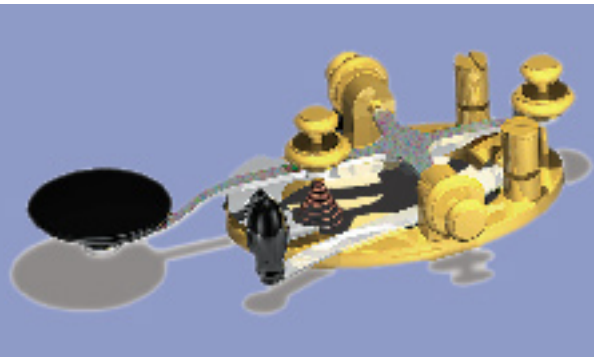
By Jim Maxwell, W6CF

Amateur Radio: 100 Years of Discovery



As we approach the new millennium, it's a happy coincidence that Amateur Radio is now almost exactly 100 years old. It seems appropriate to stop for a moment and take a thoughtful trip to our beginning years, and even before. Why should we bother, you ask? Well, for many this will be a pleasant and nostalgic look back to the early days, the early days, of course, being any day earlier than today! Moreover, as will be seen as we progress through the events of this past century, there is much to be learned from our history. As Confucius once said, "Study the past if you would divine the future."

This article deals, for the most part, with Amateur Radio in the United States. This restriction is not due to a lack of interest or a lack of importance of the broader topic of worldwide Amateur Radio, but purely for practical reasons. Consider that Clinton B. DeSoto's classic *200 Meters and Down* covers the history of Amateur Radio in the US only to 1936—but contains 184 pages.

The 1800s—Prehistory

The last few years of the 19th century set the stage for rapid development of commercial radio and established the foundations of Amateur Radio. There were numerous early contributors to the radio art, such as the great Oersted, Ampere, Faraday, Henry, and others. However, discovery really shifted into high gear in 1873 with the controversial work of the Scotsman James Clerk Maxwell (*not* related to the author of this article!). His work presented his theory of the electromagnetic field. Maxwell was the originator of those sublime equations loved so dearly by students throughout the world. (Heaviside also made major contributions to Maxwell's equations as they appear in modern textbooks, but that's another story.)

Those who came before him, especially Faraday, heavily influenced Maxwell's work, but many of Maxwell's contemporaries weren't convinced that his new theories were valid. It would take nothing less than rock-solid experimental effort to break down those walls of doubt. The German physicist Heinrich Hertz did just that, performing a series of classic experiments in the late 1880s during which he generated, detected, and measured the properties of electromagnetic waves predicted by Maxwell's equations. Hertz, though, had no particular interest in those waves except for the intellectual challenges their discovery provided. Development of radio for the use of mankind was left to others. The race was on.

One of the participants in the race to develop radio was the young Italian Guglielmo Marconi. He had a strong interest in physics and electrical science as a boy. He studied the subject in school and became aware of the possibility of using electromagnetic waves for communicating. In 1894 he started to work on the project in earnest. Two years later he was in England with what he felt was a useful radio device. During a demonstration before British officials Marconi managed to communicate over a distance of 2 miles without wires. It was an astonishing feat at the time and it launched Marconi's professional career. The rest, as the old saw goes, is history.

Who was the first Amateur Radio operator? We'll probably never know. Some would say it was Marconi. Marconi had a great fondness for Amateur Radio throughout his life, and considered himself an amateur at heart. Still, he chose to devote his life to competing in the commercial wireless marketplace; he never operated nor was licensed as an amateur.

Back to the original question, we'll probably never know who the first Amateur Radio operator was, but the Englishman Leslie Miller is surely a leading contender for that honor.

Leslie Miller has a solid place in amateur history as the first person to have published a description of a simple-to-build transmitter and receiver for an amateur (and he used that word) audience. His article appeared in the January 1898 issue of *The Model Engineer and Amateur Electrician*, published in London. Some of his readers clearly took the article to heart, for in the March 1898 issue "E. A." wrote that he had a 2-inch spark coil and three solid brass balls, but needed more construction details. (The three brass balls were called for in one of the transmitter designs given in Miller's article.) No fewer than three more letters on the subject appeared in 1899 issues of the little magazine. The Yanks weren't far behind, with a construction article in the *American Electrician* in July 1899. An explosion of interest would occur over the next decade, but as the 19th century drew to a close, Amateur Radio was on its way.

The '00s—The Beginning

As the 20th century began, commercial development gained speed. Marconi spanned the Atlantic with wireless in 1901, using high

In 1896 Marconi managed to communicate over a distance of 2 miles without wires. In 1901 he spanned the Atlantic.

power and giant antennas. Amateurs continued to tinker and experiment with their modest installations. A detailed construction article appeared in the Boston magazine *Amateur Work* in June 1902. It's clear that the experimenters at that time had already discovered the skill of scrounging that amateurs adhere to even today: one of the components recommended in that article was baling wire.

