the USS Claxton as the Torpedo Officer. In 1919, he returned to civilian life with the rank of Lieutenant, U.S. Navy.

After law school at the University of Chicago, Stokes joined the Chicago Bar Association and went to work for Fisher, Boyden, Kales & Bell (1923-24). In 1924, he returned east to work as president of his father's businesses: Onward Construction Company (1926-1947); Kesso Corporation (1926-1937); Stokes Properties (1938-1989); Chesapeake Western Railroad (1926-1937); and Mervyn Realty Company. He sailed extensively from Maine to the West Indies in his Seawanhaka schooner *Calliope*.

With his early interest in aeronautics, he helped to found the Long Island Aviation Club, and logged over 2000 hours in the air in his three aeroplanes. He visited every gold mine in North America, Mexico and Canada, and became an authority on the subject of gold mining.. He served for six years as Chairman of the Aviation Committee of the American Institute of Mining and Metallurgical Engineers, and published technical pamphlets including *AIME Aviation Survey, 1937* (published in three languages), *Free Power, Government Assistance to Small Gold Mines,* and *Origin of the Gold Pennyweight.*

Naval service as a Lt. Commander in World War II included being the Central Inspection Officer - Torpedo Program, at Newport, R.I., writing numerous publications for the Navy on torpedo manufacturing, serving as the

for the Navy on torpedo manufacturing, serving as the navigator on the U.S.S. Albermarle with service in South America and Africa and, finally, serving as Planning Officer - Navy Catalog Office, where he surveyed and reported on catalog activities in all armed services, and wrote the *Plan for a U.S. Navy Catalog System.* Following the war, he served in the Naval Reserves, serving for seven years as the Personnel and Administrative Officer of the U.S. Naval Reserve Surface Division 1-14 before retiring as LCDR USNR.

Retiring to Thistlewood Farm, Lenox, Massachusetts, after the war, he became a Trustee of the Browning School and, in 1945, became a co-founder of the Berkshire Country Day School where he served as Trustee and Secretary for over 15 years. Other activities included being a Trustee of the Berkshire Garden Center and writing *Planetary Configurations and Stock Market Sentiment* (1952).

From the late '60s until the '80s, W.E.D. Stokes, Jr., was an editorial writer for the *American Friends of Rhodesia News Letter*, feature editor for *La Liberte, New England Journal, Green Mountain Review,* and *Up-State New Yorker,* where he wrote extensively on race relations in Rhodesia and South Africa.

W.E.D. Stokes, Jr., was a long-time Chairman of the Lenox Park Commission, a special police officer in the Lenox Police Department, and was a founding member and secretary of the Lenox Police Association.

In 1977, The Radio Club recognized Stokes' contributions to radio and his services to the Club with the awarding of the coveted Pioneer Citation; in 1984, he was elected to the office of President Emeritus.

On 16 August 1938, W.E.D. Stokes, Jr., married Lucia Hobson, and together celebrated their 50th anniversary in 1988; they have a daughter, Sylvia H. Stokes, of Pittsfield, MA.; a son and daughter-in-law, Dr. & Mrs. Houston H. Stokes, of Chicago, IL, and two grandchildren, William A. and Houston A. Stokes. On 27 January 1989, Stokes was felled by a massive stroke, leaving him unable to speak or think effectively; he lives today in a nursing home.

FOOTNOTES

[1]*The meeting took place at the Hotel Ansonia in New York City which was built and owned by W.E.D. Stokes, Sr. Present at the meeting were W.E.D. Stokes, Sr., Director General; W.E.D. Stokes, Jr., President; George Eltz, Vice President; Frederick Seymoure, Legal Counsel and Treasurer; Frank King, Corresponding Secretary; Faitoute Munn, Recording Secretary; and Miss E. Lillian Todd, Honorary President and organizer of the Junior Aero Club of the United States. Professor R. A. Fessenden, of Columbia University, was chosen as Consulting Engineer.* For further details see Burghard (1984, 11)

[2]*This material taken from Stokes (1985).*

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FROM ENGINEER TO HAMBURGER FLIPPER:
How America Abdicated From World Leadership

by G. William Troxler, Ph.D.
President, Capitol College, Laurel, MD.

Presented at The Radio Club of America's 80th Anniversary Dinner & Awards Presentation
November 17, 1989.

Mr. President, Members of the Board, Honorees, Members and Guests:

It is more than a passing duty to be with you this evening. It is an honest privilege. First, because it is a rare and special thing to be amidst so many makers of history. It is both humbling and instructive.

Second, tonight provides me the opportunity to say thank you on behalf of the students of Capitol College for the scholarships that The Radio Club of America has provided over the years. Your thoughtful support has made the difference for some hard-working young people. I appreciate your support of these students. Those students, now engineers, thank you for making their careers possible. Your commitment to the production of more engineers is more important than you can imagine.

Finally, I am privileged to be here because, like you, I care about radio. Although I stand before you as an educator, you should know that I became a college president because of a love affair with radio. That love affair ended my career as an English major and turned me into an electrical engineer. That change opened horizons I could never have imagined as I mused over Shakespeare.

We share this passion for radio. But tonight I must report to you that you and I have become an endangered species. This nation does not know it, but it needs your help.

Let me frame this with a story:

Some time ago in this city, a young couple began married life in one of the many five-floor, walk-up apartments that New York is famous for. Near the end of their first year together, things were not going so well. The husband was convinced that his wife was having an affair.

G. William Troxler, Ph.D.

Without warning, he arrived home at lunch time one day hoping to catch her in an act of infidelity. The door to his home was locked, bolted and chained. Once he broke though, he found his wife in bed without a stitch on. But no one else was there.

He looked under the bed and in the closet. He rushed to the kitchen and found no one. But the window was open and someone was running down the alley. He got so mad, he searched for something to throw at the running man. Lacking anything convenient, he picked up the refrigerator and chucked it out the window. Just as the flying refrigerator struck the target the jealous husband suffered a heart attack and died.

He awoke in front of St. Peter who asked, "What brought you here ?"

The man said: "I got mad. I picked up a refrigerator and threw it at someone. I had a heart attack and died."

Just then a second man appeared and St. Peter asked the same question: "What brought you here ?"

"Well," the young fellow said, "I'm a runner for a stock broker. I was on an important errand at noon time and I was struck by this flying refrigerator. It killed me."

The explanation was hardly finished when a third man joined them. "What brought you here ?" asked St. Peter.

"I have no idea," the man replied. "I was minding my own business....sitting in this refrigerator."

I think America is like the guy in the refrigerator. We've done a dirty deed. Now we are hiding; hoping no one will find us and call us to account.

The dirty deed is that our nation has convinced itself that we don't need to make things anymore. We are above that and need soil our hands no more. We prepare young America to work either in a service-based economy which will erode our wealth, or in the industrial revolution which has ended. This is a bogus bill and if it sticks, the children of the next century will lay their economic and social distress at our feet.

If America hopes to close this millennium as the World leader, we are going to have to deal with the coming shortfall of engineers and technicians.

Just the barest history lesson is important to make a point. Recorded history stretches back about 6,200 years: all the way to about 4,231 BC and the first cities of Mesopotamia. Between us and the inhabitants of those cities stand roughly 310 generations.

Think about that -- 310 couples lived, did their part to advance mankind, and died before us. Only 310 generations took humankind from nomadic tribes to the Space Shuttle.

The most dramatic progress has occurred in the last two centuries. To demonstrate this, let's look at the year 1827. That is the year Georg Simon Ohm wrote down the mathematics which describes the relationships among voltage, current, resistance, and power in electrical circuits.

Only eight generations separate us from Ohm; 302 generations proceed him; 97.5% of our antecedents lived before Mr. Ohm.

How well would you and I do in the World that 97.5% of our ancestors knew ? They lived without indoor plumbing, hot water, BMW's, microwave ovens, cellular phones, the Trump Tower, high-resolution television, the ambulance, VCR's, Space Shuttles, deodorant, Jim and Tammy Baker, exercise bicycles, Vanna White and Dan Quale. They always left home without it. They never considered that progress was the most important product. They made the equivalent of money the old fashioned way -- they grew it or shot it.

There is nothing in that list anyone in this room would find unusual. Well, perhaps leaving aside Dan Quale. Yet, we take it all for granted and some would argue that certain items are necessities. The point is that most of what makes our modern world has been produced by the most recent 2% of human kind.

How did this great expansion of progress come about in the last years ? Human advancement always comes out of dissatisfaction. But to explain the recent dramatic human advances, I think that you must credit communications and education. It is a fool's errand to lecture this assembly about communications. But any one, even a college president, has license to speak authoritatively about education. For better or worse, in sickness and in health -- we all have been students.

You remember how the great newspaperman, H. L. Mencken, defined education ? He said education was the inculcation of the incomprehensible into the indifferent, by the incompetent.

Here is my premise. America cannot be competitive; America will not maintain its standard of living; and no nation can hold the international leadership role unless it creates wealth. Wealth cannot be created in adequate amounts from a service-based economy.

No matter how many hamburgers we flip, insurance sales we close, investment banking transactions we make; no matter how many former presidents we rent to the Japanese, how many Rockefeller Centers we sell to the Japanese, we cannot produce wealth in adequate amounts to lead the World. In the end, to hold World leadership we must manufacture and sell goods to the World.

And, my Friends, we cannot manufacture without an adequate supply of engineers, technicians, and modern craftsmen.

LISTEN TO THE NUMBERS

In the U.S., 6.5% of all undergraduate students major in engineering. Compare that to the 25% who major in business. Worse still, compare the number of engineering degrees conferred in America to those of our competitors: U.S. 6.5%, France 28%, Japan 19%, Germany 11%, Britain 14%.

When you couple student choice with the decline in the number of young people, the situation becomes terrifying. Between 1987 and 1993, the number of under-graduate engineering degrees produced by the U.S. will decline by more than one-third. Since 1985, the number of students studying to become technicians has declined by more than one-third.

The numbers are even more troubling when you realize how the engineering talent is deployed. Because of national security reasons, the numbers are elusive but various studies conclude that somewhere between 25% and 40% of all engineers in the U.S. work directly for the Department of Defense or for a private contractor doing defense work. In Japan, less than 3% of the engineering talent works on defense projects.

