

# Early Contacts

## On the Ultra-High Frequencies

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**Initial note on band activity and the definition of “contact”.** Ultra-high activity was so technically challenging in the early days of wireless that many amateurs engaged in great activities on the higher frequencies without actually establishing a “contact”, as that term is commonly used today. At first, demonstrations were common – a transmitter (of sorts) would be set up in a room, and a receiver (of sorts) would be placed in another part of the room, with signals emanating from the transmitter. Hertz’s initial experiments in 1887 were of this type, as well as a 400 Mc ARRL demonstration in 1927. The relaying of information between stations without a direct QSO, as was commonly done on the short waves, also became a standard way of communicating on the ultra-highs. The very first 5 Meter activity in 1924 was conducted in this manner. Duplex work was also commonly employed, with an amateur receiving on one frequency and then sending back on another. Some of the earliest activity on 224 Mc was conducted in this manner, and the first trans-Atlantic contact on 56 Mc also was done duplex to 28 Mc.

Throughout the early years of amateur radio, operators were quite capable of conveying information from one station to another without a direct two-way type of contact being made. Simple reception reports were often considered sufficient, and relays were the norm. Indeed, the early UHF contests awarded 1 point for the reception of information, and 2 points for the re-transmission of the information through a relay to another station. There was no requirement imposed on the participants of making a direct “QSO”.

Two-way QSO’s were considered rather extraordinary at the time, and when they would occur, were the subject of a “News Flash” or other write-up in *QST*. It wasn’t until the 1950’s that a direct exchange of information on both ends was required to have a valid amateur “contact”. With the development of meteor scatter and EME, protocols were established within the amateur community to determine how and to what extent the intermittent exchange of signals could constitute a valid and complete contact between parties. Of particular note, see Ed Tilton’s column on the requirements for a valid contact, *QST*, March, 1957. Even then, some of the UHF contests still employed the 1 point / reception rule. Tilton’s definition of a contact being a complete exchange of information between two stations ultimately became the basis for ARRL contest contacts. (See, General Rule 3.2). A wonderful article by Emil Pocock recently delved into the issue of valid contacts. See, *QST*, Sept. 2002, at 73. .

Throughout this outline on early ultra-high band activity, attention is given to the nature of the contact being made, whether through a demonstration, test, relay, duplex, or direct QSO.

**Initial Note on the nature of “contests”.** VHF contests have generated not only increased band activity, they have also provided amateurs with an opportunity to advance and improve their station equipment and operating abilities. Contests have been an important factor in the development and usage of the ultra-high frequencies.

Just as the definition of a “QSO” has evolved over the years, UHF contesting activity has also gone through a maturation process. To better understand the propagation on the various frequencies, tests were initially conducted on the ultra-high bands. The monthly tests on 56 Mc in the mid 1920’s are examples. Gradually, these tests gave way to “DX Parties”, “CQ Parties”, and “QSO Parties” in which stations would be awarded varying amounts of points for receiving and / or relaying information between participating stations. The higher scoring stations would be referred to as “contact leaders”, instead of “winners”. UHF Relays had more of the trappings of a “contest”, but even then, simple “rules of the game” were used instead of the very involved rules set we know of today. Year-long UHF Marathons also were developed, so as to provide additional time to engage in relays. In many instances, additional points were awarded for distance traveled between relays.

ARRL section multipliers started with the development of the VHF Sweepstakes and VHF QSO Parties. Patterned after the HF SS that began in the 1930’s, the VHF SS of 1948 was the first of the modern-day VHF contest. Still, no QSO points for the higher bands were awarded in the VHF SS for many years, and the one-station contact rule (regardless of band used) stayed with the VHF Sweeps for three decades. It was only with the modernization of the rules set starting in the mid 1970’s that the VHF contests began to resemble the current day events, complete with QSO points per band (starting in the VHF SS in 1978), grid multipliers (starting in the Spring Sprints in 1983), and multiple categories (beginning with the QRP class in September, 1986).

In whatever format the contests took, the first contest activity on a band often lagged behind the initial band activity, and by a number of years. The 40 year absence of contest activity after the initial contact occurred on 21,000 Mc is a case in point. Occasionally, the first, or among the first contacts on a new UHF band would be a contest QSO, but the development of regular contest QSO’s on a band has been an indication of a certain degree of maturation of equipment and band activity.

Care is taken in this outline to identify the type of contest in which initial band contacts were made in the VHF contests.

**Note on “first” contacts.** This outline presents the first reported contact on a band or in a VHF contest. There probably are other contacts prior to the ones noted here, but only contacts that can be documented either through ARRL publications, *CQ* references, or by direct confirmation with the stations involved are included. Anyone with knowledge of reported contacts that pre-date those mentioned here should convey the information to [w9gka@arrl.net](mailto:w9gka@arrl.net).

The following summary is a rendition of the early contacts on each band. While there are some references to distance records achieved on each band, there is no attempt to develop a complete chronological sequence of DX band records. Instead, the objective of this document is to reference only the earliest contacts and first contest QSO's on each VHF / UHF band. Contacts on 28 Mc through 400 Mc have been noted to the start of WWII, while QSO's on 1215 Mc through 21,000 Mc have been detailed through the post WWII period. Activities on 47 GHz and above have been summarized starting in 1975, when band allocations were made for many of the microwave bands. The sequence of events on 902 starts in 1982, and was chronicled for a few years beyond band authorization in 1986.

**56 Mc.** Amateurs were authorized use of "5 meters" in July, 1924, marking the very beginning of the ultra-high era in amateur radio. Initially, 5 Meters was viewed as a short wavelength, but it quickly became apparent that the band was radically different from the 110, 80, or the other short waves. Articles began to note 5-meters as an "Ultra-High Frequency", abbreviated as "U.H.F." 5 Meter frequencies were more specifically assigned in October, 1927 as being between 56,000 kc and 64,000 kc. In January, 1929, the spectrum was limited to the internationally recognized frequencies of 56,000 to 60,000 kc. Amateurs went off the air Dec. 8, 1941, and were then reauthorized the use of 56 Mc on Nov. 15, 1945. The frequency was shifted to 50-54 Mc (6 meters) in a post WWII realignment of amateur bands, effective March 1, 1946.

- **As to early contacts:** Several one-way experiments and reception reports were made between 1924 and 1926 using very crude and homemade equipment. The first, complete, two-way contact may have been between Boyd Phelps, 2EB, of Long Island, NY and 2NZ, E.S. Strout of Teaneck, NJ. Taking place on January 31, 1927, the total distance traveled was 30 miles, and the transmissions were at 5.19 Meters (QST, March, 1927, at 35).
- The first confirmed transcontinental 56 Mc contact occurred on July 22, 1938 between W1EYM, Fairfield, Ct and W6DNS, San Diego (QST, Sept. 1938, at 21). The MARC-ARRL trophy that was originally designed for the attempted 1936 56 Mc contest was awarded for this contact, and it was the farthest contact ever made on 56 Mc. The next transcontinental QSO on a VHF frequency, that of 50 Mc, would not be made for 8 more years (QST, August, 1946, at 66).
- Vince Dawson, W9ZJB, of Kansas City, Mo, on August 18, 1939 made the first 56 Mc "grand slam", having worked all 9 US area call districts, with several contacts being made by sporadic E. It was considered a major achievement at the time (QST, Dec. 1939, Tilton's first column, at 29).
- The first inter-continental duplex QSO took place on Nov. 24, 1946, when Ed Tilton, W1HDQ, was heard on 50 Mc by British stations G6DH and G5BY. Europe then had no 50 Mc band, so amateurs in the US listened for replies on 28 Mc. G6DH quickly radioed back on 28 Mc "*I am hearing you on 50 megacycles!*" (QST, Jan. 1947, at 50-51). A year later on Nov. 5, 1947, G6DH, under special permission to operate 50

Mc, was the first British station to work across the Atlantic on 6 Meters when he made contact with W1HDQ (VHF Manual, 1<sup>st</sup> ed, at 11).

- The first 50 Mc-only inter-continental contact occurred on March 23, 1947 when W4IUJ, West Palm Beach, Fla worked OA4AE, Lima, Peru (QST, May, 1947, at 61).
- Ed Greybill, W9ZHB, of Zearing, Illinois, was the first person to work WAS on 6 meters. On June 13, 1948, South Carolina was worked, completing the 1<sup>st</sup> 6 meter WAS (Alaska and Hawaii were not yet states). (CQ, August, 1948, at 48). Within a short time, Vince Dawson, now W0ZJB of Gashland, Mo, completed the 2<sup>nd</sup> 6 meter WAS when he worked Vermont in a rare opening to that state.
- **As to the early tests and contests:** 5 Meter tests occurred in July and August of 1926. By 1927, monthly 5-Meter tests were taking place, and regular relaying of messages on 5 Meters were being made between a few stations located a small distance from each other (QST, May, 1927, at 51-52).
- An initial 5 Meter CQ Party was held June 11-12, and June 18-19, 1927. It was in the nature of an activity test and not a real contest, but this 5 Meter event may have been the first organized gathering of amateurs relaying messages on a UHF wavelength. Many contacts on 56 Mc were made, but numerous puzzling questions arose from the event as to propagation characteristics of the band.
- Club or state level 5 Meter QSO Parties were held in early 1932 in New Jersey, Massachusetts, and Connecticut. These events were sparked by amateur interest in the band after publication of QST articles in 1931 on constructing 5-Meter radio equipment.
- The earliest Field Days had some 56 Mc activity. While designed to be an HF portable and emergency preparedness exercise, contacts on 56 Mc occurred in the 1934, 1935, and 1936 FD's, and W1HDQ had the top score on 5 Meters in all three events (QST, Dec. 1939, at 10).
- An contest on 56 Meters was then attempted in 1936. This was a year-long event, and had so few contacts and reports that the event was deemed to be "no competition" (QST, July, 1937, at 35).
- The first true "contest", as we know the term today, may have been an international event sponsored by the RSGB. This was a year long 56 Mc contest run in 1938, and a number of US amateurs participated (QST, Dec, 1937, at 53; Jan. 1938, at 62). W9NY of Milwaukee, Wisconsin led the contest with over 100 contacts (QST, Sept. 1939, at 58).
- 56 Mc contacts were then made in the first domestic-only contest. In the 1939 UHF Relay, 28 ops participated exclusively on 56 Mc. The contact leader was W3AC/3, who operated from a car at High Point, New Jersey! (QST, Nov. 1939, p.26-27+).