These early transmitters all generated RF by means of discharging a capacitor across a gap, creating an oscillatory spark. These early spark transmitters did produce RF, but were broadband by their very nature, making it difficult, and often impossible, for two neighboring stations to be on the air at the same time. Receivers were simple detectors, generally coherers, later giving way to the more sensitive galena crystal sets.

There was no regulation during those days, of course. Amateur call letters were self-assigned, and often consisted only of the operator's initials.

A hint of what the future held occurred in 1904 when the Englishman J. A. Fleming developed the first vacuum diode: the Fleming Valve. In 1906 Lee DeForest added a grid to a Fleming Valve to make the first triode, naming it the "Audion." Audions made very effective detectors, but were generally too expensive for most amateurs to use. It wasn't until some years later that it was realized that triodes could be made to generate RF. Meanwhile, crystal receivers and spark transmitters ruled the airwaves.

The '10s—Regulation

The range of an amateur station in the early 1900s was measured initially by yards, then by city blocks. As power increased and technology improved, ranges increased so that by 1912 a well-designed kilowatt spark station had a range of perhaps 100 miles. Those with more power could work several hundreds of miles. Higher power generally meant more interference and the clamor for regulation intensified.

Congress had actually been investigating problems related to wireless since 1910. In 1912, after agonizing appraisal of more than a dozen different bills, Congress finally approved the Radio Act of 1912. For the first time amateurs were to be licensed. The law also had a provision that at first was thought could bring the death of Amateur Radio: hams were restricted to the single wavelength of 200 meters. The general belief in those days was that long distance performance improved with longer wavelengths. The "short" wavelength of 200 meters was thought to be useless, and some expected that the amateurs, all crowded around this "useless" wavelength, would eventually give up and pursue other interests.

The plot didn't work. Although there was an initial drop in numbers following the Radio Act of 1912, Amateur Radio in the US started growing again. There were more than 6000 amateurs on the air by 1917.

Some hams had extended their effective range by relaying messages through others, but it took a Hartford, Connecticut ham, Hiram Percy Maxim, 1WH (later 1AW) to recognize that messages could be sent more reliably over long distances if relay stations were organized. So, in 1914, the American Radio Relay League was born, and by late 1915 *QST* started publication. The calls "1WH" and "1AW" look strange to some today, but they were the norm for the early years. Commerce Department rules issued in 1913 provided for amateur call letters, but prefixes were not defined or required. Prefixes came later, in the mid to late 1920s.

About that same time a miracle in receiver technology appeared on the scene. A New York amateur by the name of Edwin H. Armstrong invented the tube-operated regenerative receiver in 1913, and in 1915 its design became public knowledge. This new receiver had greater sensitivity than the crystal detectors then in use. Although vacuum tubes were expensive at the time, some amateurs started experimenting with Armstrong's design.

The year 1914 brought the madness of the Great War in Europe. By 1917 the US was fully involved and all ham operations in the US ended. The fact that amateurs formed a pool of trained radio operators didn't go unnoticed—Hiram Percy Maxim made certain of that!—and some 4000 hams eventually wound up in the service of the nation. The word "service" is important here, for it emphasizes one of the fundamental functions of Amateur Radio—to be of service to the public and to the nation.

The war finally came to a close on November 11, 1918. During the hostilities the Navy had been placed in control of all US radio. As hams in uniform streamed home they expected, quite reasonably, that the Navy would rescind the 1917 order that had closed them down. That was not to be the case. The Secretary of the Navy refused to permit amateurs back on the air. The future of Amateur Radio in the US was in doubt once again.

The Navy seemed determined to maintain control over all radio services, even in peacetime, with Amateur Radio seemingly not on their list of useful radio services. Legislation was written that supported the Navy's objectives. The ARRL and others objected strenuously to congress and also appealed to all hams and their families to write to their congressmen. The political pressure torpedoed the pending legislation, but the Secretary of the Navy still refused to permit the resumption of amateur operations. Finally, Representative William S. Greene of Massachusetts heard the call for help and interceded with a House Resolution *directing* the Navy to end the prohibition on ham operations. The Navy complied, the logjam was broken and Amateur Radio returned to the US in November 1919. This episode was a nearly textbook example of how the collective strength of thousands of amateurs can move mountains in Washington…sometimes.

Editorials

OF AMERICAN RADIO RELAY LEAGUE

AT LAST!

But as we were ready to mail last month's issue, the word came from Washington that the Navy Department had cut the reins and removed restrictions on amateur transmitting. After throwing everything within reach at the office boy, and finishing off by jamming the waste basket down over his head, we grabbed the telephone and told the printer for the love of Mike to make room for an extra-power sheet to go into every QST, and that we would pound something out immediately and be over in ten minutes. Talk about [illegible] Excitation! We were both hoarse and excited. It seemed like the raving vess of a dream. To realize that we could call up and holler QRT and QRK and do all of the other things that we had been longing to do since April, 1917, made it difficult to focus properly.