Without question, the U.S. builds the best military hardware in the world, but you cannot take a week-end cruise on a submarine and a B-1 bomber will not fit in your garage. The next time you wonder why we can't build a good car, why all the VCR's come from overseas, why we don't manufacture much anymore -- remember, we are a country of great engineers with an excellent manufacturing base who have consciously decided to deploy these resources to military instead of civilian causes. America still wrestles with the question of guns or butter.

Since the beginning of the '80s, we have heard a lot about how much America is spending on education. The proponents have been loud and clear. Former Education Secretary Bennett and our education President have made it clear that we are over-spent on education. Much has been made about default rates. Today, there is even an anti-trust investigation of some Ivy League schools. This is classic demagoguery. Here are the numbers:

Since the peak year of spending in 1978, no federal student financial aid program has increased its average award. NOT ONE ! In fact, they all have declined. The amount of money that students receive in financial aid is dramatically down. In terms of constant 1982 dollars: Pell Grants down 9%; Guaranteed Student Loans down 11%; College Work-study Grants down 17%; Perkins Loans down 35%; Supplemental Opportunity Grants down 47%.

To listen to the rhetoric, you would think that educational spending has increased absurdly and that we are going broke because of it. The absolute numbers are staggering. Last year, America spent $ 26.7 billion on student financial aid. Of these funds, 75% came from the federal government, 6% from state governments, and 19% from the colleges themselves.

That is a lot of money but the number to watch is the percentage of GNP spent on education. Taking into account all expenditures: public, private, kindergarten through postdoctoral work -- you find a remarkable number. Since 1970, educational expenditures in the entire U.S.A. have been stable at about 7%. These expenditures never have reached 8% nor have they fallen to 6%.

What about corporate America ? They have traditionally donated substantial funds to education. But if you ask the question: has the corporate commitment kept up with the need, you find the answer to be that the rhetoric is up and the dollars are unchanged. The constant dollar giving of corporations to colleges remains the same today as it was in 1970.

Government has reduced its support of education. Corporate America has held its educational expenditures constant. Who gets the bill for higher faculty salaries,

more student activities, increased sophistication in laboratory equipment ? The students, of course. Since 1980, disposable personal income has risen about 16%. The cost of tuition has gone up: 56% in private universities; 47% in private colleges; 30% in public colleges; and 18% in public two-year colleges.

What about our competitors ? They care about education and give speeches just like our corporate and political leaders. The difference is while America says to its students: "pay for it", our competitors say: "study -- you are our future." In Germany, higher education is free; so, too, in France and Japan. In China, education is free and students are actually paid a small wage to attend college. England is trying the U.S. model and the education which had been free now has growing tuition charges.

So students are not studying to become engineers and technicians. Government is not funding them. Corporations are not helping to create the next generation of technical talent. Maybe we don't need so many engineers in America.

WRONG !

Last month, the Bureau of Labor Statistics released its latest projection of employment demand through the year 2000. In general, the work force is expected to increase by 18%. The engineering work force will increase by 28%. Electrical engineers will increase by 40%. These figures represent NEW jobs. They do not account for the maintenance efforts necessary to fill vacancies caused by retirement, movement into management, or out of the engineering profession. Even if these data are wrong by 50%, America needs engineers.

With this strong demand for engineers, the salary potential is good. The Engineering Manpower Commission estimates that the graduating class of 1990 engineers will have an average annual starting salary in excess of $ 30,000. Because of the impending shortage, the entry salary will likely approach $ 40,000 by 1995.

When you look at these numbers, you get a very strong set of mixed emotions. You know what mixed emotions are. It's just like when your daughter comes home from a date at 4 AM carrying a Gideon Bible.

The demand side of the equation is strong and clear. But the supply side is weak and getting weaker. Why is this so ? What happened to the balance we expect from the free market ? Shouldn't students see the demand, starting salaries, and career growth in engineering ? Shouldn't they be sieging schools of engineering ?

Yes, they should. But there is a new player in the supply-and-demand equation in America. The player is best described as the "star syndrome." It is an ephemeral transient that causes inadequate supplies of what the country needs, and excess demand for what the country has in surplus. The star syndrome attracts young people into high profile activities which promise status. It causes our young people, counselors, politicians, and even parents to confuse status with success. Everything that young people see, hear and read contributes to the myth of star syndrome.

The drug dealer is a star. The ball player is a star. The attorney is a star. The doctor is a star. The politician is a star. The talk show host is a star. The investment banker is a star. Money, cars, clothes, power, media attention, and movie and TV fiction tell you this.

Can you name an engineer with star status ? No, neither can I. As a group we aren't known for our money, our cars, our clothes, or our power. Media attention to engineers comes only during the investigation of catastrophic failures like the Shuttle disaster. During the recent California earthquake, city officials and the media stumbled over themselves to find an engineer to sue over the collapse of the Nimitz Freeway. Generally, the engineer is tarred with the blame.

Fiction always portrays the engineer as the guy in the corner with the plastic pocket protector who provides something everybody needs but no one understands. Fictional engineers are bit-players ranging from anti-social types to comic buffoons. And no fictional engineer ever saves the day and gets the girl. Kids call us NERDS.

The engineering myth began long ago but recently has been exacerbated by the tremendous influence of the media. For lawyers and doctors, the trends always have been positive.

You know the core of the legal myth -- the lawyer as a crusader defending the weak against the unjust and powerful. The Dean of the Law School does not recruit students by describing the excitement of arranging the settlement of a single-family home. The Dean of the Law School does not have to recruit. *L.A. Law* does it for him.

You know the core of the medical myth -- the doctor as a healer, care-giver, life saver. Believer me, the Dean of the Medical School does not recruit students by describing the joy of wart removal. The Dean of the Medical School doesn't have to recruit. TV does it for him.

Unfortunately, the Dean of the College of Engineering must recruit students. TV if of no help. Too often the Dean tries to attract students by saying something exciting about heat transfer, the fast Fourier transform, or nodal analysis.

We've missed the point. First, the sizzle then the steak. If we can get people to marvel at the subject, to fall in love with the adventure of engineering, to see engineering as a noble profession, then details of calculus and engineering science will fall into place.

The engineering myth begins in classical Greek mythology -- with a fellow called Daedalus. He was a mechanical, aeronautical, human-factors engineer, and part-time sex therapist.

At the peak of the Minoan culture, Daedalus was employed by Queen Pasiphae to design and manufacture a mechanical process system which would allow her to act out her fantasy of having congress with a bull. Good engineer that Daedalus was, the machine was successful -- too successful. The Queen bore an offspring that was half human and half bull. This intemperate and difficult creature was called the Minotaur.

The Queen again hired Daedalus to design and build a containment structure for the Minotaur. Daedalus succeeded with the engineering effort known as the labyrinth -- a maze which confused and contained the Minotaur.

Daedalus realized the vulnerability of his position and elected to do some personal engineering. He designed and manufactured wings made of wax and feathers. Daedalus and his son, Icarus, flew out of the labyrinth. Icarus may have been a good kid but, like many adventurous young people, he neglected the instructions contained in the operator's manual of his new vehicle. When he flew too close to the Sun, the wings melted. Icarus fell into the sea and drowned. Daedalus used his design properly and survived to pull his son's body from the sea.

This is not a very noble myth. Daedalus contracted with his employer to design a device to assist in an act of fantasy which, in recent time, might only have been considered "kinky", but which in Minoan culture was definitely beyond the bounds of morality. Once the product of this unusual act arrived, the engineer was again hired to assist in containing the problem. Today, we call such an activity what it is -- a cover up. Finally, recognizing his position, the engineer attempted to pursue other interests in the field of aeronautical engineering. The strategy was only partially successful. One of the users of his design exceeded the operational limits of the equipment and perished because of the lack of the yet-to-be-invented golden parachute.

There you have it -- the engineering myth: kinky sex, immorality, cover-up and contributory negligence. Doctors and lawyers didn't start this way.

Enrollment decline, lack of funding, star syndrome, negative image -- what does it all mean ? It means that during the '90s we are not going to have enough engineers and technicians in America to retain our leadership position. We will have plenty of ball players to entertain engineers, plenty of managers to supervise engineers, plenty of investment counselors to plan the retirement of engineers, plenty of hamburger flippers to feed engineers -- but we will not have enough engineers to engage either the needs or the opportunities of America.

The solutions to the problem are clear but not easy. First, the engineering community needs to get its act together. We need to develop an ethos for engineering. We are clusters of specialists who present a confused world with a fractured picture of what we do, how we do it, and why we do it. We need to find that common, enduring set of rules that binds us together and which allows us to demonstrate to the uninformed that there is a centrality to our work and that our work is in the service

to humankind. We need to demonstrate that engineers are heroes, pioneers, and deserving of star status.

Second -- read my lips -- MONEY. Money to support education adequate to the problems it must solve. Money to students so they can afford higher education. Student aid coupled to the future employment needs of the nation -- greater aid to engineering students, less aid to business majors. Money to invest in America's intellectual infrastructure so we can compete internationally.

Third, all of us need to untangle the confusion of the '80s. As a culture, we have confused technique with purpose, status with success, acquisition with investment, means with ends, high-profile with fulfillment. We need to say to our young people that life involves hard work and the reward for hard work is the pride of contributing however modestly to the progress of human kind. We need to say that life is not MTV and that money is not success.

If you see the future as simply the sum of the past and present, you have a right to be worried. I don't think America should see it that way. Look at the future as the sum of the past, the present AND our collective will. There is no force on Earth like the will of the American People. We can do it.

It's sort of like the good news - bad news story:

A fellow got a phone call from his doctor: "Fred, I've got good news and I've got bad news for you."

"Give me the good news," said Fred.

"Well, Fred, you've got a terrible and incurable disease. It's untreatable and you're going to be dead in 24 hours."

"That's awful. If that's the good news, what's the bad news ?"

"Well," said the doctor, "I've been trying to reach you since yesterday."

So Fred went home to his wife and explained the problem. "Oh no." she said, "What are you going to do ?"

"Listen, it's over. I'll be dead by morning but I'm going out in style." said Fred. "Get dressed; we're going out to the fanciest restaurant in town, get a big meal. I'm going to eat a $ 1,000 dinner and drink a $ 10,000 bottle of wine. I want to dance until dance 'til two in the morning, and make love to four."

"Well," said the wife, "that's OK for you. You don't have to get up in the morning."

We've all got to get up in the morning. I hope I've made the beginning of a new decade and the dawn of a new millennium a little clearer for you.