**400 Mc.** In March, 1925, 400,000 kc to 401,000 kc. became the second ultra-high band authorized for amateur use. Amateurs went off the air Dec. 8, 1941. Rauthorization of the band occurred following WWII, but the frequency allocation was moved to 420-430 Mc on Jan. 16, 1946, with 430-450 Mc reserved. On June 11, 1947, the entire 420-450 Mc band became available. Eventually, the weak-signal work concentrated at 432 MHz.

- Initially, little activity occurred on this band, due to the exotic and difficult nature of the equipment on these frequencies. For example, tubes had to be modified by hand in order for them to work at these frequencies.
- A  $\frac{3}{4}$  meter transmitter and receiver was demonstrated at the Hudson Division ARRL Convention in New York on June 5, 1927 in a one-way transmission. The band lay dormant for many years thereafter due to continuing technical problems with tubes oscillating unreliably at these frequencies.
- **A 5 mile two-way voice path** between W6GPY and W6ZA was established on 325 Mc by the Spring of 1939, and this contact was described as “below one meter” (QST, May, 1939, at 16). Note that at the time of this contact, all frequencies above 300 Mc were available for experimental use by amateurs.
- On Sept 23, 1940, W6IOJ and W6MYJ engaged in an 11 miles QSO, which was a record distance at the time.
- **The first contest QSO** occurred in the 1941 UHF Marathon between W6IOJ & W6LFN, working a total of 20 miles on January 28, 1941. It was a new record distance on 400 Mc (QST, April 1941, at 53). On an interesting note, later in the same year, on September 14, 1941, W6IOJ once again established a distance record, this time 60 miles, when he worked W6MYJ. (Further distance 400 Mc records post WWII not described in this outline).

**28 Mc.** On March 6, 1928, 28,000 to 30,000 kc was authorized for US amateur usage. At the time, 10 Meters was considered to be a UHF frequency, with many similarities to 5 Meters.

- **The first reported two-way 10-meter contact** was between 3AKW and 3JN on March, 25, 1928. The first 10 meter transcontinental contacts occurred a few day later on April 1, 1928 between 6UF in Knowles, Cal.; 8EX in Cleveland, Ohio; 6DBO, Raymond, Cal.; and 8ALY in Rochester, NY (QST, May 1928, p.46). The earliest inter-continental 10 Meter QSO to Europe occurred on October 21, 1928 (QST, Feb. 1929, at 72). The Pacific was bridged Nov. 9, 1928 when W6UF worked ZL2AC for one hour and forty minutes (QST, Dec. 1928, at I).
- **The first 10-meter contest-like event** was a DX Party that occurred in May, 1928. The highest score was of 2TP, Leonia, NJ, with all of 36 points. (QST, July 1928, p.49-50).

- Other contests followed, some with rather unique rules, but which suited the times. For instance, the League conducted a year-long 28 Mc Contest in 1935, with the winner being W9NY, of Milwaukee, Wisconsin. 256 contacts were made in 128 countries. 1 point was given for every 100 miles of distance between the two stations in the QSO. Equipment description and development was also judged in the event, as well as the submission of weekly reports to the ARRL. Only six operators fully participated in all aspects of the contest, although 13 additional stations submitted one or more weekly reports (QST, Jan, 1936, at 19).
- International QSO's on the band were common by the mid 1930's. WAC was achieved on 10 meters on October 12, 1935 by W3FAR (QST, Dec. 1935, at 11). This was quickly followed up a few hours later by ZS1H completing WAC, and a few days later by W7AMX.
- 28 Mc was no longer considered a UHF band by the late 1930's, as 10 Meters was not included in the bands listed in the 1939 UHF Relay Announcement (QST, Sept. 1939, at 33). Additionally, Ed Tilton's famous column, beginning in December, 1939, focused on 56 Mc and above and was initially entitled "On the Ultra-Highs" (although Tilton would still write 28 Mc equipment articles, with one article in particular, that of portable 6 and 2 meter rigs, having great similarity to the Heathkit Lunchboxes of the future; QST, June, 1946, at 31).

**112 Mc.** In June, 1934, amateurs were authorized the non-exclusive right to operate at all frequencies above 110,000 kc on an experimental basis (QST, August, 1934, at 32). The League quickly moved towards developing activity on 112 to 120 Mc and 224 to 240 Mc, (QST, June, 1934, at 7-8; Sept. 1934, at 13). In 1936, the FCC reserved 112 to 118 Mc as a future amateur band, and then expressly granted amateur privileges on Dec. 1, 1938 (QST, Dec. 1938, at 13). Amateurs went off the air Dec. 8, 1941, and were then reauthorized the use of 112 Mc from August 21, 1945 until March 1, 1946. The frequency was shifted by the FCC to 144-148 Mc on Nov. 15, 1945, and today is our 2 meter band.

- **First contact on band:** Local two-way contacts were being made on this band by early 1935 in the New York area and Boston (QST, March, 1935, at 98), but no citation could be found as to specific dates or stations.
- A 90 mile 112 Mc path between Hartford, Ct and Boston was established by March, 1935 with W1HBD and W1XW as the operators, and was part of very extensive 56 Mc tests conducted by Ross Hull and others on propagation characteristics of ultra-high frequencies. This may be the earliest reported contact with specific information (QST, March, 1935, at 16).
- A 142 mile one-way transmission was evidently made at Mt. Washington, NH in 1935 on 122 Mc, but the reference contained no details as to operator call-signs (QST, 9-39, at 62).

- On August 13, 1939, a two hour, two-way QSO was accomplished over 120 miles in Colorado between W9WVX and W9VTK using a transmitter built as per a W5CSU construction article in 1938. These two operators extended the distance to 160 miles on Oct. 8, 1939, working between Pikes Peak, Colorado and Cheyenne, Wyoming (QST, Dec. 1939, at 31; May, 1940, at 52). This was a record distance at the time.
- **The band was first used in a contest** in the 1939 UHF Relay, #2. Numerous stations passed relays on 112 Mc (QST, 2-1940, at 52-53).
- The DX record was extended to 200 miles by W6BCX and W6OIN on April 28, 1940; 206 miles was accomplished over FD weekend, 1940 from the same spot as in April, 1940 (but with different operators); 255 miles was achieved on July 4, 1940 by W6BJI/6 at Tulare, California, and W6KIN/6 at Mt. St. Helena; and this record was broken on October 5, 1940 by W2LAU and W1MON (QST, June, 1940, at 64; Dec 1940, at 53). The final pre-WWII record was established on August 21, 1941, by W2MPY/1 and W1JFF, for a distance of 335 miles. (QST, Dec. 1945, at 62).
- Farther distances would have to wait until after WWII, and the beginning of the more modern 2 Meter band at 144 Mc. Distance records post WWII on 2 meters are not included in this outline, and Tilton listed records on both 112 Mc and 144 Mc (QST, March, 1946, at 68).

**224 Mc.** The League encouraged development of this band in June, 1934, after the FCC allowed access to all frequencies on an experimental basis above 110,000 kc. In 1936, the FCC reserved 224-230 Mc as a future amateur band, and then on Dec.1, 1938, the band was specifically authorized for amateur usage. The unassigned and experimental, non-exclusive frequencies were then moved from 110 Mc to 300 Mc (QST, Dec. 1938, at 133). After WWII on March 13, 1946, the band was shifted to 235-240 Mc, but then was moved to 220-225 Mc on April 28, 1948. In August, 1991, amateurs lost the bottom 2 MHz to commercial interests. In 1995, 219-200 MHz was allocated to amateur use for the sole purpose of fixed point-to-point digital message forwarding system, including packet backbone networks. Currently, the band is referred to as 222 MHz.

- **First contact on the band:** Sometime before November, 1934, Ross Hull engaged in a 35 mile duplex type of contact using 56 Mc one way and 224 Mc the other (QST, Nov. 1934, at 8).
- Another duplex contact occurred in late 1934 from Mt. Wachusetts, Mass between W9BOE and W1AL, for a distance of 75 miles. 224 Mc was used on one end, while 56 Mc was used on the other (QST, Jan. 1935, at 35).
- One-way broadcast type of portable “pack sets” were designed and in use for 200 to 300 Mc interviews and auditorium work by March, 1938. Using acorn type tubes, these small units provided audio for radio and TV feeds at broadcast stations.

Distance traveled was less than a mile. Amateurs involved included W9XXT, W9XXU, and W9UNJ (QST, March, 1938, at 40 +).

- A 92 mile effort occurred on 225 Mc at Mt Washington, NH in 1939 (QST, 9-39, at 62). The transmission appeared to be a one-way contact from Mt. Washington. The reference also notes a one-way test at MIT of 10 miles with the same transmitter on May, 18, 1938.
- Confirmed two-way communications existed by September, 1939 in the Washington, DC area, with local paths of over 4 miles. W3AWS, W3FQB, W3EIS used acorn-type tube receivers (QST, Sept. 1939, at 59).
- Local two-way contacts of up to 18 miles were being reported in late 1939 in the Boston area. Western Electric doorknobs were being used, for about 8 watts of output. W1KH, W1HSV, W1BZR, W1CCX, and W1BJB were all noted as being on 224 Mc (QST, Dec. 1939, at 31).
- The 1939 QSO's in the Boston area were not submitted as DX records to Ed Tilton's new column, and the farthest "record contacts" through the summer of 1940 stood at under 20 miles. Then, W1COO (at Mt. Washington), and W1JK (at Exeter, NH) worked 90 miles on July 13, 1940; W6IOJ and W6LFN had a 135 mile QSO on August 18, 1940 between San Diego and Los Angeles for a DX record on the band.
- **First used in a contest:** W1AIY made one 224 Mc contact in the January, 1940 UHF Marathon. Seven contacts were made in the February version of the Marathon. Also in February, the Third UHF Contest and Relay, 1940, also saw 224 Mc activity from three stations. (QST, March, 1940, at 106; April, 1940, at 92; June, 1940, at 116).