The far reaching effect of the removal of the ban on transmitting cannot be estimated. Probably every amateur in the country got as excited as we did here in the editorial sanctum. Maybe they didn't dance things, but if they were real dyed-in-the-wool, blown-in-the-glass, all mail and a yard wide radio bugs, they wanted to. These amateurs are going to make the removal of the ban on receiving look like a half-inch spark coil that has been ruined on. Receiving is all right, but it is not to be compared with receiving and transmitting. It is the transmitting that makes amateur radio what it is. The removal of the restrictions is going to be felt in every line of business from the lumber yard to the instrument maker. The Old Man's electrical supply store will have to order soldering paste by the barrel and the hardware stores are going to note a marked increase in the demand for everything from nails to copper wire.

But there is another side to this fair picture. A lot of us are going to find that some pet scheme is not going to work anywhere nearly as positively as we expected it would. Instead of radiating five amperes, it is going to be three-quarters of an ampere, or the tone is going to be rugged or the coupling has got to be looser, or the insulation about five times better. We are not going to have the air chock full of QRM right off quick. It is going to take time to get back, and a terrible lot of good hard work. But that is where we minimum shine. All of the trouble will be gradually dealt up and transmitting distances that we never dreamed of are going to be matters of every day occurrence. The days of real sport are at last with us. Come on, fellows, and get into the ole again.

This editorial in the November 1919 *QST* celebrated the return of Amateur Radio privileges after the end of World War I.

The '20s—Discovery

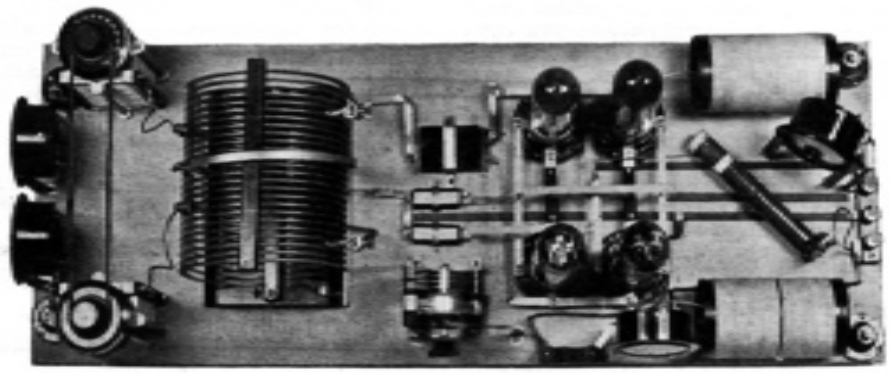
As the nation entered the '20s, amateurs

were solidly back on the air around their 200-meter wavelength. The ARRL relay network was up and humming, with records being broken regularly. One of the most impressive was a showing in early 1921 during which a message was transmitted from Hiram Percy Maxim, 1AW, in Connecticut to V. M. Bitz, 6JD, in California. *A return reply was received in only 6$^1/_2$ minutes, round trip!*

Still, few would have predicted the revolutionary changes that took place in Amateur Radio in only a few short years. If one had to point to a single most significant reason for those changes it would be the vacuum tube, accompanied by an almost insatiable curiosity by hams.

By the 1920s the price of vacuum tubes had fallen, which caused an upsurge in the use of Armstrong's sensitive regenerative receiver design. This development led to an increased range achievable by spark stations, for with the new receiver hams could hear weak signals that previously hadn't been detectable. Some advanced amateurs were also experimenting with the superheterodyne receiver, invented by Armstrong as well as the Frenchman Lucien Levy during the war years. Increasing numbers of amateurs also used tubes in their transmitters, generating uniform, continuous wave (CW) signals. The CW signals were narrow, scarcely 1% the width of a spark signal, reducing interference and making it possible to increase the number of stations that could be on the air at the same time.

As the range of amateur stations increased, thoughts turned to *real* DX. Transatlantic transmitting and receiving tests were kicked off in 1921 to see if low power amateur signals could cross the pond. The tests ultimately showed that they could, and they also showed conclusively that CW was far superior to spark. By 1923 Europe-North America two-ways seemed only a matter of time. All the preparations, sweat and tears finally paid off on November 27, 1923, when French station 8AB worked Connecticut hams Fred Schnell, 1MO, and John Reinartz, 1XAL, using CW on a specially authorized wavelength of 110 meters. Testing continued and by late 1924 a CW contact was made between England and New Zealand, almost halfway around the world. In 1926, Brandon Wentworth, 6OI, achieved what was considered by many to be the ultimate in DX prowess: he worked and confirmed all continents, from a station in a pasture on the Stanford University campus in California. The next year saw the beginning of the ARRL International Relay Party, the predecessor to the ever-popular ARRL International DX Contest.