Thank you and good evening.

G. William Troxler is president of Capitol College, of Laurel, MD. and has a doctorate in higher education from Walden University. After earning an undergraduate degree in engineering technology from Capitol and a master's degree in electrical engineering from John Hopkins, he worked for the Honeywell Corporation in computers.

Dr. Troxler recently returned from the Peoples Republic of China, having been one of ten college presidents invited to the International Conference on Engineering Technology Education for the purpose of exchanging ideas and experience.

LT. GENERAL WILLIAM J. HILSMAN RESPONDS FOR FELLOWS

Lieutenant General William J. Hilsman was elected a Fellow of The Radio Club in June 1989 in recognition of outstanding leadership in military telecommunications, computer usage and information systems, and for post-military services in providing digital radiotelephone systems in rural domestic and international communication services.

Ladies and gentlemen. It is certainly a great honor to be with you tonight and to be the Respondent for, and a member of the 1989 Radio Club of America Fellows. I have had the opportunity to review the list of others you have chosen in the past years, and to meet and learn about those you have chosen this year.

I know I can speak for everyone of the Class of 1989 Radio Club Fellows. We all accept our awards with a great sense of pride as well as a deep sense of humility ... pride in what we as a group have accomplished in the field of radio over the years, but deep humility because we know personally so many hundreds of more that have made equal or greater contributions.

As I was getting ready to leave the office and come here, one of our young secretaries asked me, "What is so special about a radio club ? Is there something special about people in the field of radio ? What is it ?" I was racing to catch my train so I did not have time to answer her. But I knew right away what my answer was ... because it came from one of the most meaningful personal experiences in my life.

In 1982, I was a member of a seven-person U.S. government team that was sent to China by then President Ronald Reagan with the mission of opening up telecommunications exchange and trade protocols between our country and the Peoples Republic of China. Our meetings were with the MPT -- the Ministry of Post and Telecommunications.

However, on our fourth day, I received an invitation from our Embassy to meet with the Chief of Telecommunications of the Peoples' Liberation Army (PLA). I did not even know his name nor, by the way, did any of our U.S. Intelligence Services. We met around noon for what was to have been a one-hour meeting.

Lt. Gen. William J. Hilsman

On that day, General William J. Hilsman, Chief of Communications for the U.S. Defense Department, met with General Li Li, Chief of Communications for the Chinese Defense Department.

Our meeting began with a toast by General Li Li who welcomed us and stated that this was an historical event since, in his mind, this was the first meeting between communicators of our two nations since he had been a private and a radio operator assigned to a U.S. radio team in China in the 1940's.

And then we began to talk ... one hour, two hours, five hours, eight hours, ten hours. We just kept talking ... about experiences.

There was a special camaraderie ... you all know what it is. We always have the same enemies -- the weather, atmospherics, the trees, the power, the batteries, the ever-changing technologies and, yes, our bosses who do not understand how it works, why it works, or even its limitations. They just want it to work the way they want to to work, wherever they are, all of the time ... and for free.

Yes, that something special that General Li Li and I found is, in fact, the same something special that we all here share together ... that special camaraderie. we all know what it is.

And that is certainly the major reason we, the Class of '89, feel as we do tonight ... even though many of you never met us ... nor we you. You know us and we know you ... through that very special camaraderie.

The annual meeting and banquet commemorating the 80th anniversary of The Radio Club of America was held on Friday, November 17, 1989, at the New York Athletic Club. Two hundred and sixty-nine members and guests attended.

Dr. G. William Troxler, President of Capitol College, of Laurel, MD. was the keynote speaker at the banquet and addressed the audience on the need to publicize the work of engineers, and of the need for financial support to education.

The annual meeting held during the afternoon included a technical seminar directed by Stuart F. Meyer, Executive Vice President. The speakers were Leonard F. Kahn (F), Bruce L. Kelley (F), and John D. Goeken (F). A reception for members and guests followed. The meeting concluded with the formal announcement of the election of officers and directors for the 1990 - 1991 tenure.

The achievements of 37 members of the Club were recognized by their advancement to the grade of Fellow. Twenty-five were present at the Awards Dinner and received plaques from President Fred M. Link.

Awards and Citations were made to Club members for distinguished services to the art and science of radio communications; those receiving recognition were: William E. Endres (F) - Sarnoff Citation; Capt. William G. H. Finch USN (ret.), Sc.D., (LF) - Pioneer Citation; Mal Gurian (F) - Fred M. Link Award; James E. Brittain, Ph.D. (F) - Ralph Batcher Memorial Award; Avery G. Richardson (LF) - Busignies Memorial Award; Kenneth A. Chittick (LF) - Allen B. DuMont Citation; Fred Shunaman (LF) - Lee deForest Award; Eric D. Stoll, Ph.D. (LF) - Special Services Award; and Joseph R. Sims (F) - President's Award. A special award was made to Hugo Cohn (LF) in recognition of being the oldest member of the Club, at age 102. The Jack Poppele Broadcast Award, initiated in 1989, was awarded to Leonard R. Kahn (F) as its first recipient.

Once again, the success of the meeting, reception, and banquet resulted from the generous contributions of 30 industry sponsors and friends of the Club plus the hard work of the Banquet and Meetings Committees.

THIRTY-SEVEN MEMBERS BECOME FELLOWS

Twenty-five of the thirty-seven members who were elected to the Grade of Fellow were present at the Annual Awards Dinner and received their plaques from the Club's president, Mr. Fred M. Link.

Twenty-one of those attending the Awards Dinner appear in the photo above. Seated (L. to R.): F. Jay Huber, Jr., Fort Lauderdale, FL. William S. Hoovler, Stafford, VA.; Ms. Mercy S. Contreras, Denver, CO.; Col. Arthur D. Hendricks, Carson City, NV.; Edward J. Riechler, Calabasas, CA.; Duane L. Huff, Whippany, NJ.; and Ms. June Poppele, Morristown, NJ.

Standing (L. to R.): Ralph O. Williams, Orient, NY.; Theodore R. Faust, Roswell, GA; Lt. Gen. William J. Hilsman, Philadelphia, PA.; David M. Crawford, Taylorstown, PA.; Lt. Col. Robert J. Howell, Raymore, MO.; Albert D. Helfrick, Ph.D., P.E., Kinnelon, NJ.; Reuben A. Isberg, P.E., Berkeley, CA.; Kenneth A. Hoagland, Smithtown, NY.; Howard L. Lester, Alplaus, NY.; W. H. Galpin, Winnipeg, Man. Canada; Aldo A. Bottani, Jr., Paramus, NJ.; Leonard F. Davis, Cambridge, England; Stanley Reubenstein, Denver, CO.; and Robert W. Weir, Agincourt, Ont. Canada.

1989 Fellows not in photo: Jack G. Beverly, Kansas City, MO.; Raymond L. Collins, Mountain View, CA.; David N. Corbin, Littleton, CO.; David E. Hubertz, Loxahatchee, FL.; Joel I. Kandel, Miami, FL.; Seymour Krevsky, P.E., Little Silver, NJ.; Robert W. Maher, Chevy Chase, MD.; Roy E. Place, Westlake Village, CA.; John W. Reiser, Washington, DC.; Warren C. Struven, San Carlos, CA.; Frederick G. Suffield, P.E., Sequim, WA.; Derek Turner, Bury St. Edmunds, Suffolk. England; Harry Vorperian, Flushing, NY.; Col. John G. Webb, Auburn, CA.; Walter B. Williams, St. Clair, MI.; and Jan A. Zachariasse, Cambridge, England.

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PREMISES AREA RADIO ACCESS NETWORKS

by Chandos A. Rypinski (F)

Presented at the Joint Meeting of the IEEE San Francisco Bay Area Section VTS/CTS
Stanford University.
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Abstract: The development of short-range radio often is seen as a further advancement of cellular technology. What could happen is the development of many different single purpose systems that would fragment markets and greatly limit its usefulness.

The view presented is that the next step to short-distance radio should meet the needs of pedestrians in buildings, or of business areas as temporary wiring for fixed stations -- as a universal radio access method. New services, technology, and radio plans are required that are distinct to these needs.

To illustrate, a plan for an integrated ISDN-Packet LAN with an information capacity of 4.096 Mb/s is presented.

An industry effort is necessary to develop an air interface standard for a ubiquitous wireless access network to encourage development of the technology and to present a unified position to the FCC in order to obtain formal recognition of the frequency use.

Chandos A. Rypinski

OVERVIEW - WHAT IS HAPPENING NOW

One manifestation of future communication needs is the activity of standards committees. Another is the development of commercial products using radio for telephone access using standards of local scope. The radio is often, but not necessarily, personal and portable.

STANDARDS COMMITTEES

A brief report of the area of work for some of the standards committees which have relevance to Premises Area radio follows:

CCIR IWP 8/13

The mission of this committee is to consider future Public Digital Mobile Telephone Systems and to examine the feasibility of international agreements on frequency bands and/or air interfaces. The idea of the CCIR IWP 8/13 Committee is that a common personal telephone design might be used equally in residential cordless, commercial PBX, and public access systems if international standards could be reached on some of the major interfaces in the system. Many believe that a common connection set-up protocol could be designed which would encompass all of the imagined personal radio-telephone applications.

It is also a goal of this Committee to encourage development of standards that can create large volume requirements and low costs for personal radios. Such radios would use very-low power transmitters of 1 to 10 milliwatts for distances associated with micro- or pico-cell sizes; and this also would enable the use of the higher microwave frequencies.

IEEE 802.4L Token Bus Access Method Wireless Medium

This committee originally was formed as a result of encouragement from General Motors to extend the Manufacturing Automation Protocol by providing wireless links for mobile robots. It is limited to the access method of its sponsors. In the last few months, it has become more active under the leadership of NCR-Netherlands, to be applied as much to office systems. There are, as yet, no technical conclusions.

IEEE 802.9 Integrated Voice-Data Workstation Interface

IEEE Local Area Network Standards Committee 802.9 is relevant because this group is forming a standard that integrates ISDN telephony and packet data into one access protocol and medium. It has not yet evolved whether the LAN is to be competitive in capabilities and attractiveness with 10 Mb/s 802.3, or 4 Mb/s token ring, though many of the participants think this is essential to marketability. Other participants are more concerned with the ISDN functions which carry circuit-switched and store-and-forward data links at transmission rates that are integer multiples of 64 kb/s. Both are needed, but there is not yet consensus on relative importance.