**5,300 Mc.** 5250 – 5650 Mc became available for amateur use in Nov. 15, 1945, but then was reallocated on Sept. 10, 1946 to 5650-5850 Mc. The top frequency was extended by 1954 to 5925 Mc.

- **The first contact** on 5300 Mc occurred on the first date of availability on November, 15, 1945 when W2LFG and W6BMS/2 in New York used war surplus equipment to make a two hour voice duplex contact. The transmissions covered 5 miles, and klystron tubes were used. (QST, Jan. 1946, at 19; UHF/Microwave Experimenters Manual, at 1-7). The equipment for this contact has been referred to as the "first amateur microwave station" (VHF Manual, 1<sup>st</sup> ed, at 13).
- Using the same equipment as for the November contact, W2LGF worked W7FQF/2 on December 2, 1945 at 5250 Mc over a 31 mile path in New York. 2 meter rigs taken along could not make contact over the same path (QST, Jan, 1946, at 116).
- It took another 11 years before the distance record was extended to 34 miles. On Oct. 12, 1957, W6VIX and K6BML made a contact between San Bernardino and South Pomona, Ca. Klystrons were used for power, and an eight foot parabola was used for



an antenna on one end. The contact probably was the first amateur use of the band since it shifted in 1946 to 5650-5925 Mc. (CQ, 12-57, at 58).

- On Sept. 25, 1965, WB6JZY and WA6KKK operated from Copernicus Peak at Mt. Hamilton and Sentinel Dome at Yosemite and made a 120 miles contact. (CQ, Dec. 1965, at 71).
- **The first known contact in a contest** on this band occurred in the 1961 June VHF QSO Party by K1DIT, who used all 10 bands between 50 and 21,000 Mc (QST, Sept, 1961, at 29).

**2,400 Mc.** 2300-2450 Mc became available for amateur use on Nov. 15, 1945. On Nov. 8, 1984, the band was split into two segments, 2300-2310; and 2390-2450 MHz, due to telemetry systems for aircraft and missiles being assigned to the 2310-2390 MHz range.

- **The first contact** on 2410 Mc took place on April 29, 1946 between W9WHM/2 and W6OJK/2 using a lighthouse tube for the transceiver and an electric heater as a parasitic reflector. The QSO spanned 0.7 miles with 50 to 100 milliwatts of output and lasted for 15 minutes (UHF/Microwave Experimenters Manual, at 1-8; QST, June, 1946, at 126; July, 1946, at 32).
- On June 23, 1946, W1JSM/1 and W1ILS/1 operating on 2375 and 2350 Mc, extended the DX record on the band to 1.6 miles, having all of 100 milliwatts (QST, August, 1946, at 150). Ironically, the contact was done during a Field day exercise, making this the first contest QSO on the 2,400 Mc band. (QST, Feb. 1947, at 48).
- The record distance was extended by W6IFE as a portable, working his own fixed station operated by W6IMZ, for a distance of 24.6 miles, on May 24, 1947. (QST, August, 1947, at 118).
- This distance was increased by W1ILS/1, operating at Blue Hill Observatory, Milton, Mass., and W1JSM/1 at Mt. Wachuset, Princeton, Mass, for a distance of 45 miles on August 30, 1947. The output power was 100 milliwatts (QST, Nov. 1947, at 128). The pair then advanced their own record a few months later on Oct. 5, 1947, when they worked 66 miles between Mt. Wachuset and Mt. Greylock (W1OTH was also active in the contact on this day). The same equipment was used for the 2<sup>nd</sup> contact.
- W6IFE/6 and W6ET/6 extended the distance to 150 miles on April 25, 1948 between Mt. Hamilton and General Grant Park, Ca. W6BON assisted W6ET. W6ET was assisted by his XYL (QST, 12-48, at 124; CQ, 6-48, at 74; CQ, 7-48, at 80).
- **Ironically, the first contest QSO** occurred in a Field Day on June 23, 1946; between W1JSM/1 and W1ILS/1 at 1.6 miles, and 100 mw (CQ, 3-48, at 24). Several groups worked various UHF frequencies, including 50 Mc, 144 Mc, 420 Mc and 2400 Mc, as a VHF only category had been tried out in the 1946 FD rules.

- The first reported VHF contest QSO occurred in the 1949 June VHF QSO Party, by W9GLY, Chicago (*QST*, August, 1949, at 38).

**10,000 Mc.** 10,000 to 10,500 Mc became available for amateur use in November, 1945.

- **The first QSO** took place on May 5, 1946, when W1LZV/2 worked W2JN/2 in New Jersey over a distance of 2 miles at 10,300 Mc. Power output was 25 milliwatts (*QST*, July, 1946, at 140).
- The DX record on the band was increased to 7.65 miles when W6IFE/3 worked W4HPJ/3 in the Washington, DC area on July 11, 1946 on a split frequency of 10,010 and 10,040 Mc. Parabolic reflectors 30 inches in diameter were used (*QST*, Sept. 1946, at 152).
- An interesting contact occurred in late 1947 at Corpus Christi, Texas when two amateurs and Navy operators used their military radar transmitters on 10,000 Mc to work each other by reflecting their signals off a group of oil tanks located 10 ½ miles away (*QST*, Nov. 1947, at 128).
- In October, 1954, W7OKV and W7JIP made a 10,000 Mc contact over a 109 mile distance (*UHF / Microwave Manual*, at 1-9).
- On July 25, 1959, W7JIP and W7LHL extended the record to 187 miles, working between Oregon and Washington. By July, 1960, the amateurs even went further, to 265 miles (*UHF / Microwave Manual*, at 1-11).
- Today, making 10 Ghz contacts have become a favorite weekend pastime in the UK, Denmark, and many other European locales. A duct over the Mediterranean Sea was established in the 1990's, with some spectacular results.
- **The first reported contest QSO** was in the 1955 January VHF SS, between W7JIP & W7OKV (*QST*, April, 1955, at 57). 10,000 Mc may have been first used in a CQ sponsored event in the April 1957 VHF contest, when W8NRM, Ohio, made one contact on that band (*CQ*, August, 1957, at 45).

**21,000 Mc.** The frequencies between 21,000 to 22,000 Mc became available for amateur use on Nov. 15, 1945, and were the highest allocated amateur frequencies at the time. In 1946, the band was shifted one megacycle to 22,000 to 23,000 Mc. The band again shifted upward on Nov. 14, 1975 to 24.0-24.25 GHz.

- **The first QSO** on the band occurred on May 18, 1946 between A. H. Sharbaugh, W1NVL/2 and R.L. Watters, W9SAD/2, working in Schenectady, New York on a frequency of 21,900 Mc. They enjoyed duplex voice communication for over an hour at a distance of 800 feet. The tube employed for both receiving and transmitting was developed during the war by GE (*QST*, August 1946, at 19; July, 1946, at 140; *UHF/Microwave Experimenters Manual*, at 1-8).

- Little activity occurred in the early years of this band, and the 800 foot record stood for over a decade. Sharbaugh and Watters made a 14 mile contact in Oct. 1958 (UHF / Microwave Manual, at 1-10; QST, Nov. 1964, at 98; May, 1959, at 11). Horn antennas were aimed visually using field glasses.
- Five years later, Sharbaugh (now with the call, W2UKL) pushed the record to 27 miles when he worked WA2VWI on Oct. 24, 1964 over 27 miles (QST, April, 1965, at 26; Dec. 1968, at 150). All of the Sharbaugh and Watters contacts on both 21,000 and 50,000 Mc used klystrons and FM voice modulation.
- **The first reported contest** contact may have been from K1DIT in the 1961 June VHF, with his 10 band effort, who also had the first reported contest contact on 5,700 Mc. See, *QST*, Sept, 1961, at 29.
- No documented contest activity occurred again until June, 1981, when W2SZ/1 made one contact on the band. The same multi group used 24 G a few months later in the September 1981 QSO Party. By the following June VHF in 1982, at least two other multi groups were on 24G.
- With surplus equipment becoming available by the early 1980's, great activity then occurred in both Europe and the US, with distances steadily increasing throughout the 1980s' and 1990's. By the end of the 1990's, distances of greater than 265 km in the US and 400 km in Europe had been achieved (QST, August, 1999, at 78).

**3,300 Mc.** The frequencies of 3300-3500 Mc was allocated to amateur service on Sept 10, 1946. The frequency shifted in June 1958 to 3500 to 3700 Mc, and then once again shifted back to the original frequencies in 1962.

- **The first contact** on the band was by W6IFE on June 5, 1947 in a portable station built in his panel truck, with W6IMZ using W6IFE's fixed station; distance was 20.2 miles. A waveguide was fashioned from home-made tin cans soldered together (QST, August, 1947, at 130; UHF/Microwave Experimenters Manual, at 1-8).
- W6YX worked W6VQB/6 on Sept. 20, 1947 for a distance of 31 miles between Mt. Hamilton and Stanford University, using reflex klystrons and 28 inch parabola reflectors. (QST, Nov. 1947, at 53).
- A few days later on Oct. 5, 1947, W1OTH and W1JSM worked 66 miles, but then was bettered only a few hours later by W6IFE/6 and W6ET/6, working between Mt. Hamilton and Grant National Park on the West Coast, for a distance of 150 miles (QST, Nov. 1947, at 49; Dec. 1947, at 128; CQ, 3-48, at 24).
- **The earliest documented contest QSO's** on 3300 Mc took place in the 1955 June VHF QSO Party, with activity coming from both coasts. The San Bernardino Microwave Society operated a multi, W6VIX/6 on 6, 2, 220, 420, 2400, and 3300

Mc. Known operators at this station included W6VIX, K6GMV, K6HXM and W6JMY. Their contact total was the highest in VHF contest history. On the East Coast, W1UIZ/1 & W1IUN/1 made one 3300 Mc contact in the contest, with W1IUN using equipment initially built in 1947 (*QST*, Sept, 1955, at 56).