The transmitter that spanned the Atlantic from 1MO on a wavelength of 110 meters.

By the mid-1920s the value of short waves was clearly recognized by the government as well as commercial entities, due in large measure to the work of the amateurs themselves. By the end of the decade the wide open spaces were gone, but the amateurs did have harmonically related bands from 160 through 5 meters, plus a narrow band at 400-MHz.

Transatlantic transmitting and receiving tests were kicked off in 1921.

Two other events in the '20s also deserve mention: First, the International Amateur Radio Union (IARU) was formed for the purpose of representing Amateur Radio within the international community. The IARU is still the single most important body for representation of Amateur Radio internationally. Second, the broadcast industry in the US was in chaos due to insufficient legislative authority for the Commerce Department to control it. As a result, congress passed the Radio Act of 1927 and the FRC (Federal Radio Commission) was created.

The '30s—Growth

As ham radio entered the 1930s, spark was a thing of the past (some would have said "good riddance!") and all amateurs were using vacuum tube transmitters and receivers. Phone operation wasn't as common as CW, but was gaining in popularity. A few years earlier, in Japan, Professor Hidetsugu Yagi had studied an array of dipoles that formed and directed a microwave beam. By the 1930s the design had been adapted to HF, and a few hams were experimenting with these new-fangled "Yagi" beam antennas. They were built with both wire and metal elements, but generally sported wooden booms. Some of the more technically sophisticated hams also continued to experiment on the 5-meter band and on even higher frequencies.

The ARRL Sweepstakes contest was introduced in 1930, and 1933 brought the ARRL Field Day. The ARRL DX contest continued to be popular with the DXers.

Almost unnoticed at the time, the small Los Angeles magazine *R/9* published a three-part article starting in the September-October 1933 issue titled *Single Sideband Transmission for Amateur Radiophones* by Robert M. Moore, W6DEI. Moore described a system of single sideband that he and others were experimenting with and had actually put on the air. The article didn't generate much interest, however, and it wasn't until 1947 that new experimental work was carried out on the ham bands.

The Radio Act of 1927 lasted only seven years: in 1934 Congress passed the Communications Act of 1934. It had no immediate effect on hams, except that their affairs were henceforth handled by the FCC (Federal Communications Commission), which exists to this day.

The Old Man himself, Hiram Percy Maxim, one of the cofounders of the ARRL and the IARU, passed away in 1936. He was a man of many talents—leader, author, photographer, engineer, entrepreneur—Amateur Radio everywhere lost a friend.

Interest in DX continued to be high, and in 1937, after extended discussion of what should be called a "country," the DXCC program was announced by ARRL. The question of what kind of entity deserves to be credited to DXCC awards continues unabated today, over 63 years later.

In September 1939 war came to Europe once again. Amateur operations immediately halted in most European countries. Most of the British Commonwealth nations went off the air as well, including Canada. US hams continued operating, although DX pickings were mighty slim. Even with DX disappearing from the bands, the West Coast magazine *Radio* announced their

1MO and his "Hay Wire" receiver, the one he used to work French 8AB in 1923.

The ARRL Sweepstakes contest was introduced in 1930...1933 brought the ever-popular ARRL Field Day.

first annual International DX Contest in 1939.

The '40s—War and Peace

The '40s arrived with US hams still active on the air, but DXing was essentially a thing of the past. By June 1940 the FCC issued an order prohibiting American hams from contacting foreign stations. Portable and mobile operations on frequencies below 56 MHz were also prohibited, although the FCC made a specific exception for Field Day, and later for the Amateur Emergency Corps.

Then came the Pearl Harbor attack on December 7, 1941; the US was suddenly at war. Amateur activity in the US screeched to a halt, although those on the home front kept their technical and operational skills honed on 112 MHz as members of the War Emergency Radio Service. This service was important and was taken very seriously by the participants, but it still lacked the freewheeling pleasures of normal ham operations.

At the start of hostilities some 60,000 Americans were licensed as radio amateurs. It has been estimated that approximately 25,000 of those served in the armed forces during WW-II. Another 25,000 served in critical war industries, or as instructors in military schools.

Unlike WW-I, ARRL stayed open for business for the duration. *QST* continued to be published, although with fewer pages than before as a result of wartime paper rationing. ARRL publications were used heavily for military and civilian training, and a special Defense edition of the ever-popular *Handbook* appeared in 1942.

By the beginning of 1945 it was clear that it was only a matter of time until the war would draw to a close. Some hams in New York were so certain that peace was nearly at hand, and that ham radio would have a future following the war, that they kicked off a new magazine called *CQ* in January 1945. Hostilities finally ended on August 17 of that same year. Only four days later, amateurs were back on the air on VHF. By summer 1946 nearly all amateur bands were restored, from 3.5 to 30 MHz, with the old bands at 5 and 2.5 meters replaced by new bands at 6 and 2 meters. HF DXing was back, the DXCC program was restarted, and interest in VHF/UHF operations took a jump upward as surplus military gear became available at prices that were near giveaways.