CORDLESS TELEPHONES, ZONE PHONES, WIRELESS PBX

The Europeans have done considerable work on standards for the air interface of wireless PBX. UK has an early practice of this technology in the "Zone Phone" intended to provide radio access in public places like airports and rail stations using a low-cost 50 milliwatt personal unit. So far the European effort has been devoted mostly to voice telephone service in specific environments.

Development of the next generation radio telephone in Europe has created a large portion of the world's available technology and data on speech coding, channel coding, equalization, FEC and propagation.

WIRELESS LAN PRODUCTS

Most known wireless LAN products are mainly adaptations of personal radios under Land Mobile rules adapted to transmission of serial data at analog modem rates.

The AT&T Acampora patent is concerned with 10 Mb/s radio LAN. (US 4,789,983)

PROPAGATION STUDIES

There have been many propagation studies at 800 MHz and higher dealing with the interior of buildings . Many more were added at the Vehicular Technology Conference in May 1989 at San Francisco. Enough is known for system designers to work.

A surprisingly large amount of data is available for applications of microwave frequencies above the 900 MHz bands.

ESTIMATE OF THE PROBABLE RESULT

If, for any of several reasons, it is impossible to get consensus on a general system plan and air interface, then there will be many discrete "niche" businesses some of which may be fairly satisfying to its small circle of suppliers and users. Many of these will poorly serve a larger public (including industrial and commercial users) because of:

1. Cost
2. Various narrowly-defined service functions
3. The archipelago pattern of compatible service areas.

OPINION - WHAT SHOULD BE HAPPENING

This forecast is based on defined applications, services, volume and regulatory arrangements.

APPLICATIONS

While the use of short distance radio for "telephony" is obvious, "telephony" has changed in meaning from voice-only and now means: connection-oriented services which include traditional voice and, also, data communications that, historically, have been served by dial-up connections and modems.

ISDN telephony now includes direct access to packet-switched networks using end-to-end packet technology rather than modems and connections. There is "departmental communication" which is between computers within one department where megabyte-sized data files are transferred, applications downloaded, and pixel-defined pictures reproduced.

Example: In hospitals, the purpose of the radio is to avoid trailing cables and hookups as patients are moved and as their needs change. The varieties of data and voice transfer needed cover a wide span which has, heretofore, been limited by technical capabilities of available systems.

Example: There are warehouses where orders are filled, factories where the machines are movable and fed information in real time, retailing where available space is frequently reconfigured and there is automation of inventory and pricing, and many other applications that might not be imagined.

The radio problem is different depending on whether it is treated as a niche for voice-only communications, or whether it is a viable alternative for all of the different forms of communication now carried by overlay wire networks.

Opinion: The radio network must provide an access for all types of voice and data communication now widely used including intradepartmental as well as off-premise destinations.

INTEGRATION OF LAN AND ISDN AND MULTIPLE ENVIRONMENTS

This network will serve needs that are found mostly inside of buildings or places of public concentration such as airline terminals, sports stadiums, convention halls, hospitals and factories. The common denominator is not so much the walls of the building as it is intensive use of communications within small geographic boundaries. What is excluded is communication with vehicles moving at high speeds. Vehicles moving at pedestrian speed such as manufacturing robots or hospital patient carts must be served.

Opinion: The system design for the interior of buildings also will serve moving users at pedestrian speeds, and outdoor applications where there is high-user density.

If a radio access service is to be put into wide use, it cannot exist except temporarily and at a premium unless it is fully integrated into a suitable ISDN compatible method of wired local distribution. To a large degree, existing TTP (telephone twisted pair) can be used for high megabit rates over short distances, but longer runs to major central equipments must evolve to optical fiber.

Opinion: The radio-access system will depend upon the existence of high bandwidth local distribution systems which will be required in the future independently of the radio system.

For the system to have a universal character, it must do much more than pass highly-processed voice and the low-rate data of EIA RS-232 ports. Communication within departments by means of LAN (local area networks) probably absorbs far more of the money spent on interior wiring than does the PBX local function. Without megabit transfer rate capability, a new technology for departmental networks will not be useful.

Opinion: The trend toward high bandwidth communication is irreversible and will be an integral part of the way we do business in the future. More importantly, the cost of providing the wiring for this type of communication could be so much higher than that required for ordinary telephony, that the financial rationale for the integrated network may be based on the cost of alternatives for high bandwidth.

Outdoor cellular systems are optimized for vehicles in cities. Their use for personal systems must be superseded because the units are too powerful, too costly, too heavy and greatly burden the design of the fixed network. The hand-off concept is not spectrum efficient nor economical for short distance radio systems. Nonetheless, the cellular systems will remain quite useful within the scope of their proper use.

Opinion: The creation of an effective premises area radio-access system will allow existing cellular systems to be used for the purposes for which they were designed: vehicular access. New facilities for personal services will coexist, and will become ubiquitous for pedestrians and within buildings.

IMPORTANCE OF QUANTITY AND STANDARDS

There is need for quantities of units and access points to achieve wide coverage and low cost. This achievement implies formal or accepted standards and a multivendor environment. It is most difficult to get a well-designed technology with "too many cooks in the kitchen." This is a critical problem but, nonetheless, there is no better way than the development of standards to create a high-volume market. Much will be decided simply from the coming together of potential participants.

This technology must not be controlled by one company and it should not be something where each of several companies have something different. Fragmentation of the technology and suppliers into incompatible islands also will result in a near impossibility of securing frequency usage rights within the FCC regulations.

Market Size The penetration of cellular telephones in industrialized areas has now passed 1% of the population and may rise eventually to 3% to 5%. The number of radio-access terminals within buildings may be far larger than the penetration of cellular telephones;**the market size is substantially greater than 1% of the urban population.**

Acceptance of this estimate is imperative to attract investments not merely in the beginning technology but also in the standards process necessary to have an economically and functionally useful result. The effort to develop a technical solution will become a waste unless a constituency can be built which can bring political pressure necessary to achieve regulatory recognition of the frequency useage.

FCC REGULATORY CONSIDERATIONS

As soon as the use of radio is considered, it is necessary to understand where the system might fit within FCC regulations and uses of frequency space.

For a bandwidth of many MHz, it is impossible to obtain frequency space exclusively for this type of service without going through the political process of taking it away from someone who will resist giving it up (frequently using large financial and political resources.) There is no possibility of defining a system of this type except in frequency space that is already in use. The best solution is in two services which, because of differences in geography, functions and signal characteristics, may co-use the same frequency space -- non-interfering.

It is better if this frequency space is now being used by an organization of lesser political influence. For example, it is almost hopeless to project use of frequency space now controlled by the U.S. government because that nebulous entity has no inducement or need to make concessions. An optimal competitor might be one occupying frequency space for point-to-point microwave distribution of pornographic movies. In between these extremes of political influence there are a number of possibilities.

Opinion: The selection of technical characteristics using short-range, minimum-power transmitters and micro- wave frequencies has a chance of succeeding on a co-use basis with existing services. The concept of new allocations below 6 GHz is simply not realistic under present conditions in the USA.

A PLAN SHOWING POSSIBLE TECHNOLOGY

FUNCTIONAL CHARACTERISTICS

There are two major types of communication system architecture which are named for their main field of use and characterized in the Table below:

	TELEPHONY	LOCAL AREA NETWORK
Architecture:	Hierarchical = many levels	Flat = peer-to-peer direct
Primary mode:	Connection oriented	Packet/connectionless
Intelligence located:	Centrally = low cost stations	In stations = low cost media
Transmission cost:	Long distance = high	Short distance = low
Medium usage:	Concentrated = over 50% typical	Low = less than 1% typical
Setup message:	Separate signaling channel	Header on packet
Duration/message:	3 minutes per connection average	2 milliseconds (1,000 bytes per 4 Mb/s)

The difference in criteria for the design of the systems is evident, and this difference has been used to justify and create autonomy of computer wiring from the PBX. It is easy to assume that there is no one protocol or medium that can reconcile these two sets of needs, but this is not true.

The cost differential between these two architectures is minor when all costs are considered. The short term advantage for telephony is lost if the existing voice/analog facilities are upgraded sufficiently to meet a larger portion of data transmission needs. The blending process requires definition of the communication services to be provided.

Service Functions

There are the definitions of the services to be provided, and beyond that a definition of the quantities of such services in relation to resources used. The latter is the difficult part. A personal opinion on the radio access capacity required for about 250-500 users is shown below:

		0 6 4 S l o t s
Voice only:	Demand-assigned 32 kb/s	12 - 24 trunks
	Dedicated access channel 64 kb/s	1 1 channel
ISDN D-channel:	Shared use 64 kb/s	1 1 channel
ISDN Basic Rate:	Demand-assigned 64 kb/s B plus D-channel access	12 12 B-chnl trunks
ISDN H01:	Demand-assigned 384 kb/s block plus D-channel access	6 1 C_6 trunk
Packet Channel:	Shared use 2.048 Mb/s payload	32 1 channel

The aggregate of all these services is 63 x .064 Mb/s, or one B-channel less than 4.096 Mb/s. If this menu of services is technically feasible, other sizes and combinations will be only dimensional changes and will not involve matters of principle. It is imagined that local voice-only communication will be carried on 32 kb/s channels. ISDN calls completed via the public network will be carried at 64 kb/s and will offer the required services of the BRI interface. Data communication within the entity will be carried on the LAN. Off-premises data messages will also be transmitted over the LAN and forwarded to public or private networks by a shared Communication Server.

Overhead Functions

Some octets or slots must be reserved for internal physical medium management functions, particularly including access control for the D-channel and the P (packet) channel. Access to the B and C-channels is requested and granted via the D-channel (there is a possibility of sending D-channel messages on the P-Channel). The detail of an access protocol requirement includes a "fairness" criteria and a statement of how much available communication space is lost to the access protocol function. Some desirable characteristics are shown in the following Table:

Fairness criteria:

All users shall have equal probability of access independently of station number, distance from Access Point, or Access Point used.

Access delay:

ISDN access delay shall not be greater than that occurring at Primary rate interface serving a PBX with the same ratio of users to trunks.

Packet access delay:

Access to the P-channel shall be granted to each new user in less than 80 octets following the end of prior use of the P-channel within one frame, not considering capacity block allocated for other services and overhead.