**1215 Mc.** 1215-1295 Mc became available Jan. 16, 1946. On March 1, 1986, the band shifted to 1240-1300 Mc in an implementation of WARC 79, and is today generally known as “1296” Mc.

- **The first contact** on the band occurred in May, 1947 when W1BBM made a contact with W1ARC some 0.4 miles away using lighthouse tubes and parabolic reflectors. (May, 1947, at 136).
- This modest distance was increased to 12.5 miles on Sept. 24, 1947 by W3MLN/3 and W3HFW/3 in Pennsylvania (*QST*, Nov. 1947, at 128).
- By 1958, distances that could be covered had increased substantially. W6QDI and W6MMU operated from Mt. Pines (8830 ft) and Mt. Hamilton (4420 ft) to complete a 225 mile contact. Then on Sept. 21, 1958, W6MMU/6 worked K6AXN/6 for a distance of 270 miles. Both stations were camped out on the 8,000 foot peaks of Mt. Diablo and Mt. Pinos.
- K6AXN broke his own distance record in the 1959 June VHF QSO Party, when he worked W6DQJ over 400 miles. 10 watts was used with crystal controlled converters. (UHF / Microwave Manual, at 1-11).
- **The first known contest QSO** took place in the 1951 Sept VHF QSO Party, by John Chambers, W6NLZ, of Los Angeles, who was also likely the first person to work six bands in a VHF contest - 6 Meters through 2400 Mc, including 1215 Mc. (*QST*, Dec. 1951, at 66). W8NRM of Ohio may have been the 1<sup>st</sup> person to make a 1,215 Mc contact in a CQ VHF contest (April VHF contest, 1957; *CQ*, August, 1957, at 45).

**Above 30,000 Mc.** Following WWII, microwave frequencies above 30,000 Mc were unassigned, and could be used by amateurs for experimental work. The following contacts are illustrative of amateur activities in the microwave region.

- On July 17, 1957, W6NSV and K6YYF used the roof of the Hughes Aircraft building in Culver City, California, as well as Hughes radio equipment to make a contact some 500 feet in distance **at 36,500 Mc**. The distance could have been considerably greater, had only the roof been longer! (UHF/Microwave Experimenters Manual, at 1-9). Four decades later, Hughes radio equipment would also be used to make the first contacts on even higher frequencies (see, 75 and 241 GHz contest contacts, below).
- On Sept. 1, 1968, W7CAF and WA7EDI, made a record contact of 3,750 feet distance. The frequency was only specified as “Above 30,000 Mc” (*QST*, Dec. 1968, at 150).

- In addition to making the first contact on 21,000 Mc (see above), Sharbaugh and Watters (by now, W2UKL and W2SAD, respectively) are credited with the first QSO on **50,000 Mc** in October, 1958. RF power was estimated at 1 microwatt, and the contact spanned 150 feet. This was the highest frequency reached by amateurs until light wave experiments occurred in the 1970's and 48 GHz contest activity occurred in 1982.

**Light.** The frequencies above 300 GHz are unassigned, and can be used for amateur experimental purposes. DX Records have generally divided the light spectrum into two ranges: one at 448-475 THz (red light), and another at 675 THz (lower ultra-violet).

- In a historic scientific paper in 1958, A.L. Schawlow and C.H. Townes proposed a method of constructing a device that would produce coherent radiation at optical wavelengths. In 1960, Theodore Maiman, working at the Hughes Aircraft Corp, used this research to produce a beam of coherent red light at a single frequency. A ruby crystal generated the light. In February, 1961, scientists at Bell Labs achieved the first continuous operation of a quartz gas laser using a mixture of helium and neon. A semi-conductor diode driven by an electric current generated coherent light in November, 1962. This feat was accomplished by scientists at IBM, GE, and MIT, and the device was referred to as Electron Injection or Junction laser (CQ, 8-64, at 24; 9-64, at 32).
- A one-way laser communication demonstration occurred on May 3 and 4, 1963. The Radio Club of Electro-Optical Systems of Pasadena transmitted a voice message 118 miles across the California desert on 464 THz. W6POP and W6QYY were the amateurs involved (UHF / Microwave Manual, at 1-13). Many other audio and even video laser transmissions were also occurring by 1963 in labs around the country.
- The United States Air Force Academy in Colorado may have been the setting **for the first two-way amateur laser contact.** WA8WEJ/0 and W4UDS/0 established a 950 foot QSO on February 25, 1971 **on 475 Terahertz (THz)**, using red lasers. (UHF / Microwave Manual, at 1-13).
- Another 474 THz QSO occurred between K6MEP and WA6EJO on June 9, 1991 over 92 km. This was a record DX contact at the time for this frequency of light (QST, April, 1993, at 90). This contact occurred during the June VHF QSO Party (CQ, 10-91, at 62).
- KC7AED and N7VUB made a record 192.4 km contact from Four Peaks, Arizona to WB7VVD and KC7PCV at Smith Peak on Sept. 21, 1997. A helium-neon (red) laser was used at 474 THz, running 5 mw of power, with 16 inch fresnel lens, photomultipliers and audio amps. CW was run by interrupting the laser beam (QST, Dec. 1997, at 88).

- On June 7, 1991, a new distance record was achieved at 153.97 miles (247 km), and the QSO was made by a group of amateurs including KY7B, WA7CJO, WA7LYI. (QST, Feb. 1992, at 94). **This contact was at 678 THz**, and was a record distance for the segment of light. The contact was made between Towers Mountain, south of Phoenix and Mt. Lemmon 150 miles to the south. A 15 mw helium cadmium laser was used (CQ, 9-91, at 46).
- **The first contest QSO** in the light range may have occurred in the 1979 June VHF QSO Party, when W6OAL worked for 22 miles to K6MEP on 474.1 THz. A 3 mw Helium Neon laser was used in the effort. This probably was a record distance at the time, as almost all contacts occurring prior to this effort were short-range in nature, conducted under laboratory conditions. Indeed, the amateurs making the 1979 contact felt that it was the first “legitimate” light QSO, as all other attempts were under artificial conditions (QST, Sept. 1979, at 71).
- A light wave contest QSO was first noted as “L” in the line scores in the 1982 June VHF QSO Party, when the multi group W1FC made a contact on Light. No note was made as to the distances involved (From, QST, Sept. 1982, at 78).

**47 GHz.** The FCC allocated 48-50 GHz to amateur use on Nov. 14, 1975. WARC 79 changed the frequency allocations of this band to 47.0 to 47.2 GHz, effective March 1, 1986.

- See the above 50,000 Mc contact by Sharbaugh and Watters In Oct. 1958. This was probably the first QSO at this general frequency range.
- The band laid completely dormant for many years after its initial authorization in 1975. This was likely due to the complexities of the equipment involved.
- The famous multi-op group, W2SZ/1, **made the first reported contest QSO** on 47 GHz. Operating all bands through 47g in the 1982 June VHF QSO Party, W2SZ set a new record for the multi category (QST, Sept. 1982, at 77). This may have also been **the first reported contact on the band**, as no earlier band activity could be found, and there were no previously documented contacts to comprise a DX record on the band (See, QST, July, 1982, at 68).
- Two months later in the 1982 August UHF, the first 48G contact in the West Coast was made by the K7AUO group.
- A 47 GHz international contact occurred on Jan. 13, 1985, when HB9MIN and HB9AMH made a 33 mile (53 km) QSO. 10 mw and 25 mw Gunn oscillators were used (UHF / Microwave Manual, at 1-19; QST, Oct. 1985, at 63). This contact was a record distance, for the time. Earlier contacts on 47 G between these two operators occurred on Dec. 26 and 29, 1984. (QST, March, 1987, at 78, has the 53 km contact being made on June 11, 1984).

- Oregon hams experimented with the band in 1987. On March 6, 5.42 miles was traversed, possibly for a North American DX record (QST, June, 1987, at 62). A few days later, a 47 G SSB QSO occurred, when the same group, led by WA3RMX and WB7UNU / W7TYR, worked over a 13.92 mile path. (QST, July, 1987, at 61 and 62). This distance was extended in the 1988 August UHF contest when WA3RMX and K7AUO made a 47 G contact over a 65.37 mile (105 km) path. A 3.5 mw transmitter was used in the efforts (UHF / Microwave manual, at 1-17; QST, Dec. 1988, at 87).
- On Sept 15, 1992, Erich Zimmerman, HB9MIN, and Fred Staempfli, HB9MIO, had a QSO over 166 Km. They used narrow band “constant amplitude” SSB and ran 8 mw into 2 meter dishes (CQ, 3-93, at 90).
- HB9MIN and DF7FJ made a 184 km record distance QSO on Oct. 5, 1994 (QST, April, 1996, at 99).
- 162 km contact was accomplished by DB6NT and OZA9ZI on 47 G during the Danish Microwave Activity Week, June 15 to 21, 1996. 100 mw was the power level at OZ9ZI (QST, April, 1997, at 89).
- A UK distance record QSO on 47G was made on Oct. 25, 1977, by G3FYX and G4KNZ. 65 km was traversed using 100 mw gunn diode transmitters. Initial contact was established on 24G, just to align the antennas (QST, Feb. 1988, at 88).
- On April 5, 1998, WA1ZMS/4 and K2AD/4 worked on 47 G for over 109 km in the Virginia mountains. 100 mw gunn oscillators were used with frequency multipliers. A 35 minute QSO was achieved on FM wide-band. On May 8-9, 1998, the pair then used the W2SZ/4 call-sign to work 5 grids on 47G for the first VUCC on the band. One of the contacts occurred over 114 km (QST, July 1998, at 84).
- On May 15, 1998, F6BVA and F5CAU worked over 193 km, for a world DX record distance (QST, August, 1999, at 78).
- The UK distance record was extended on Sept. 12, 1999 to 161 km during the third UK 24/47 GHz Contest. G7MRF and G8VZT set up one station in Wales while G0HWN operated from Cumbria, in the north of England. (QST, Dec. 1999, at 80).
- The US record was broken on Dec. 8, 1999, when W0EOM and KF6KVG worked each other over a 135 km path in California. Transmitters were running 10 and 40 mw of power. (QST, March, 2000, at 88).
- An Australian record of 45 km was established on April 23, 2000, by VK5ZAY and VK6TRG, running 1 to 2 mw of power (QST, August 2000, at 93).
- The English team of GW0IVA and GM0HWN with GM7MRF made a 47 GHz contact over a 203 km path on Oct. 21, 2001. The QSO traveled from Wales to

Scotland. DB6NT transverters were used, generating 24 mw QST, March, 2002, at 87).