HF operators weren't overlooked, of course. Surplus transmitters, receivers, power tubes, components—just about anything the heart desired was available from the friendly, local surplus emporium. Surplus also gave a big boost to a new mode, at least new to hams: RTTY. Many hams had worked with RTTY while in the military during the war, and when machines appeared as surplus, they quickly disappeared into ham shacks throughout the country.

As hams were joyfully getting back on the air, the public was just as joyfully buying TV sets; one of the greatest threats ever to ham radio arrived under the name of Television Interference, the dreaded *TVI*. The TVI "problem" has decreased over time, although it has never been completely solved. Interference to and from home entertainment devices continues to plague us to this day, but it doesn't seem to be as threatening as TVI was in those gloomy '50s.

Remember the 1933 *R/9* article on Single Sideband? Well, others did too, and by September 1947 Mike Villard, W6QYT, and a group of student hams started experimenting with SSB at Stanford University. It took a decade before SSB was a common sound on the bands, but it did ultimately displace dual-sideband AM phone, except for a relatively small number of AM aficionados. These folks, quite simply, enjoy operating the old rigs and enjoy the sound of a well-adjusted AM transmitter.

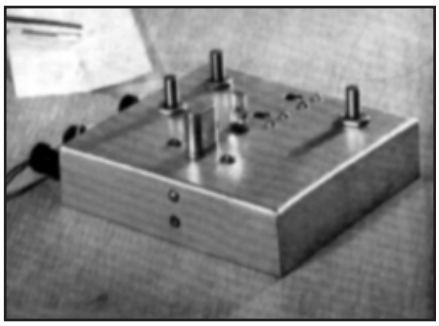
By September, 1947 Mike Villard, W6QYT, and a group of student hams started experimenting with SSB.

The '50s—Normalcy

The 1950s began with a bang: basic changes in the amateur license structure were announced in 1951. The Novice, Technician, and Amateur Extra licenses were announced by the FCC, along with name changes of the old class A, B, and C licenses to Advanced, General and Conditional, respectively. The Novice license was a one-year, non-renewable, ticket with CW privileges on portions of two HF bands, and phone on a portion of 2-meters. The Technician license was created in response to a clamor to accommodate those who wished to experiment on the VHF and UHF bands above 220 MHz, without taking a 13-WPM code test. Both of these new licenses required 5-WPM code tests. These new license classes were highly successful, if the number of new hams was any measure.

Scarcely a year later, in late December 1952, the FCC changed the licensing structure once again. No new Advanced licenses would be issued, and special phone privileges on HF for

Advertisements like these appeared in *QST* and other radio magazines during World War II.



This 2-meter CW transmitter, designed and built by K2AH in 1952, was among the first all-transistor amateur rigs.

Advanced and Amateur Extra licensees were withdrawn. Privileges for the Novice and Technician licensees remained unchanged. (Technician licensees eventually gained privileges on 6 and 2 meters.)

Meanwhile, a gradual technical revolution was taking place—consumer products employing those strange creatures called *transistors* began appearing and construction articles using transistors began appearing in ham magazines. Just as the spark operators had to learn about vacuum tubes in the 1920s, now the tube buffs had to hit the books and learn about transistors.

Another hint of things to come occurred in January 1953 when Ross Bateman, W4AO, and Bill Smith, W3GKP, working together at Bateman's Falls Church, Virginia station, heard echoes of their own 2-meter signal reflected from the Moon. So began the era of moonbounce communications between amateurs.

The '60s—Incentive Licensing

The 1960s were exciting times for Amateur Radio. The decade brought us amateur moonbounce, OSCAR satellites and FM repeaters. Still, the '60s will forever be remembered by old timers not for exciting technical achievements, but for something quite different: incentive licensing.

Back in 1952 the FCC had eliminated the incentive licensing system on HF; the General, Advanced, and Amateur Extra class licensees all were given identical privileges. As the years passed many hams came to believe that the lack of special privileges for higher-class licensees acted as a *dis*incentive for some to better themselves technically and operationally. As a result, and after months of debate within the pages of *QST* and other magazines, in club bulletins, at conventions, on the air and elsewhere, the ARRL petitioned the FCC to bring back incentives to amateur licensing. The filing, made in October 1963, asked for reinstatement of the Advanced license. No new privileges were proposed for Advanced or Amateur Extra class licensees, but it did propose that HF phone privileges for General licensees be phased out on the 80, 40, 20, and 15 meter bands. Growth of the US amateur service had been brisk, running at about 8% to 10% per year since the Novice and Technician licenses were created in the early '50s. Once the debate started, however, the growth rate fell sharply.