Forward Error Correction (FEC) is probably required on the P-channel, and this function will reduce capacity by 10 to 30%. FEC will generally reduce error rate by a factor of 100 to 1000. FEC also might be used on the C and D-channels. Normally, error management is considered an upper level function, however, within the rules of 802, the error rate must be brought down to 1 in 10^7 before the data is passed to a higher level.

Packet channel bit error rate:

Not poorer than 1 in 10^8 for messages with valid CRC character (inexact definition).

Missed messages due to CRC error not more than 1 in 500 (personal opinion).

ISDN channel bit error rate:

Not poorer than similar circuits over wire facilities: 1 in 10^{-4}

Time must be allowed between transmissions from different remote radio stations for differences in distance from the serving Access Point and for acquisition of the data stream. This point must be fully considered in the design of the RF system plan and in the detail of data frame structure.

RADIO PLAN

The radio plan is based on the use of simple Access Points with omnidirectional antennas and simple electronics arranged on a regular grid. Groups of four Access Points are cable connected to a Common Controller where the main radio functions are located. The arrangement is shown below:

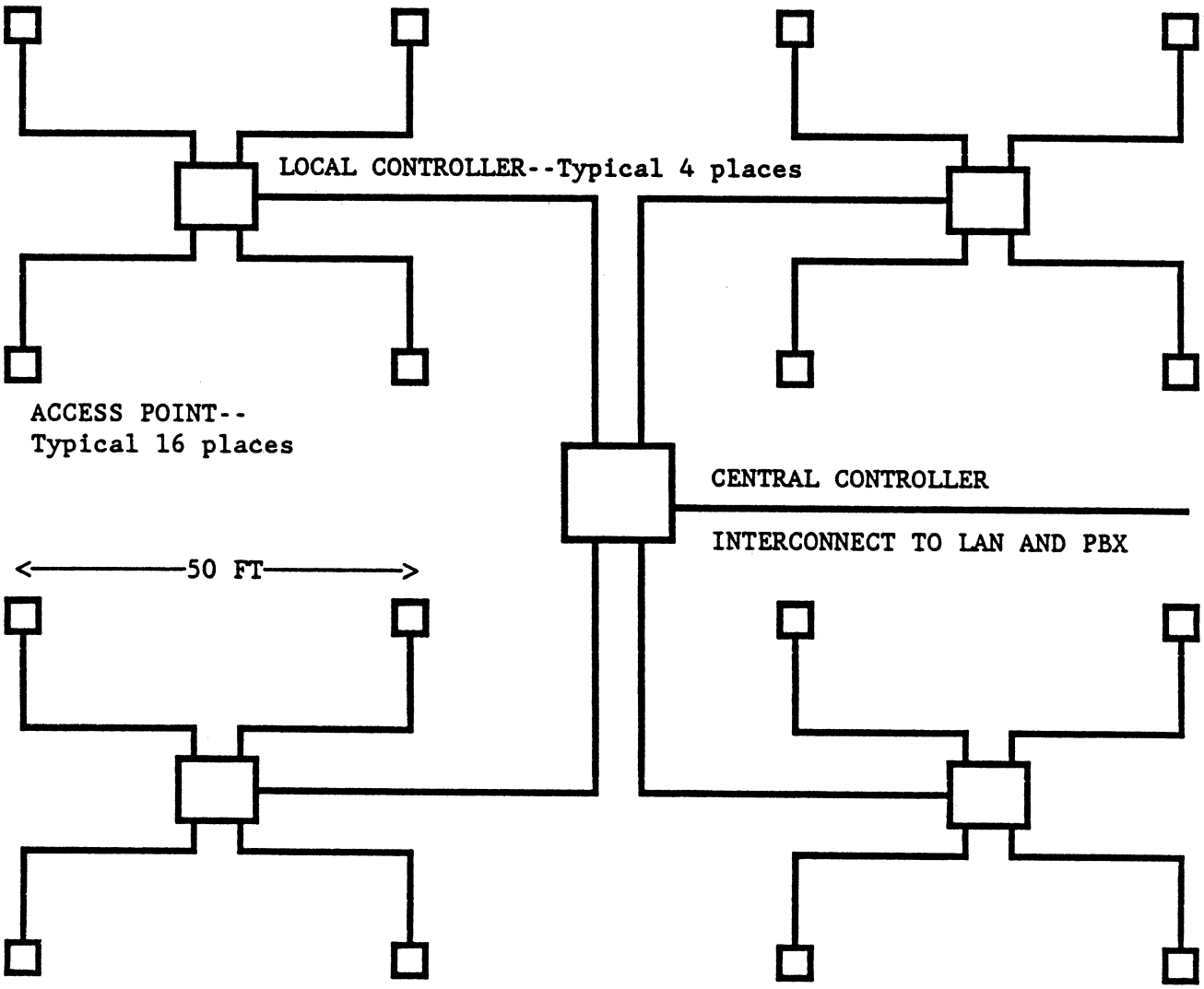

Figure 1. Layout of 16 Access Point and 4 Local Controller Premises Area Radio Access Network

System Layout Model

The model chosen uses many radio Access Points at typical ceiling height. Coverage is defined as an area extending from the ceiling downward to 5 feet above the floor. The untethered station is unlikely to depend on a signal which has gone more than 100 feet through the air or an even shorter distance.

The location pattern is based on a grid spacing of 100 feet with Access Points located at grid intersections. To reach the center of a square, a path length of 71 feet is required. If the range of each Access Point is 100 feet, then all locations will have multisite coverage from those sites where the path is not obstructed.

The time dispersion is typically equal to the path length. A permissible symbol period is about 5 times the time dispersion for the modulation method chosen.

All Access Points are co-channel, and transmit the identical information. For quantitative calculations, it is assumed that there are 16 Access Points in a pattern though systems could be designed with any number.

Reference Propagation Loss Calculation for 30 Meter Path Length:

Free space loss between isotropic antennas: [32.44 + 20 log F (MHz) + 20 log D (km)]	-69 dB at 2200 MHz and 30 meters	
Fixed Station antenna gain less cable loss:	8 dB [all gain in vertical pattern]	
User Station antenna gain less cable loss:	0 dB	
NET LOSS BETWEEN ANTENNA TERMINALS:	**-61 dB**	
Thermal noise in 10 MHz bandwidth: Pn = k T B (terminated)	$.04 \times 10^{-12}$ watts = -104 dBm	
Receiver noise figure:	10 dB	
Demodulation margin:	9 dB	
Error rate margin:	13 dB	
Fade margin:	24 dB	
NET REQUIRED RECEIVE LEVEL:		**48 dBm**
NET REQUIRED TRANSMIT POWER:	**20 milliwatts peak**	**+ 13 dBm**

The method used for the required power calculation is shown above. Considering an intuitive feeling that the transmitter should be limited to 10 milliwatts, 3 dB ought to be found from shorter distance, less bandwidth, or lower frequency. Authorization for use of the system will be sought as a second or third user of frequencies with existing users, on the condition of non-interference with the existing primary use and with no guarantee against interference from the primary use. Considering this criteria, a set of detail technical characteristics (with estimated values) which might be satisfactory are shown in the tabulation below:

Operating frequency band:	Somewhere between 1.710 and 3.300 GHz
Medium signaling rate:	10.240 Mb/s
Modulation symbol rate:	1.28 or 2.56 megasymbols/second
Radio range:	100 feet - nominal with 20 dB margin
Duplexing:	Time Division
Reuse factor:	4:1 for continuous coverage
Single system bandwidth:	16 MHz block with time division duplexing
Multiple system bandwidth:	64 MHz block including guard bands for non-interference
Spectral energy density:	2 microwatts per kHz per transmitter
Peak power:	20 mW (milliwatts) per transmitter averaged over 62.5 microseconds
Peak power-Fixed Station:	10 mW per transmitter averaged over 8 milliseconds
Peak power-User Station:	6 mW per transmitter averaged over 8 milliseconds -- packet mode 0.2 mW per transmitter averaged over 8 milliseconds -- voice mode
Fixed Station antenna pattern:	Horizontal = Omni Vertical = -10 dB minimum at $>10^{o}$ above horizontal
Packet channel usage:	3 seconds per hour per user station (Assumption) = 10 milli seconds per transmission

These values are neither precise nor final, but are given to show the area of interest and a possible way to express the quantities. The timing relationships recognize the fractional duty cycles inherent in the frame structure described below. These values reflect the interlocking relationship between traffic assumptions, modulation methods, framing patterns and methods of measuring and expressing field strength. For reference, the FCC has authorized a peak power of 1 watt with spread spectrum or frequency hopping in some ISM bands. These methods correspond to about 1 milliwatt per kHz of energy density.

The Air Signal

The transmitted signal is quartet or octet parallel and chosen to be minimally sensitive to multipath with the type of time dispersal obtained from multiple radiation sites ("simulcast").

In addition, an embedded error detection property providing signal quality information on each transmitted symbol is used. This redundancy expands the spectrum required to about 1.6 Hz per bit of payload. The detection method used is an important system design consideration. The desired method provides fast acquisition going from silence to lock within two transmitted symbols. In addition, received power is the decision criteria thus allowing multiple signals to be largely additive in effect.

With these considerations, allocated spectrum is 16 MHz for a time-division duplexed capacity of 4.096 Mb/s at a medium transmission rate of 10.240 Mb/s. Because of the parallel subcarrier type of signal, the out-of-band sidebands will roll off very rapidly compared with a single fast- modulated carrier.

FRAME STRUCTURE

At a medium signal rate of 10.240 Mb/s, the following dimensions are used:

1 second	= 125 frames = 1,280,000 octets
1 Frame	= 128 time slots = 8 milliseconds = 10,240 octets
1 Time slot	= 80 octets = 1 segment + 7 octets OFF time
1 Segment	= 73 octets = 1 payload + 9 overhead octets

The Access Point and the User Station transmit alternately each using 64 time slots with 64 octets of payload. The User Stations, in the aggregate, transmit in 64 time slots alternating with the Access Point transmitter.

Voice samples and packet data segments are sent in blocks of 64 octets corresponding to the number of samples taken (64) in a time interval of 8 milliseconds; however, the samples for each direction must be transmitted in about 2 milliseconds of air time; 2 milliseconds of transmit time are also used for LAN P-channel in each direction. Overhead octets and transmitter OFF time add 16 octets for a total of 80 octets per slot. It would seem that providing for a complete re-synchronization after each slot is wasteful but it is also wasteful, as an alternative, to have a transmitter ON when no intelligence is being carried. This arrangement makes it possible to turn each slot ON or OFF independently of the use of any other thereby allowing minimization of power consumption and total radiated energy.