- Americans W3IY and W4SW made a 174 km mountaintop contact between Pennsylvania and Skyline drive in Virginia in Nov. 2001. 20 and 30 mw transmitters were used (QST, April, 2002, at 81).
- W6QI and AD6FP established a world record distance of 290 km (E-mail of AD6FP), completing a contact over 290 km (details in CQ, 12-2004, at 80).

**75 GHz.** The frequencies of 71-76 GHz were allocated to amateur use on Nov. 14, 1975. The band was shifted to 75.5 to 81.0 GHz as a result of WARC 79, effective March 1, 1986. In 1998, the band was split to allow auto avoidance radar in the 76 to 77 GHz range. The band now is: 75.5-76.0 GHz, and 77.0-81.0 GHz, with operating privileges suspended between 76 and 77 GHz.

- **The first contact** on this band may have been a split frequency duplex QSO involving West Germans. On Dec. 10, 1985, DL5KR, DL6KAM, and N4CDS/DJ0KP had a QSO over 29 miles using 77 GHz and 430 MHz. A 10 mw, Gunn oscillator was used on 77 G. The receiving system was a radio telescope site at the University of Cologne, and the return path was through the 70 cm Cologne repeater (UHF / Microwave Manual, at 1-19).
- On June 6, 1987, OE9FKI and OE9PMJ worked 1.3 miles (2.1 km) on 75 GHz (QST, Feb. 1992, at 94). This was the first DX record on the band that was noted by Tynan. In fact, it may be **the first two-way QSO** on the band, as no prior documented QSO has been found.
- At some point before Spring, 1993, HB9MIN made a contact of 0.5 km on the band, but no other information is available about the QSO (QST, April, 1993, at 91).
- On June 6-12, 1993, during the Danish GHz Activity Week, OZ1IUM and OZ/DB6NT made a 8.8 km SSB QSO on 76 GHz. Both stations ran a few microwatts to a 25 cm dish antenna (QST, Nov. 1993, at 101; CQ, 12-93, at 120). The two operators then made a 11 km contact in the next year's Danish event, June 1994 (QST, April, 1995, at 99).
- On July 7, 1995, HB9MIO and DK4GD made a 114 km contact on 76 GHz, running 2 mw on cw with 30 and 40 cm dishes (QST, Dec. 1995, at 98).
- **The first reported contest contact** occurred in the 1997 January VHF SS, with NS6X operating almost everything from 6 meters through light. Making contact with his daughter, KB6JVV, and using equipment borrowed from the Hughes satellite communication division, the line score lists all bands except for 119 GHz. QRP levels were used on all bands, and NS6X scored 2<sup>nd</sup> in the nation in the QRP Portable



category (*QST*, June, 1997, at 106, 107). This also was probably **the first US contact on 76GHz**, as no other contact could be documented prior to 1997.

- On Nov. 28, 1997, AA6IW and W0EOM had a two-way QSO over a 4.6 km path in Stanford, Ca. Both stations used harmonic multipliers, with one station at 2 mw and the other at less than 1 mw of output. They extended this on Dec. 11 to 12.7 km by using CW. These two contacts were the 2<sup>nd</sup> and 3<sup>rd</sup> 76G contact on the North American contact, and established the initial US distance record on the band. The QSO was reported as being the “first ever” 76G QSO on the North American continent, in spite of the 1997 January VHF SS contact by NS6X being prominently mentioned in contest write-ups. This was likely due to the contest QSO never being claimed as a DX record.
- WA1ZMS worked K2AD on April 5, 1999 over 34 km in Virginia. Starting with a 12 GHz LO, the equipment was tripled to 37 GHz, and then doubled with diode mixers (*QST*, July 1999, at 78).
- Then, WA1ZMS, K2AD and WA4RTS completed several additional 75 GHz contacts from May 1 through May 20 to obtain the first VUCC award on the band on June 1, 1999, using the call W2SZ. The farthest contact was 114 km (or possibly 110 km), for a US and possibly, a world, DX record. All contacts were on CW using a 12 GHz LO, and fed to a multiplier chain, for 10 mw of output (*QST*, August, 1999, at 77).
- W0EOM and KF6KVG worked over an amazing 145 km path on 75 GHz on Feb. 1, 2001 (*QST*, May 2001, at 94). A 12 inch dish and 1 mw output was used on one end of the QSO (*CQ*, 5-2001, at 96).
- A 151 km QSO occurred in Japan on Nov. 16, 2001. The operators, JA1ELV and JA1KVN, ran from Mt. Fuji and Mt. Tsukuba with 1 mw and 3 mw of power (*QST*, Feb. 2002; March 2002, at 87; *CQ*, 3-2002, at 96).
- A world DX record was set in March, 2002 at 177 km between AD6FP, KF6KVG, and W0EOM (e-mail of AD6FP).

**902 MHz.** On Sept. 28, 1985, 902-928 MHz was allocated to amateur use.

- Amazingly, **the first experiments** on the band occurred three years prior to authorization to amateurs. In an incredible effort, W4WD and W6PO conducted EME experiments on 902 MHz in the summer of 1982 under an experimental license designation granted by the FCC (*QST*, Oct. 1982, at 71). K2BLA also obtained an experimental license, and conducted tests in 1984 (*QST*, Jan. 1985, at 27).
- The band authorization was well publicized in advance, with several technical construction articles appearing in *QST* on 902 equipment and antennas. When the band opened in September 1985, several amateurs around the nation were among the

first to make initial contacts on the band, but no specific documented information exists as to initial contacts on the band prior to January, 1986.

- The 1986 January VHF SS **was the first contest** in which 902 MHz was authorized. 11 operators made contacts on 902 in this contest (*QST*, June, 1986, at 78).
- The initial DX record was established on Christmas Eve, 1986 when W2PGC worked K3SIW/9 over 480 miles in a major tropo opening over much of the Eastern half of the country (*QST*, March, 1987, at 78).
- This record was extended on March 22, 1988 to 623 miles by WB5LUA and W4ODW (*CQ*, 8-88, at 98; *QST*, Feb. 1992, at 94); and by 1992, 1072 miles was achieved by WB5LUA and W4WSR (*QST*, Jan. 1992, at 94).
- On Augst 23, 1993, Chip Angle, N6CA and Paul Lieb, KH6ME, used the Hawaii Pacific Duct to achieve an over water record of 2,469 miles on 902. This follows their Hawaii contacts of similar distances on 34566 and 5760 MHz in July, 1991. (*CQ*, 11-93, at 92).

**120 GHz.** This band was initially authorized on March 1, 1986 by WARC 79, and includes the frequencies of 119.98-120.02 GHz. This band has proved very technically difficult to operate on, as it is very close to the oxygen resonance / absorption line. The temperature, dew point, and relative humidity all become critically important at this frequency (and also play a very important role on other SHF bands, as well).

- **First contact:** WA1MBA and WB2BYW completed a 1.15 km QSO on 120G on July 11, 1994 using a 10 microwatt transverter (*QST*, Sept. 1994, at 112; Oct. 1994, at 97; ARRL DX Records; *CQ*, 9-94, at 58).
- W0EOM & KF6KVG had a CW contact of 5.3 km on Nov. 16, 1999 in Redwood City, Ca. Hughes harmonic mixers were used. (*QST*, March 1999, at 87). Later references listed the same operators with a contact on Oct. 19, 1999 at 11.7 km on 120 GHz (*QST*, May, 2000, at 78; April 2002, at 82).
- ARRL DX records have three contacts in 2003:
  - WA1ZMS/4 and W4WWQ, March 11, 2003, at 20.7 km; KA4YNO was also involved in this contact (*CQ*, May, 2003, at 88, contains more details of this QSO).
  - KF6KVG/6 and W0EOM on March 29, 2003, at 24.8 km;
  - And, WA1ZMS/4 and W4WWQ, April 2, 2003, at 30 km (current record);
- **No contest QSO:** no documentation can be found of any contact being made on this band in a US VHF contest.