The debate continued until the FCC handed down its decision in 1967: incentive licensing was restored. Exclusive sub-bands on the 80, 40, 20, 15, and 6-meter bands were set aside for Amateur Extra and Advanced class licensees. Those subbands were withdrawn from use by General hams. Suffice it to say, most Generals were *very* unhappy.

Since 1967 there has been liberalization of privileges for Novice and Technician licensees, plus expansion of HF phone bands and modifications to the specifics of the exclusive subbands for Advanced, and Amateur Extra hams. Even so, the broad scheme set by that 1967 decision by the FCC is with us still. Today, some 33 years later, there are those who are still bitter about the outcome of the incentive licensing debate of the 1960s. Remember the quote from Confucius given at the beginning of this review? Applying Confucius' thoughts to the 1960s incentive licensing debate it's clear that a lesson has been learned: Never, *never*, **never** should anyone propose to *reduce* operating privileges!

Incentive licensing was by no means the only major event in the '60s. For example, in July 1960 the first two-way contact via the Moon on 1296 MHz was logged by the Rhododendron Swamp VHF Society in Massachusetts. It took place between station W1BU, spearheaded by Sam Harris, W1FZJ, and the Eimac Radio Club in California, led by O. H. "Hank" Brown, W6HB. Only a bit more than a year later Amateur Radio leaped into space in the form of a small, beeping, OSCAR (Orbiting Satellite Carrying Amateur Radio) satellite. It was the brainchild of a group of hams from the area now known as Silicon Valley. They arranged to have three more small satellites launched, and then passed the baton to AMSAT, the Maryland-based Amateur Satellite Corporation, still the principal satellite-specialized Amateur Radio organization in the US. The 1960s also saw the first move to amateur FM repeaters, destined to reshape the character of 2-meters and above.

In July 1960 the first two-way contact via the Moon took place on 1296 MHz.

The '70s—Repeaters and Packets

The '70s must surely be remembered as the decade of the FM repeater. Not because FM repeaters were "invented" in the '70s—they actually appeared much earlier—but because it was during this decade that amateur FM repeaters on VHF and UHF "took off" and literally reshaped the 2-meter, $1^1/_4$-meter and 70-cm bands.

Sam, W1FZJ, was one of the top amateur moonbounce pioneers in the 1960s.

The amateur FM repeater revolution had roots much farther back in time. Repeaters had been in use on 5 meters in the 1930s, but they were essentially experimental machines and never gained much popularity. In the 1950s AM repeaters started appearing, scattered throughout the nation. The repeater idea was sown.

It was the success of commercial FM repeater systems that gave amateur FM repeaters the greatest boost. After WW-II commercial users discovered the value of channelized FM for mobile use. Throughout the 1950s manufacturers churned out large quantities of equipment designed to satisfy that new demand. As the popularity of the new systems increased, so did congestion on their bands. In order to relieve that congestion the FCC finally required the commercial users to tighten up on their channel spacing. The commercials were obliged to do so, with the result that, throughout the 1960s, large quantities of outmoded (from the commercials' standpoint), but entirely serviceable equipment became available on the surplus market. Guess what? The gear operated on frequencies close to the amateur 6 and 2-meter bands, as well as 70-cm, and was easily converted from commercial to ham use. As the installed base of amateur FM repeaters grew, mostly built of converted commercial equipment, a demand for low-cost mobile and handheld equipment grew and was satisfied by both domestic and foreign manufacturers. The era of the ham FM repeater was in full bloom.

While repeater systems were being brought on-line across the nation, a new kind of revolution was quietly underway, thanks to early

The '70s must surely be remembered as the decade of the FM repeater.

work by some of our ham friends in Canada. This revolution was based upon the digital computer, which was attracting interest from many technically oriented hams. The Canadian experiments using packet techniques began in 1978. By 1979 Doug Lockhart, VE7APU, had developed a board capable of assembling and disassembling packets, and the board was offered to the ham community as kits. The kits sold briskly, and as the decade ended, so began the new gold rush—the rush to amateur packet radio. Unfortunately, ASCII modes weren't allowed under FCC regulations, so although experimentation was moving right along, US couldn't legally converse on packet with each other or with their Canadian counterparts.

Another significant event in 1979 occurred in Geneva at the World Administrative Radio Conference. At the end of the conference, due in no small measure to superb planning and lobbying by the IARU delegation, hams had three new HF bands, at 10, 18, and 24 MHz.

The '80s—Space and Packet Radio

In March 1980, the FCC finally permitted ASCII modes in the US. This coincided with the sudden rise in popularity of affordable personal computers. That was all it took to ignite amateur enthusiasm for packet radio and other digital modes. Members of AMRAD (the Amateur Radio Research and Development Corporation) in the Washington, DC area represented one hard-core group of packet enthusiasts. They were responsible, in collaboration with AMSAT, for the first ARRL Amateur Radio Computer Networking Conference. Out west, in Tucson, Arizona, TAPR (Tucson Amateur Packet Radio) was formed. The TAPR group proceeded to produce a line of popular terminal node controllers, further fueling the packet conflagration.