Regular Slot Structure

Each time slot is formatted as an 80 octet interval, as shown in Figure 2, which is autonomous for the isochronous transmissions and for each segment (also called "row" in 802.9) of packet transmission. The format of all transmission intervals is similar whether packet or isochronous, as follows:

Octet #	# octets	Function
0-2	3	Synchronization
3-7	5	Label, Access control
8-71	64	Payload
72	1	Off transition
	73 octets	Transmitter ON interval
	7	Transmitter OFF interval

80 octets x 64 slots = 5120 octets per frame for Access Point or User Station transmitter.

2 x 5120 octets per frame x 125 frames per second = 10.240 Mb/s data rate

Seven octets use 5.5 microseconds of air time corresponding to 5,500 feet of propagation time. This is a fundamental limiting dimension on design factors which contribute uncertainty or delay. One octet of apparent OFF time is an absolute requirement at the Access Point receivers.

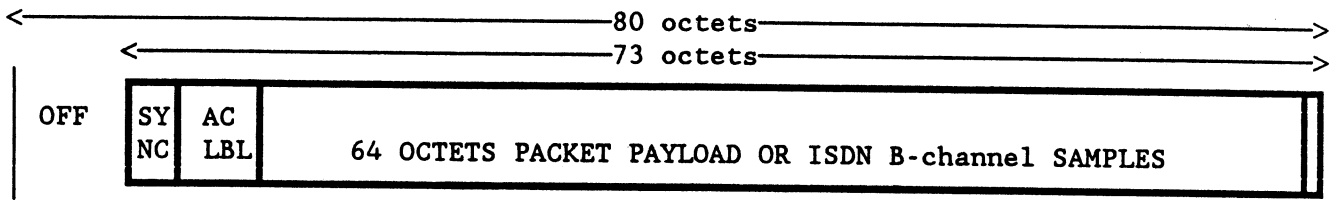

Figure 2. Regular Time Slot/Segment Structure

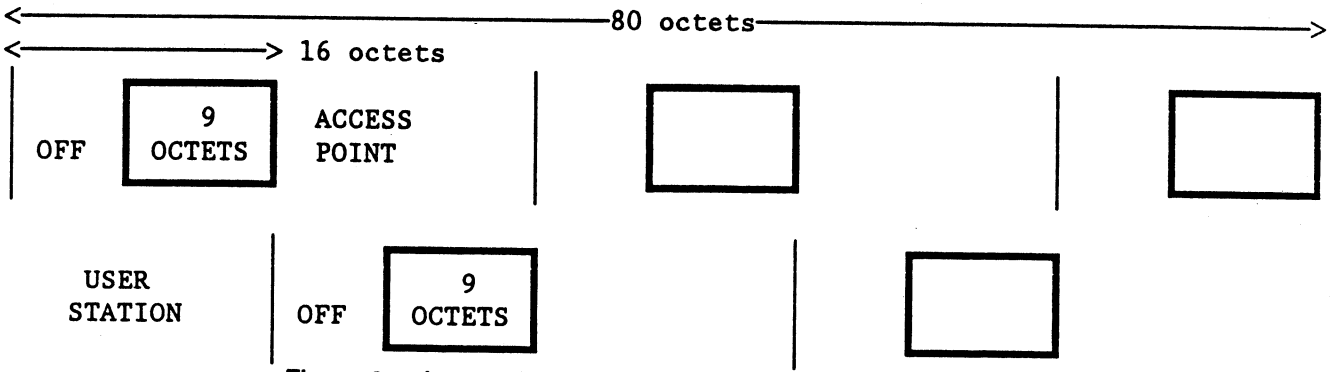

Figure 3. Access Request/Grant Sub-segment/Sub-slot Structure

Access Mode Slot Structure

Access mode divides each normal time slot into subsegments of 16 octets each as shown in Figure 3. The assignment of octets is the same as for a normal slot except that the payload is omitted. The five label and access control octets are the payload.

Octet #	# octets	Function
0-2	3	Synchronization
3-7	5	Label, Access control
8	1	Off transition
	9 octets	Transmitter ON interval
	7	Transmitter OFF interval
	16 octets	x 5 sub-slots = 80 octet slot

Time Division Duplexing

With alternating transmission from Access Point and User Station, there are two modes of duplex operation. For isochronous slots, there is a separate communication path in each direction: full duplex. For the P-channel slots, the Access Point repeats exactly the segment that it receives. While it is possible for one User Station to directly receive another, no dependence can be placed on this possibility. Only transmissions from the Access Point can be assumed to be received by any or all User Stations. The alternating transmission structure is also essential to rapid disposition of service requests that are part of the access protocol to be described later.

Slot Assignments

There are 64 slots available symmetrically assigned for both directions. Any slot could be used for any purpose, and that purpose marked by bits in Label/Access Control field. For this description, a symmetrical fixed assignment is given as follows:

Slot #	Function
1	1 each D1 channel access control for isochronous B-channels and C6 channel
2-13	12 each B-channels for outside ISDN connections
14-19	6 each B-channels used as one C6 channel
20	1 each D2 access control channel for 24 local voice connections
21-32	12 each B-channels, used alternately, to provide 24 each 32 kb/s channels for local voice connections
33-64	32 each P-channel segments with access control in the segment preamble.

ACCESS PROTOCOL

This subject is critical to the design of the system. It controls the dead time between consecutive uses of a service, and the time lost from contention is determined by the way the access protocols reacts to simultaneous attempts to use the system. It is impractical to either propose a fully explained protocol or to present a thorough analysis of the alternatives.

The access protocol uses independent access provisions for B, B/2, C and P channels. B and C channel access uses the relevant subset of ISDN D channel standards. A physical medium procedure resolves contention inward for the D channel. The access process uses subsegments of 16 octets including the 7 octet OFF interval. It is possible to ping-pong three transmissions from the Access Point and two from the User Station within the duration of one 80 octet time slot. This procedure is used for access with contention resolution for both D and P channels. On the D channels, once exclusive access is gained by an originating User Station, the D channel is used as defined in ISDN. This mechanism is not needed for the outward D-channel since there is no contention possibility.

B-channel/C-channel/D-channel ISDN

The access control path for 64 kb/s channels is Slot 1 D-Channel which has its own request/grant access protocol. Various uses are defined by a template designator in the non-payload five octet field.

All potentially terminating User Stations monitor the outward D-channel detecting their Port Identifier in the broadcast message. A reply on the D-channel results in an auxiliary fixed network function to assign a B or the C-channel for use.

An originating User Station must wait for broadcast of "available status" to attempt access. Within the D-channel field, five each 16-octet access subslots are defined (see Figure 3), and a requesting station may use the 2nd and then if necessary and permitted, the 4th one. In the 3rd and 5th subsegments, a winner is granted access or a retry is announced. Retry uses a rotated permission sequence algorithm.

The following calculations are used to estimate the blocking probability on the D-channel resulting from 24 voice channels attempting to set up a connection simultaneously. Without contention, one call setup could require three inward and two outward slots or less than 24 milliseconds of duplex frame time for messages resulting in a total D-channel occupancy of nearly 600 milliseconds (24 channels x 24 milliseconds).

The average connection time might be as small as 60 seconds duration which is 100 times greater than the duration of all of the D-channel messages to setup and release connections on 24 channels. With these very high peak loads, the probability of D-channel contention is about 1% on the first try, and the contention probability is much smaller for reasonable traffic assumptions. Retries occur once every 8 milliseconds until an access is granted.

It is not necessary to support the ISDN packet services on the D-channel. Such a message can be sent on the P-channel to a Server that will put it on the network via a Primary Rate Interface.

The serializing function for Basic Rate access is performed inherently by the radio system access protocol.

Half B-channel/D2 Local Voice Connections

D2 (slot 20) is used for access protocol on the half-bandwidth channels. Since these slots are used alternately for two different connections, the processing delay is doubled to 16 milliseconds. It is not expected that these channels will be used for data since local data transfers are better accomplished via the P-channel. The access protocol is similar to the B-channel method, but is reduced in complexity because of reduced addressing possibilities.

P-channel Access

Once the packet space is allotted to a user of the Access Point, the sender is the sole occupant of the space until finished. The Access Point transmits marking corresponding to one of the following states within the AC field of each segment:

1. "Available for use" marking in subslot 1 of each vacant segment
2. "Busy" marks a segment and then starts a packet transmission in the payload space with a preamble in 802 format.
3. "Busy Continuing" marking for a further segment of a packet already started
4. "Busy Ending" marking for the last segment of a packet already started.

The packet space operates in repeater mode; a segment is transmitted by the User Station, and it is repeated in the following Access Point segment.

Access to each segment (also called row or cell in other contexts) is regulated by the AC field within the five preamble overhead octets. Once a User Station is granted access, all following slots are reserved until the entire packet is transmitted. Limits on the length of one packet are carried over from other 802 LAN's.

A User Station may request P-channel access when the status of the segment is broadcast "available for use" in the first Access Point subsegments. A request is made in the second subsegments, and it is granted or refused in the third subsegments. Retry is conditionally permitted in the fourth subsegments, and may be granted in the fifth. Once a User Station receives a grant of access, the next packet can start at the beginning of the payload in the next regular segment.

HARDWARE

Many details of this plan are chosen to minimize hardware cost, some are as follows:

1. Non-simultaneous operation of receiver and transmitter
2. Same frequency operation of receiver and transmitter
3. Higher fractional bandwidth and non-coherent modulation allows less accurate frequency reference
4. Parallel transmission of 4 or 8 bits at lower symbol rate avoids need for adaptive equalization and training interval
5. Use of omni-directional fixed and user station antennas.

SYSTEM CAPACITY

The model for the layout of the radio Access Points is a 50 foot grid with an Access Point at each intersection located just below an 8 to 12 foot high ceiling. The arrangement is as shown in Figure 1 except that there are 16 Local controllers and 64 Access Points. Each group of four Access Points is cabled to a common controller located at intersections of a 100 foot grid. An actual system may not have this uniformity, nor would it be needed.