**145 GHz.** WARC 79 allocated 142-149 GHz to amateur service, effective March 1, 1986.

- **The first contact on the band** occurred between WA1MBA and WB2BYW in Dec. 1992 for a total of 2 inches across a lab bench at the University of Massachusetts. Less than 1 microwatt was obtained from mixers at the 13<sup>th</sup> harmonic of 11 GHz local oscillators. On May 2, 1993, the two operators took the equipment to the field, and made a 950 meter contact. They then extended this to 3.8 km. (QST, July 1993, at 91; Sept. 1984, at 112)).
- DB6NT and DF9LN at one station and OZ9ZI and DJ5HN at the 2<sup>nd</sup> station made several 145 G contacts on June 9, 1993, including a 3.1 km contact over open water. Equipment resembled Gunn oscillators running 5 microwatts (QST, 1993, Pocock column; CQ, 12-93, at 120). DB6NT and DF9LN then worked on 145G and 241G over 2.1 km on June 26, 1995 (QST, Dec. 1995, at 97).
- WA1MBA & WB2BYW also made **the first contest QSO** on this band in the 1993 June VHF QSO Party, a year before the League started publishing contest activity above 47 GHz. Their line scores listed this contact as “L” for light (source: 2004 e-mail from WA1MBA).
- OZ9ZI and OZ1IUM made a 11 km contact on July 2, 1994 using the same terrain as they did 11 years before for 10 GHz tests. The transmitters put out less than 1 microwatt (QST, April, 1995, at 99).
- OZ1IUM and DB6NT made the first reported SSB contact on the band during the Danish Activity weekend in 1994 for a distance (CQ, 2-85, at 88; also referred to in CQ, 4-95, at 102).
- DB6NCI and DB6NT had a 53 km QSO on 145 G on April 7, 1997 (QST, July 1997, at 91).
- On August 12, 1999, W0EOM and KF6KVG made a 5.4 km contact on 142 G near Stanford, Ca. Hughes harmonic mixers were used, the same one as used on 120 G in earlier contacts between the two stations. Then on August 18, 1999, the pair completed a QSO over 11.7 km path (QST, Nov. 1999, at 88).
- WA1ZMS and WA4RTS made a 34 km contact on Nov. 6, 2000 (ARRL DX Records; CQ, 1-2001, at 112). This was followed a few months later with W2SZ/4 (possibly, with WA1ZMS operating) working WA4RTS over an incredible 61.6 km distance on 145 GHz on Jan. 1, 2001 (QST, May 2001, at 94).
- On Jan. 12, 2003, WA1MZS worked W2SZ/4 operated by WA4RTS, W4WWQ, and KA4YND for a distance of 79.6 km. This contact not only occurred over a record distance, but provided the 5<sup>th</sup> grid for W2SZ/4 in which to claim VUCC #1 on 145 G.

**241 GHz.** The frequencies of 240 to 250 GHz were allocated to amateur use on Nov. 14, 1975. The unassigned frequencies were then moved from above 30 GHz to above 300 GHz.

- **The first contact:** DB6NT and DF9LN made a 0.5 km QSO on June 10, 1993 for probably the first radio contact on the band (CQ, 12-93, at 120). DB6NT the possibly made a 1 km contact sometime in 1994 using the same 24.1 GHz LO as with his 145 GHz contact (see above), but then used a 10<sup>th</sup> harmonic, providing a small output signal at 241 G (QST, Sept. 1994, at 112).
- DB6NT and DF9LN worked on 145G and 241G over 2.1 km on June 26, 1995 (QST, Dec. 1995, at 97). The two stations then made a contact on June 7, 1996, also in the 2 km range (QST, August, 1999, at 78).
- **The first known contest QSO** on this band was by NS6X and KB6JVV in the 1997 January VHF SS (see above note, 75 GHz). This may have also been **the first US reported contact** on the band, as QST references later indicated that the “initial” contact and distance record on the band had been claimed in Dec. 2001 (QST, 4-2002, at 81; 3-2002 at 87). Possibly, the 1997 contest QSO by NS6X was never claimed for purposes of a “DX Record” on the band.
- Using the W2SZ/4 call, WA1ZMS contacted WA4RTS on 241 GHz and 322 GHz on Dec. 15, 2001. The distance spanned on 241 GHz was 1.1 km (QST, March, 2002, at 87; CQ, 3-2002, at 96).
- WA1ZMS and WA4RTS made several 241 G contacts on Feb. 23, 2002 of 3.8, 6.1, and 7.3 km distance. The equipment from the Dec. 2001 contact was improved upon by stabilizing frequencies with phased locked gunn sources and temperature controlled crystal oscillators. (QST, Feb. 2002, at 91).
- The next month on March 11, 2002, the same two operators extended the distance to 11.4 km (QST, Sept. 2003, at 89; CQ, 5-2002, at 98).
- ARRL DX records contain the additional contacts:
  - WA1ZMS and W4WWQ on Feb 23, 2003, at 7.3 km;
  - Not in the ARRL DX records: WA1ZMS worked W4WWQ on 11-14-2003 at 34.9 km (CQ, 1-2004, at 86).
  - Then, WA1ZMS, using the call W2Z/4, and W4EEQ on 12-3-2003 at 61.8 km (CQ, 2-2004, at 89);
  - W2SZ/4 (W4WWQ, operator) and WA1ZMS/4 at 79.7 km on Feb 17, 2004. This was the 5<sup>th</sup> grid on the band from W2SZ/4, allowing VUCC #1 to be

issued on 5-5-04. W2SZ/4 obtained VUCC #1 on 5-5-04. A nice article on this technical problems faced in making this contact is contained at QST, May, 2004, at 86. Another article on the feat is at CQ, 5-2004, 86.

**Micrometer Radio.** Currently, all frequencies above 300 GHz are unassigned, and are available for experimentation. Several amateurs are experimenting with the micrometer radio range. Discussions are beginning between the US and IARU officials as to possible allocation of frequencies above 275 GHz (QST, April 2004, at 98). The frequency and wavelength range is considered to be (see, QST, May, 1999, at 78, for more details):

<b>Band</b>	<b>Frequency</b>	<b>Wavelength</b>
Radio	300-3000 GHz	1000-100 um
Infrared	3-461 THz	100 um-0.7 um
Visible Light	461-667 THz	700-400 nm
Ultraviolet	667-30,000 THz	400-10 nm
X-Ray	$3 \times 10^4 - 3 \times 10^6$ THz	100 nm - 1 A
Gamma Ray	$> 3 \times 10^6$ THz	<1 A

The ARRL keeps separate DX records of the various frequencies used for both micrometer and light contacts. Micrometer records and contacts are provided below, and QSO's at Light wavelengths have been noted above.

- **The initial contact on 323 GHz** was made Dec. 15, 2001 between WA1ZMS operating as W2SZ/4 and WA4RTS (QST, March, 2002, at 87; CQ, 3-2002, at 96). The distance was 0.05 km. Modulated CW was used with wide-band FM equipment. The antenna was a 6 inch parabolic dish. (QST, March 2002, at 87).
- Further distances on 322 GHz have been achieved by WA1ZMS and W4WWQ on March 1, 2002 (.5 km), and then on March 4, 2003 (1.4 km). (ARRL on-line DX records list; CQ, 5-2003, at 88). 5 wpm cw was used for the 3-4-2003 contact.
- **The first contact in the 403 GHz** range occurred on Jan. 6 1998 between DL1JIN and DB6NT over 50 meters (at 411 Ghz). A 119 MHz LO was used by DB6NT with a multiplier chain to produce a 20 mw transmission at 45.6 G. This was fed to Schotty diode, for a nine times multiplier. The dish antenna was 150 mm, or about 6 inches! (QST, Sept. 1998, at 89).
- A group working with DB6NT completed a 50 meter contact at 411 GHz sometime before March, 2002 (QST, March 2002, at 87).
- The first US QSO at 403 GHz occurred Nov. 11, 2003 between WA1ZMS/4 and W4WWQ/4 at a distance of 0.521 km, or 1,709 feet. (MGEF web-site; CQ, 1-2004, at 86).

- The 403 GHz record was extended on 12-21-2004, again by WA1ZMS and W4WWQ, working 1.4 km. (ARRL on-line news article; CQ, 2-2005, at 88).
- **There have been no contest contacts** in the 300-3000 G range, due to the technical difficulties involved with equipment. Since all contacts above 300 GHz are considered to be in the same “band”, it has been far easier to make a light contact using lasers.

**122 GHz (new authorization).** 122.25 – 123 GHz is a new authorization at to in WARC 2000, and was opened to Amateurs in March 2004. The 120 GHz allocation initially made in 1986 is still intact.

- **The first reported contact** was between W0EOM and KF6KVG on August 27, 2004 over 24.8 km (ARRL DX records).
- WA1ZMS and W4WWQ claimed a world and North American record on the band when they worked a distance of 79.6 km on Jan. 15, 2005. Power output was 5 mw. Over a ten hour period, the same two operators also managed to work five grids for VUCC #1, using the call W2SZ/4 at a fixed location (ARRL web-site news release; CQ, 3-2005, at 74).
- **There have been no contest QSO’s** reported so far.

**165 GHz.** The frequencies of 165 to 170 GHz were allocated to amateur use on Nov. 14, 1975. This band was then lost in WARC 79, effective March 1, 1986, but with two new allocations at 120 and 142 GHz. No amateur contact or activity can be documented on this band.

#### **Other Early and Significant Amateur VHF Band Activity ----**

- VHF contacts through tropospheric scatter and refraction were occurring as early as 1931, but were poorly understood.
- Sporadic E contacts were being made by 1935, with the first known 50 Mc QSO from E skip occurring on June 22, 1935 between W8CYR, Ohio, and W1CBL, NH (Pocock, at 29; QST, August, 1935).
- Starting in 1936, a radio engineer and amateur radio operator, Grote Reber, W9GFZ, conducted many of experiments at UHF frequencies, having attempted radio observations first on 3300 Mc and then on 900 Mc. By 1941, Reber had completed the world’s first radio sky survey. For almost a ten-year period before and during WWII, Reber was the world’s only radio astronomer.
- For many years, aurora was known to effect radio signals (QST, Oct. 1926, at 23; Dec. 1926, at 62; Dec. 1929, at 18), but it was a long time before anyone realized that

UHF contacts were possible using aurora ionization. The first 50 Mc contacts via aurora were made in 1939, and the first reported widespread aurora radio event occurred in February, 1940 (QST, May, 1940).