Digital activity blossomed on HF as well. In 1982 Peter Martinez, G3PLX, put the power of the personal computer to work, combining it with a modified version of the SITOR protocol to create AMTOR—the first amateur HF digital mode that offered error-free communication.

Meanwhile, the ham community was electrified in 1983 by the launch into space of Owen Garriott, W5LFL, an astronaut with the Space Shuttle program. Garriott carried a 2-meter rig with him, and passed out nearly 300 QSOs from space. Since that time amateurs have been included in the crew of virtually every Space Shuttle launch. In later years the SAREX program (Shuttle Amateur Radio Experiment), initially spearheaded by Roy Neal, K6DUE, has turned out to be a superb tool for helping students throughout the world develop an appreciation for the wonders of space and the space program. It has also been a boon for recruiting young, eager, new hams.

On the regulatory side, 1984 saw the launch of the highly successful Volunteer Exam Coordinator program. In addition, PRB-1 was issued by the FCC, which provided some measure of protection for hams from the arbitrary action of community planning commissions.

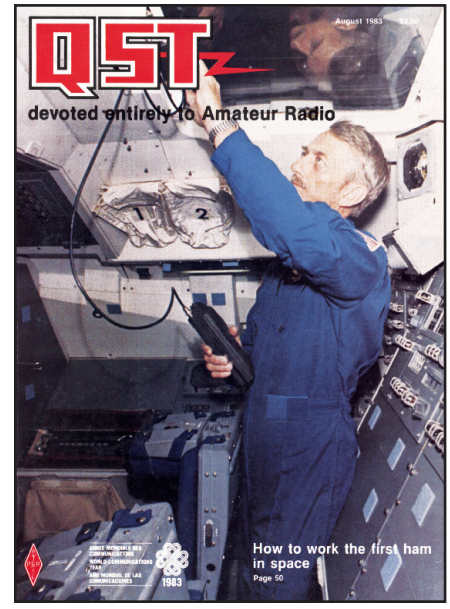
Last, but not least, in July 1989, the ARRL Board of Directors voted unanimously in favor of petitioning the FCC for a code-free ham license for use above 30 MHz. Many felt that its time had come.

The '90s—The Codeless License and the Digital Revolution

Even though the Morse speed requirement was set at 5 WPM for Technicians and Novices, Morse code continued to discourage many potential hams, who could point at the dwindling importance of Morse in military and commercial communications worldwide. Following intense debate in the amateur community the ARRL proposed that a new, code-free Technician license be created, with access to bands above 30 MHz. The FCC agreed in 1991 and growth of the amateur service took off again, reaching over 700,000 US licensees by the end of the decade. Amid predictions of doom by some, the "codeless Techs" went on the air, built repeaters, joined clubs and emergency organizations and took leadership positions.

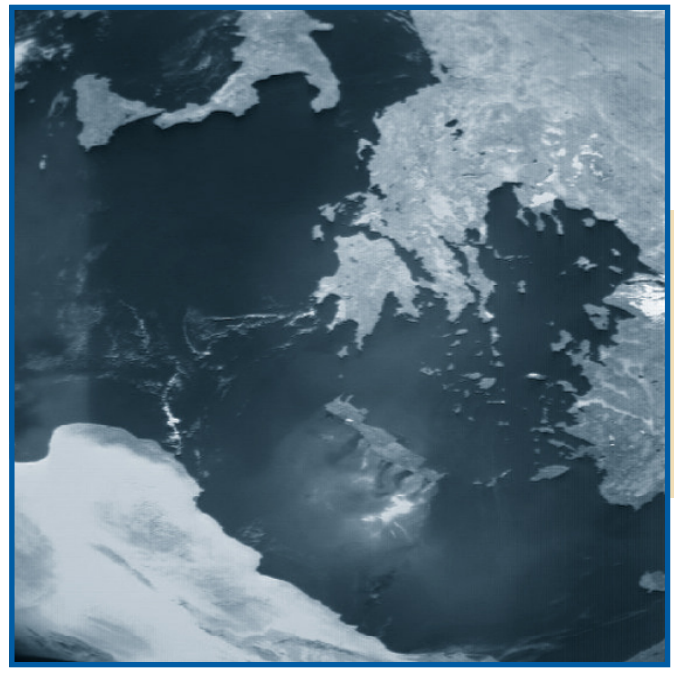
And then came the Internet, dramatically reshaping our world in a few short years. In the early '90s some pundits claimed that we were entering an era that would see revolutionary changes in communication.