Also considered is a 100 foot grid for both controllers and Access Points. The lesser spacing requires 6 dB less transmitter power and half the radio range. The propagation calculation and the required transmitter power conclusion shown above was based on the 100 foot grid dimension.

The user density shown is a geometric calculation unrelated to the traffic capacity of the system.

The necessary technical measures would be included so that all access transmitters transmitted the exact same information at the exact same time. The necessary fixed cabling and distributed electronics required is assumed. The parameters of the model system are tabulated as follows:

Area served per Controller:	10,000 square feet
Area served per System:	160,000 square feet

Grid dimension:	50 feet	100 feet
No. of Access Points:	64	16
No. of Access Point Controllers:	16	16
Worst case required radio range:	50 feet (15 m)	100 feet (30 m)
Worst case time dispersion:	50 nanoseconds	100 nanosseconds

User density:	1/125 ft^2	1/250 ft^2	1/500 ft^2
Users served per Controller:	80	40	20
Users served per System:	1280	640	320

THE NEXT STEPS

There is an agenda for those organizations that wish to participate in this business area.

It is first necessary to decide that there should be an ubiquitous radio access environment, that it is technically feasible, and that the regulatory environment can be adjusted to permit it.

A very significant business decision is whether this technology is exclusively proprietary or whether a multivendor environment is necessary and inevitable. Large scale application and adequate breadth of function are unlikely unless it is the result of the effort of a Standards Committee.

The radio access requires yet another MAC (Medium Access Control). An unrecorded objective of IEEE 802 is to minimize MAC proliferation, and this a difficulty with the creation of a new 802.X committee. The preferred sponsoring Standards body should be the IEEE because it includes users, manufacturers, service organizations and overseas participation.

If this work is a further subgroup of 802, then there is a charter obstacle to consideration of anything but the physical layer up through layer 2. This work will involve ISO level 3 and 4 considerations. A further difficulty is that 802 is reluctant to consider systems dependent on central intelligence. For this reason, there is an incentive for a separate IEEE standards committee.

The starting point is a Project Authorization Request to the IEEE Standards Board. For such a request to be granted, it is necessary to show a broad need and an active interest in meeting it. It is a process that requires the effort of several organizations to show a measure of consensus and the capacity to follow through. A Standards Committee, backed by a wide consensus of suppliers and users, is the type of entity which can be successful in petitioning the FCC authorization of this service under the rules.

Because of the ultimate scale of resources required, it is inevitable that there will be a staircase increase of applied resources with each step supported by further validations of feasibility and market scale. The time to begin is last year. To me, this market appears larger than HDTV or cordless telephone, citizens band, wireless PBX and cellular telephone all taken together.

There is a great deal of activity in this field outside of the USA. In most countries, the problem is viewed as extension of residential cordless telephone, business wireless PBX and personal cellular telephone. Much relevant technology has resulted from large scale projects in Europe and Japan. By recognizing the importance of integrating packet data and ISDN and the special requirement of business premises, it is possible to find a solution that is favorable for US suppliers to participate in a very large market.

Chandos A. Rypinski is President and Chief Technical Officer of LACE, Inc. (Local Area Communication Equipment) of Petaluma, CA. He is a Fellow of The Radio Club of America, a Senior Member of the IEEE and recipient of their Centennial Medal for contributions to vehicular radio technology. His authoritative paper on future high-capacity public-safety radio technology was published in the November 1989 issue of The Proceedings of The Radio Club of America.

TREASURER'S REPORT FOR FISCAL YEAR 1989

(October 1, 1988 — September 30, 1989)

REVENUES

Dues Collected & Applied	$13,629
Other Member Fees	952
Sections Operations - net	(20)
Banquet - net	894
Advertising Sales	4,775
Pins & Plaques Sales	1,272
Interest on General & Life Funds	2,939
Miscellaneous	13
TOTAL Revenues	$24,454

EXPENSES

Publications	
Printing & Supplies	$9,470
Mailing Expenses	2,244
Meeting Expenses	3,077
Office Expenses - Rent	550
Printing & Stationery	1,233
Postage	903
Telephone	168
Computer Expenses	334
Consulting Fees	2,750
Legal & Accounting	1,200
Pins & Plaques	1,306
Miscellaneous	812
TOTAL Expenses	$24,047
NET Revenues less Expenses	$407

BALANCE SHEET

ASSETS

Inventory & Receivables	$ 1,034
Section & Banquet Funds	14,079
Cash in Bank - Operating	16,587
Investments - Securities	34,694
GNMA Certificates	95,301
Putnam fund	27,487
Certificate of Deposit	10,000
TOTAL Assets	$199,182

LIABILITIES

Prepaid Dues	$ 8,941
Prepaid Banquet Tix-89 Banquet	1,740
Fund Balances:	
Scholarship Funds - Principal	113,699
For Distribution	8,878
General Funds - Op'g Balance	35,625
Reserve Op'g Deficits	11,345
Life Member Fund	13,266
Legacy Fund	1,254
Other Assets & Liab-Net	4,434
TOTAL Liabilities	$199,182

SCHOLARSHIP & GRANTS FUNDS

	Capital	Available for Distribution	Totals
Opening Balance Oct. 1, 1988	$106,610	$ 4,905	$111,515
Contributions	7,089		
Interest Earned		9,923	
Scholarships & Grants Awarded (see note)		(5,950)	
Ending Balance Sept. 30, 1989	$113,699	$ 8,878	$122,577

N.B.: Scholarships designated for research on Edwin A. Armstrong were allocated for the years 1989 and 1990. The amount reserved from the 1989 activities was $3,000. Had these grants been made in 1989, the Ending Balance in the Available for Distribution Account would have been $5,878.

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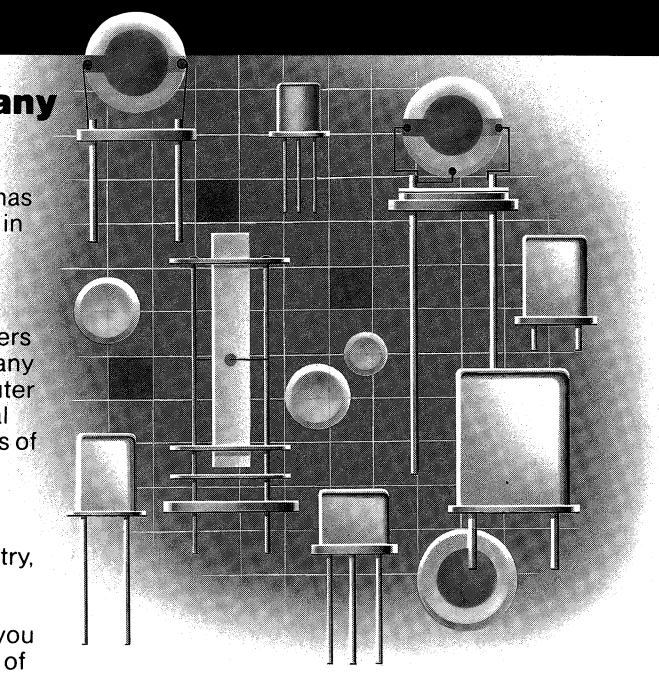

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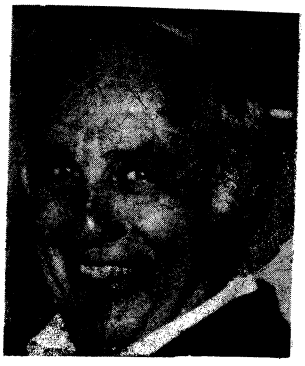

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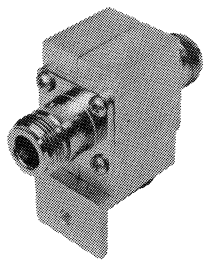

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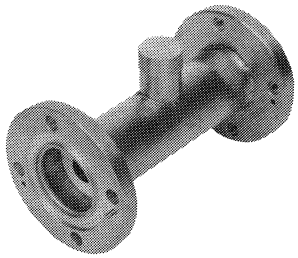

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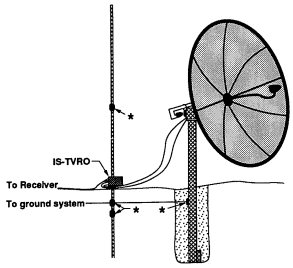

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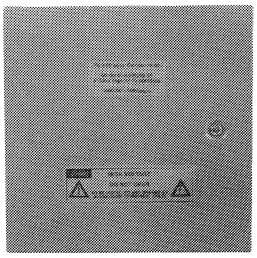

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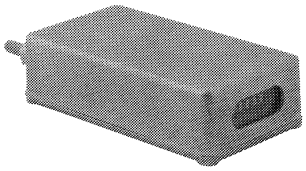

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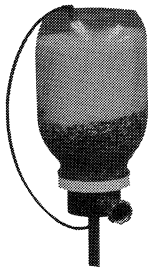

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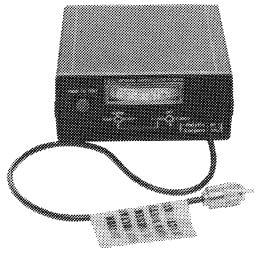

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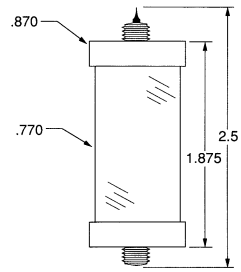

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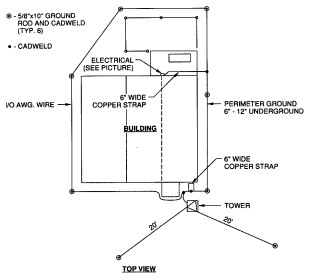

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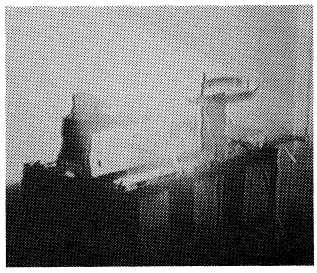

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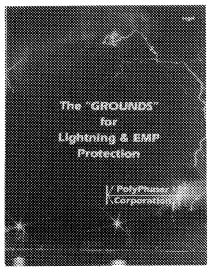

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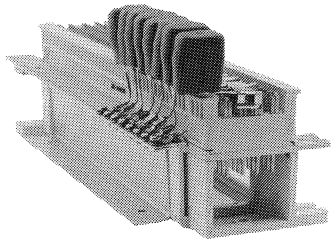