- Amateur interest in the microwave frequencies exploded after WWII. With the development of radar and other higher frequency activities in the war, our knowledge and ability to use the uhf frequencies measurably increased. Surplus war radio equipment quickly became available after WWII, generating a perfect environment for amateur experimentation on microwave frequencies.
- In January, 1946, a US Army Signal Corps lab, engaged in "Project Diana", and used a 4000 watt 111 MHz transmitter to bounce signals off of the moon. Station engineers for this historic event included amateur radio operators, such as W4ERI and others.
- The first meteor scatter contacts on 50 Mc were completed on October 9, 1946 when the comet Giacobini-Zinner produced a very intense meteor storm. Hundreds of meteor contacts were completed (UHF / Microwave Experimenters manual; Pocock, at 95; QST, Dec. 1946, at 43).
- On the night of June 13, 1948, W9ZHB, of Zearing, Illinois became the first amateur to work all states on 6 Meters, although he was reluctant to be recognized for the achievement. Within a month, a 2<sup>nd</sup> station also made contacts with 48 states who was none other than W0ZJB, the same person who worked all call districts in 1939 on 56 Mc under the call W9ZJB (QST, 8-48, at 48; 9-48, at 128). W0ZJB was the first to claim and be given the 50 Mc WAS award.
- Transequatorial Propagation (TE) on 6 meters began to be documented by 1950. Over the course of the next several years, it became evident that north-south VHF propagation of several thousand miles was possible on 6 meters, and possibly higher bands (QST, April, 1950; QST, Dec. 1959). W5VY was one of the first to use TE on 50 Mc. He also worked W8WXV on June 24, 1950 in the first documented sporadic E contact on 144 Mc (QST, Oct. 1996, at 89).
- W1PNB conducted the 1<sup>st</sup> experiments on 6 meter SSB in 1951, and also made the 1<sup>st</sup> 50 Mc SSB contact on aurora in 1952 (5-52 QST, at 61). W2JJC, New Market, NJ made the 1<sup>st</sup> 2 meter sideband QSO on the 27<sup>th</sup> of March, 1954 with W3HWN, Mechanicsburg, Pa (12-54, Tilton, at 69; 4-55, at 62; also see 5-56, at 59).
- The first amateur transmission using transistors was made in late 1952 when K2AH, using a one-transistor transmitter, worked W2UK on 2 meters some 25 miles away. The power output was 50 microwatts, and a single transistor was used for the transmitter. (2-53 QST, at 65; 3-53).
- The first successful amateur reception of moonbounce echoes occurred January 27, 1953 between W4AO and W3GKP. (3-53 QST; also, Tilton, 4-53 on Project

Moonbounce). 2 Meters was used for the experiments, but the effort was so technically difficult on this frequency that work shifted to 1296 Mc.

- Commencing in 1952, the Navy received moon echoes from a 200 Mc pulse transmitter. In September, 1953, the Collins Radio Co. established a moon reflection link, beaming a 20 kilowatt, 418 Mc signal from Cedar Rapids, Iowa to Sterling, Virginia via the moon. By 1960, the Navy had developed two-way EME paths bridging both the Atlantic and Pacific Oceans on several frequencies between 100 to 1000 Mc, although even today, very little public information exists as to these Navy efforts (VHF Handbook, 1<sup>st</sup> ed. at 14; 3<sup>rd</sup> ed. at 80-81).
- Meteor scatter work on 2 meters was pioneered in the early 1950's by Paul Wilson, W4HHK, of Coulterville, Tennessee, and Ralph Thomas, W2UK, New Brunswick, NJ. (10-54, at 61-63; also Tilton's column in 10-55). This was considered such a breakthrough in radio communication that audio tapes of the meteor scatter contacts were played at a meeting of propagation physicists of the International Scientific Union in 1954. Wilson and Thomas won the 1955 ARRL Merit Award for their success with meteor scatter communications on 2 meters (QST, 10-56, at 62).
- W6BAZ claimed the first 50 MHz WAC award in April, 1958 (QST, Jan. 1959).
- Tremendously powerful test transmissions (over 50 kw) on 49.6 Mc occurred in the late 50's between Collins Radio Co in Iowa and the Northeast area. The tests were to ascertain the extent that positive propagation characteristics existed across long distances on VHF frequencies. The tests concluded that openings and regular communication were far more plentiful than had been thought, and were more consistent than on many HF frequencies. Dubbed the "big signal" by VHF enthusiasts, amateurs through the eastern to Midwestern sections of the country could regularly hear the transmissions.
- The first successful amateur radio EME contact occurred between the EIMAC Radio Club, W6HB, and the Rhododendron Swamp VHF Society, W1BU, on 1296 MC on July 21, 1960. Sam Harris, W1FZJ, writer of *The World Above 50 Mc* column in the 1960's, led efforts on the East Coast end. Both parties used kilowatt level klystrons.
- John Chambers, W6NLZ, and Ralph Thomas, KH6UK (who also pioneered meteor scatter work as W2UK) made the first transpacific 2 meter and 220 MC contacts. Also, Chambers heard Thomas' signal on 420 Mc (QST, Sept. 1957, at 63; August, 1959, at 68), but Thomas heard nothing. It was later learned that the lack of a two-way contact at 420 Mc was merely due to receiver problems on the Hawaiian end (QST, Sept. 1960, at 78). For their endeavors, they won the 1961 Edison Award and 1960 ARRL Merit Award.
- In December 1961, the first amateur radio satellite was launched. Named Oscar I, the satellite contained a 140 milliwatt beacon at 145 MHz that transmitted the very friendly CW message "hi". Within only a few years after the launching of the first



Soviet and US satellites, Oscar I was considered a remarkable achievement for amateur radio. (Cover picture, 1-62 QST; cover story, 2-62, at 9; 11-24, several articles).

- After a “maybe” contact on 2 meters in 1962 by others, the first definite EME QSO on 2 meters was achieved on April 11, 1964, between W6DNG and OH1NL (June, 1964 QST, at 95-96). This contact may have been the first amateur EME QSO involving equipment not borrowed from military, commercial, or educational sources (VHF Handbook, 3<sup>rd</sup> ed. at 83).
- 420 Mc efforts at EME began in earnest once power levels were increased by regulatory changes in January, 1963, and W5DSA engaged in moonbounce work shortly thereafter. The first actual QSO on 432 occurred May 20, 1964 between W1BU and KP4BPZ, operating from the Arecibo radio telescope in Puerto Rico (7-64 QST, at 105; 8-64, QST, at 92-93).
- Several other bands were developed on EME thereafter:
  - 220 was achieved on March 15, 1970 between WB6NMT and W7CNK (UHF / Microwave Manual).
  - On October 19, 1970, W4HHK and W3GKP completed a 2300 Mc EME contact, after 3 ½ years of effort. This was the highest frequency used up to that time for EME work. (UHF / Microwave manual). The next EME contact on the band occurred 13 years later, with W4HHK once again involved in the QSO, this time with WA4HGN (QST, Dec. 1984, at 71).
  - The first 50 MHz EME contact was made in 1972 between W5SXD and K5WVX (QST, 9-2004, at 77).
  - The first EME contact using solid-state gear took place on Sept. 20, 1981 when WA2GFK, K2UYH, and K2KTN worked G3LTF on 1296 MHz. Two transistors, coupled together for approximately 160 watts of output were used in the effort (UHF / Microwave Experimenters Manual, at 1-15; QST, 12-81, at 89).
  - 3300 and 5650 MHz was pioneered in 1987 by W7CNK, WA5TNY, KA5JPD, and KD5RO who initially received echoes on these bands running a TWT for 50 watts on 3000 and 100 watts on 5.7GHz (Pocock, *Beyond Line of Sight*, at 203; QST, May, 1987, at 65). They went on to make two contacts on April 7, 1987 on 3.4G, and April 24, 1987 on 5.7G (QST, March, 1996, at 87).
  - 903 MHz was achieved in 1988 between KD5RO and WB5LUA (QST, Feb. 1989, at 82).

- 10 GHz EME was first achieved by the group of WA7CJO, KY7B, WA5VJB, and KF5N on August 27, 1988 (QST, Feb. 1989, at 82; March 1996, at 87).
- The initial 24G EME contact occurred on August 18, 2001 between W5LUA and VE4MA.
- On July 24, 2004, RW3BP, a Russian amateur, heard his own 47G echoes on the moon. Four other amateurs, including AD6FP, VE4MA, VE7CLD, and W5LUA, have also now heard the echoes (QST, Oct. 2004, at 21; E-mail of AD6FP). Also, RW3BP copied call signs of AD6FP in Dec. 2004.
- In 1976, the Mt. Airy VHF Club led an EME expedition to Barranquilla, Columbia with club member K2UYH becoming the first amateur to work all continents on 432 MHz. The EME station assembled in Columbia may have been the first EME effort in South America.
- The Big Ear radio astronomy antenna at Ohio State University recorded a one-minute anomaly on August 15, 1977. Nicknamed the “Wow” signal (Dr. Jerry Ehman circled the data on a computer print-out, and in the margin wrote “Wow!”), it is even today the single most likely candidate of a SETI signal being received on Earth. The antenna was built and maintained by amateur radio operators, mostly notably, Dr. John Kraus, W8JK. Kraus was notable for having developed popular amateur beam antennas, inventing the helix antenna, and developing one of the world’s largest radio telescope antennas over the years at Ohio State. His contributions to radio astronomy have been immense.
- WAS on 2 Meters was first obtained by K0MQS, in Iowa, on Dec. 15, 1976. Wayne Overbeck, N6NB traveled to Alaska with his “cabover kilowatt EME Dxpedition” to give out state #50 to K0MQS. Two years later on May 4, 1978, K5CM, was awarded WAS #2.
- A new propagation mode was discovered after YV5ZZ worked LU5DAU on 2 meters on Oct. 29, 1977. In early 1978, KP4EOR, Puerto Rico, and LU5DJZ, Argentina, worked on 2 Meters, for a distance of 3943 miles. Through much research, such contacts were thought to be the result of Field Aligned Irregularities (FAI) occurring over an equatorial path (QST, April, 1978; Oct., 1978; Nov. 1981; Dec. 1981; June 1983; July 1983).
- WAS on 432 was achieved on June, 1979 when W0YZS took his own EME equipment to Wyoming and worked his home station in Missouri, which was operated by K0TLM. K2UYH was close behind, who only needed Wyoming for the WAS award. (QST, Sept. 1979, at 80).
- In 1980, European VHF enthusiasts had developed a new grid locator system, and publicly introduced it at a conference at Maidenhead, England. The ARRL adopted the use of the Maidenhead grid squares in 1983, and then went on to develop the

VUCC awards system. Grid squares were widely accepted in the VHF community, and quickly revolutionized all of VHF operating and contesting.