As we leave the '90s it's crystal clear that those early pundits were correct (they may have even understated their predictions). Who would have believed only a few years ago that telephone calls could be made across the entire US for five cents per minute, or that the price for calling the UK from the US would be only twice



The August 1983 cover of *QST* featured Owen Garriott, W5LFL, aboard the Space Shuttle.

The ham community was electrified in 1983 by the launch into space of Owen Garriott, W5LFL, an astronaut with the Space Shuttle program. He carried a 2-meter rig with him, and passed out nearly 300 QSOs from space.



Amateur satellites became more sophisticated in the '90s. Many carried digital cameras that captured amazing images like this one from TMSAT-OSCAR 31.

that? Who would have believed that something called the World Wide Web would change basic patterns of doing business that have existed for a century or more? All of this, of course, creates challenges for the Amateur Radio service. The fascination of computers and the Internet attracts many of the young, technically inclined people who in previous years had often found their way into Amateur Radio. This challenge, and others, has caused some to predict the death of our service at the hands of computers in general and the Internet in particular. Hams, though, seem to be taking it all in stride. Today the majority of ARRL members have Web access (ARRL Headquarters in Newington, Connecticut receives more than 1200 e-mail messages per day!), DXers use packet and Web-based spotting networks and users of the Automatic Position Reporting System (APRS) employ the Internet for long-distance relays. Amateurs have embraced cyberspace with a vengeance, using the Web to swap information and software. Hams sell used gear on Ebay and many other Web sites, and argue *ad nauseum* on USENET newsgroups.

The emergence of PSK31, the exciting new HF digital mode, was fueled by the availability of free software on the Web. DXpeditions are using the Web to publicly post log files within hours after contacts are made—even from remote locations (thanks to amateur satellites as well as PACTOR and CLOVER HF digital technology).

The computer is also leading Amateur Radio into exciting new areas of experimentation, such as harnessing computers to radios, making possible experimenting with new digital modulation techniques which would have been almost unthinkable only a decade or so ago. TAPR now has an active effort, for example, which will ultimately result in affordable spread spectrum gear, an appropriate follow-on to their pioneering work in terminal node controllers less than 20 years ago. It's clear that the "threat" of the Internet to Amateur Radio has been somewhat overblown. On the contrary, computers and the Internet have made Amateur Radio a richer avocation, even more interesting and absorbing than it was before.

As the 20th century draws to a close, both the ARRL and the FCC have once again proposed changes to the US amateur licensing structure. The most contentious element of the ARRL proposal, predictably, is the idea of reducing the speed of the Morse code testing requirement for all HF licenses. As this article is prepared, the FCC's response to the ARRL's proposal and to the thousands of comments and counter-proposals hasn't appeared. When it does, history suggests that Amateur Radio in the US will be moving along a new road, but a road that is sloping upward, not down.

In Conclusion

I hope that you've enjoyed this romp through history. The shame of it all is that there is so much to say and so little space in which to say it! Many of the important individuals and developments of the past century have had to be omitted, as have many of the exciting new developments on the horizon. As only two examples, consider Pansat, an amateur spread-spectrum satellite, or the incredible Picosats. The list goes on and on.

Computers and the Internet have made Amateur Radio a richer avocation.

A quote from Confucius was given at the beginning of this article: "Study the past if you would divine the future." What, you may now ask, are the lessons to be learned from the history of Amateur Radio?

Perhaps the most important lesson is that Amateur Radio's history over the past century has been one of adversity and change, inevitably followed by struggle, success and growth. Today, in the year 2000, a new era in communication technology is upon us. We have survived the technological challenges of the past by understanding new technologies and embracing those portions that would lead Amateur Radio forward. We have survived change and overcome adversity by *working together*.

When Amateur Radio began there was only one way for a ham to get started: learn Morse code, build a receiver and a spark transmitter, string up an antenna, and start tapping on the key.

Today we have a multifaceted Amateur Radio. We're on CW and phone; SSB and FM; packet and TV; PACTOR, PSK31 and RTTY, as well as other modes, bouncing signals off the ground, off the ionosphere, and off the moon, enthusiastically working bands from almost dc to daylight. We have ragchewers and contesters, public service communicators and experimenters, QRPers and more. Hams are active in nearly every country of the world, and at ages ranging from less than 10 years to more than 100.

Can any group with common interests be quite so diverse? In spite of that diversity, and in spite of the fact that the Amateur Radio service encompasses a very large number of special interests, it's important to understand that we all have one common, overriding interest: to ensure that Amateur Radio not only survives, but flourishes in the century ahead. With the support of all hams everywhere our future prosperity is assured.

My thanks to my wife Trudy, KC6NAX, and old friend Jack Troster, W6ISQ, for their helpful reviews of the final draft. Any errors of omission or commission, of course, are mine alone. My thanks also to Steve Ford, WB8IMY, for his thoughtful and careful editing.

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