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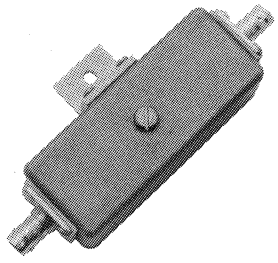

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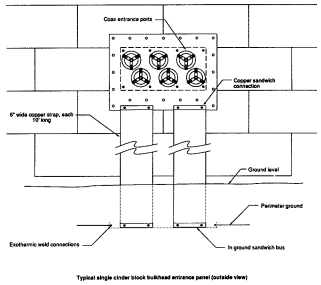

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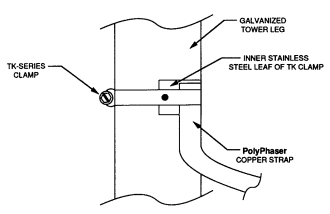

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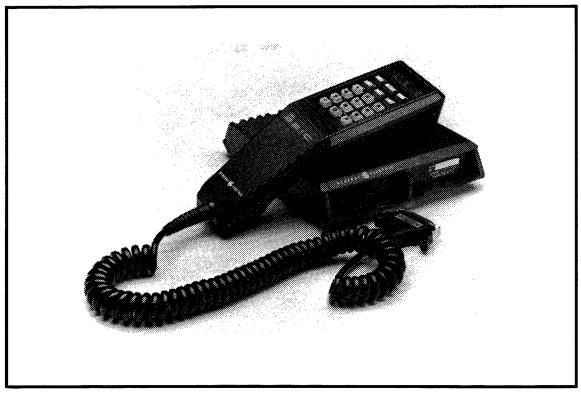

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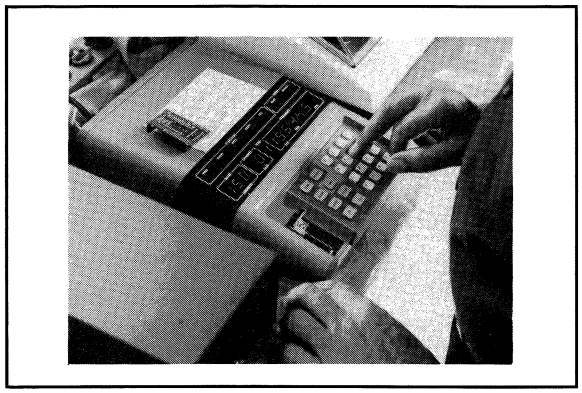

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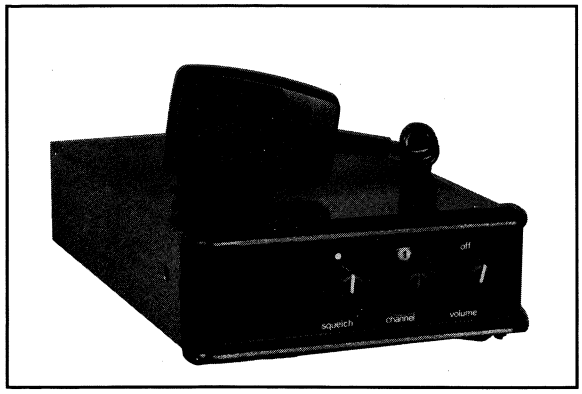

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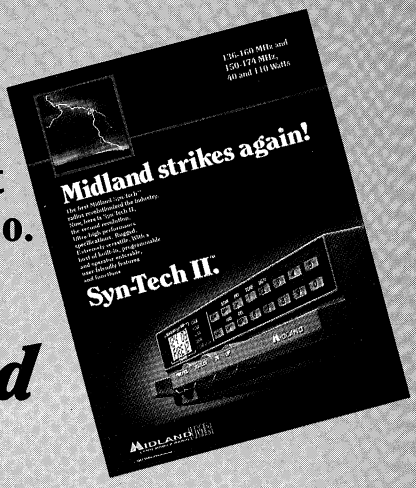

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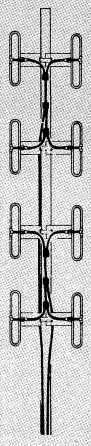

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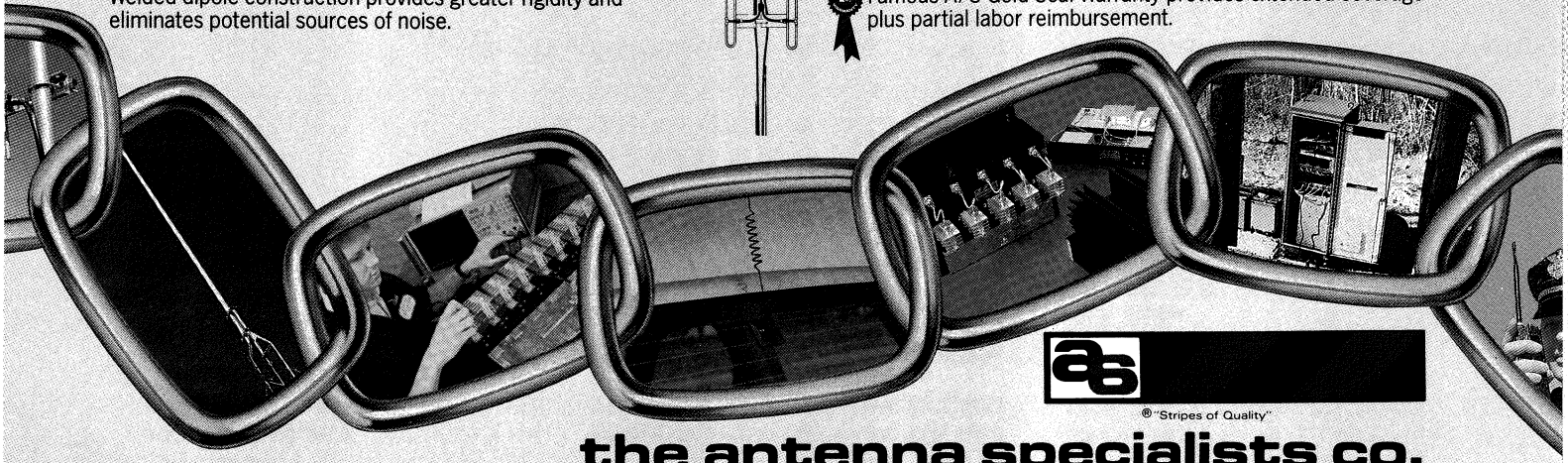

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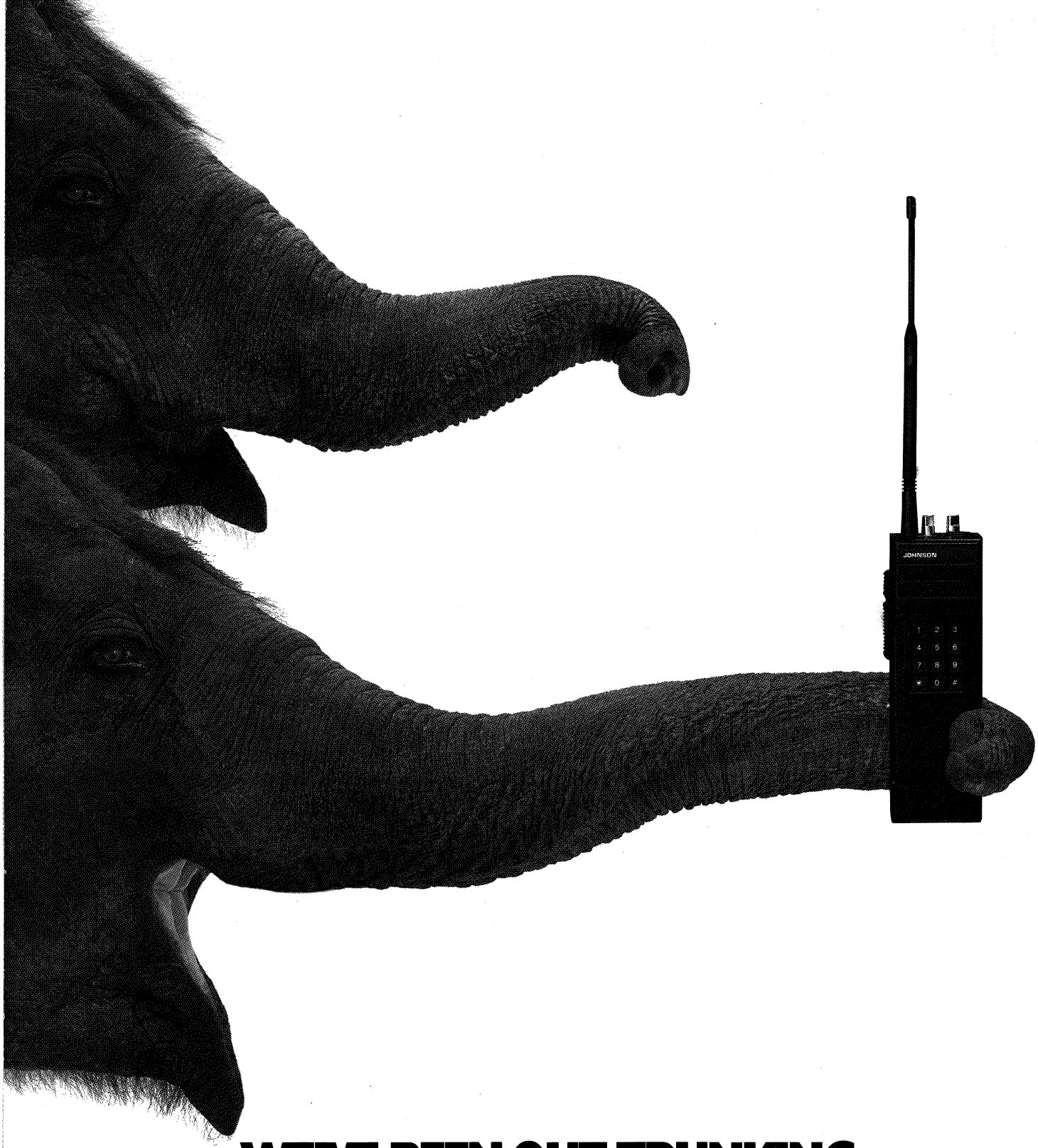

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