- In 1983, Owen Garriott, W5LFL, was the first amateur to fly on a shuttle mission. In his spare time aboard the shuttle, he made almost 300 2 Meter FM contacts. Today, QSL cards from that first “amateur” mission are highly prized. In following years, it became common for many of the astronauts to have amateur licenses, and make contacts on various VHF bands.
- The first VUCC award went to W1JR, who worked several stations on 432 EME on April 15, 1983. K8WW obtained VUCC #2 on 432, working EME, as well. Other first VUCC awards included (some of the following information is from the VE2PIJ web-site):
  - K8WKZ, 6 meters, June 13, 1983 (QST, Sept. 1983, at 81).
  - 2 Meters, K9MRI, June 23, 1983.
  - 1296, WB8BKC.
  - 220 was first claimed by W1JR, Feb. 13, 1984 (QST, Dec. 1984, at 71).
  - By 1985, WB5LUA was the first to claim the award on 2.3 GHz.
  - W2SZ/1 was to claim VUCC on 3.4, 5.7, and 10 GHz, all on April 3, 1985.
  - 902 was initially claimed on Oct. 20, 1986 by AA2Z.
  - W2SZ/4 was first with VUCC on 24 GHz in 1987, with WA3RMX and WB7UNU #2 and #3.
  - W2SZ/4 also was awarded the first VUCC on 47G on May 19, 1998, as well as 75G on June 1, 1999. To date, this is the only VUCC given on 75G.
  - No one has claimed VUCC on 120G.
  - W2SZ/4 is the only station to have claimed 142G (on Jan. 23, 2003); and 240G (on March 5, 2004).
  - KY7B obtained VUCC on light (>300G) in 1989.
  - OH5LK was the first of many to be awarded satellite VUCC.
- W0VB was the first to work all states on 220 MHz. Traveling to Hawaii with EME equipment, he worked his own station in Iowa on Nov. 15, 1983, with W0OHU operating (QST, Jan. 1984, at 70). Over the next few years, several stations obtained WAS on 220, all through EME efforts. To date, the only operators to achieve WAS on this band worked EME in the 1980's.
- The first packet meteor scatter contact occurred on August 5, 1984 between W0RPK and W3OTC. FM was used on 6 Meters for the contact. (QST, Oct. 1984, at 61). This contact represented the first effort at using computer based technology for VHF communication. Many years later, computer programs, such as JT44, would revolutionize the VHF communication abilities of amateurs.
- Just past the peak of solar cycle 22 in the early 1990, several stations confirmed the long sought objective of 100 countries on 6 meters, with W5FF, K5FF, VE1YX, JA4MBM, and JA1BK being the first operators to obtain DXCC.

- 2 Meter DXCC was first accomplished by a great moon-bouncer, Dave Blaschke, W5UN. After the destruction of his enormous antenna from a nearby tornado when his country count stood at 98, W5UN spent months rebuilding his EME array. He passed the 100 country milestone by working a 2 meter contact with VS6BI on October 28, 1990. (QST, Jan. 1991, at 60). Another moonbouncer, KB8RQ, was awarded DXCC #2.
- On June 18, 1995, Fred Fish, W5FF, worked the last of all 484 continental US grids on 6 meters. He started the quest when the grid squares were initially developed in the 1980's. His total grid square count by 1995 stood at 843 grids, the highest total in the world. He also was high on the DXCC list at the time, with 128 countries. Fred and his wife, K5FF, also provided the enthusiasm in the early 1980's that propelled 222 EME activity to high activity levels, allowing several amateurs to achieve WAS on 222 (QST, Sept. 1985, at 112).
- A small region of the Midwest lies within 2300 km of both coasts, where all lower 48 states can be worked from (QST, June, 1997, at 91; 10-97, at 101). The following stations have worked all 48 lower states by terrestrial means, only.
  - W0SD, SD, August, 1979;
  - K5CM, OK, in Dec. 1980;
  - W0EMS. NE, in August, 1981;
  - WQ0P, KS, August 1993.
  - K0ALL, EN16, ND.
  - K5UR, EM35, AR
  - W5ZN, EM45, AR
- On August 23, 2003, Brian Justin, WA1ZMS, was awarded Worked all Bands certificate #1, for having working at least one contact on all 26 amateur bands, from 160 Meters through light. The award was presented by the North east Weak Signal group (NEWS).

**Early and historical experiments at ultra-high frequencies.** (See, my Historical Notes, for more details).

- In the 1800's, Samuel Morse successfully developed communications via telegraphic methods. Numerous experiments had occurred by the mid 1850's that were aimed at eliminating one or more of these telegraph wires. Conduction methods, induction experiments, and electro-static communication were all efforts at a "wireless" form of telegraphy. Today, they are seen as the early pre-cursors of electro-magnetic form of wireless or "radio".
- In 1850, James Clerk Maxwell proposed a rather radical theory for the time: he believed that that electrical activity was the result of electromagnetic waves of

radiation, much as Newton had shown that light stemmed from wave-like behavior emanating from a source of known energy in the light spectrum.

- David Edward Hughes, an English professor, was probably the first person to actually transmit and receive electromagnetic waves, circa 1879-1880. Unheralded at the time, it was only many years later that Hughes early work was more fully documented, and it has only been recently that Hughes has been acknowledged as achieving electrical-magnetic radiation of energy.
- Heinrich Hertz is widely credited with proving Maxwell's electromagnetic wave theory. In 1884, Hertz observed electrical discharges from a Leyden jar. He then developed a spark discharge device excited by an induction coil. In 1886-1887, Hertz publicly demonstrated before students in a college auditorium a spark-gap type of transmission of 50,000,000 "vibrations" per second and higher (in today's nomenclature, 50 MHz and higher). In so doing, he proved that the sparks were generating electromagnetic radiating waves. Hertz's discovery was considered so significant that for many years thereafter, radio frequencies were often referred to as "Hertzian waves".
- Hertz's early resonators (or, receivers, in today's verbiage) may have intercepted energy generated by the sparks in the range of 400 – 500 Mc. The resonators were composed solely of a loop of wire bearing a close resemblance to today's UHF TV antennas.
- Hertz also made a "small oscillator", comprised of two spheres attached to very radiating small wires, operating around 500,000,000 vibrations per second, somewhat above today's amateur 432 MHz band.
- Hertz then made a parabolic device that produced waves possibly as high as 500 Mc to 1 GHz.
- Sir Oliver Lodge independently determined the existence of electromagnetic waves at the same time as Hertz, but Lodge's efforts had not been finalized when Hertz published his findings. Lodge presented his own conclusions to the British Association in 1888. Lodge developed a "coherer" that was more sensitive than Hertz's simple receiving loop, and extended the distance of reception to one hundred yards. Popov, of Russia, then used similar equipment over a distance of 1800 feet.
- Professor Righi of Italy immersed a spark gap in oil to generate oscillations at 3,000,000,000 vibrations per second (3 GHz). He then decreased the size of the spheres, and obtained oscillations four times as rapid.
- Professor Jagadis Chunder Bose of India (sometimes spelled Bhowse) used three platinum spheres placed in a small box to produce spark radiations at an incredible wavelength of six millimeters (somewhere around today's 50 GHz). Bose commented that he was then within 13 octaves of visible light.

- William Conrad Roentgen, a professor of Physics at the University of Wurtzburg, discovered X rays while experimenting with vacuum tubes. The unit of measurement of exposure to X rays is today known as the “Roentgen”.
- A student of Professor Righi, Guglielmo Marconi initially experimented in Italy with ultra-high frequencies. He also engaged in ultra-high frequency tests in Great Britain. Marconi may have been one of the first, if not the first person, to have actually observed and experienced absorption tendencies at ultra-high frequencies. This problem may have lead Marconi to explore and concentrate on the other end of the radio spectrum, the short wavelengths of 100 to 200 meters. Marconi extended the distance of his ultra-high transmissions to several miles. Then, as he lowered the frequency of transmissions, his range extended remarkably, culminating in his famous 1901 transmission across the Atlantic Ocean.
- In 1919, Marconi used dipoles and parabolic reflectors on frequencies near what is today 2 meters. Other experimenters in Europe were also active on UHF frequencies. Triodes were adapted to work at 900 mc, and magnetrons were developed as early as 1920.
- In 1927 and 1928, Hidetsugu Yagi and Shintaro Uda invented the beam antenna, after experimenting with antennas on frequencies as high as today’s 6 GHz range.
- In 1931, Andre Clavier, of Paris, made the first trans-English Channel microwave transmission on 1,700 Mc. He used a 3 meter parabolic dish antenna and AM equipment. (UHF / Microwave Experimenters Manual).
- In 1932, Marconi conducted some famous experiments off the Italian coast at frequencies near 500 Mc. He was able to achieve consistent transmission paths over 150 km (90 miles), and the farthest distance achieved may have been 128 miles. This is quiet notable, as there was virtually no activity occurring at the time on the closest US UHF band, that of 400 Mc. In fact, there may not have been a confirmed, two-way amateur QSO on the band until 1939, and the 400 Mc distance record as late as 1941 was only 20 miles.
- In 1941, Clavier used 3,000 Mc for tests on tropospheric scatter. US amateurs did not being work on the 3300 Mc band for an additional 14 years, until after WWII.