

Amateur Television—A Progress Report

BY EDWARD P. TILTON,* WIHDQ

TELEVISION is not exactly new to amateur radio. Though most of us paid little attention to TV until the "I" was added, making television our Number One Menace, the facts are that enterprising amateurs have been playing with this branch of the electronics art for a matter of 25 years or more. Doubtters are referred to files of *QST* dating back to the '20s for proof that there was amateur television before many of our present-day amateurs were born.

The methods they used bore little resemblance to the techniques employed today, to be sure, but hams were sending and receiving pictures (or trying to) a generation ago. *QST* carried many articles on television from 1925 on, and there was plenty of interest — for a while. But the work was being done by the motor-driven scanning disc method, and it was doomed to failure. Though many dollars and man-hours were spent on the problem, nobody succeeded in developing mechanical systems that were completely practical. As early as 1928, a *QST* author¹ was pointing out the possibilities of electronic television, using the then rare-and-expensive cathode-ray tube. The days of the scanning disc were numbered.

*V.H.F. Editor, *QST*.

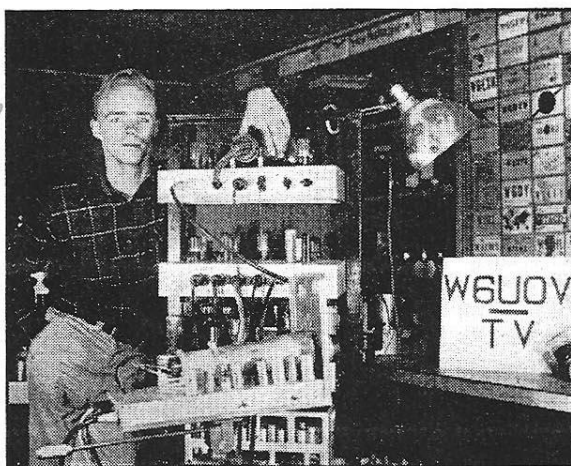
¹"Radiovision," Dewhirst, Sept., 1928, *QST*, page 15.

²"Television—What About It?" Hull, Nov., 1931, *QST*, page 20.

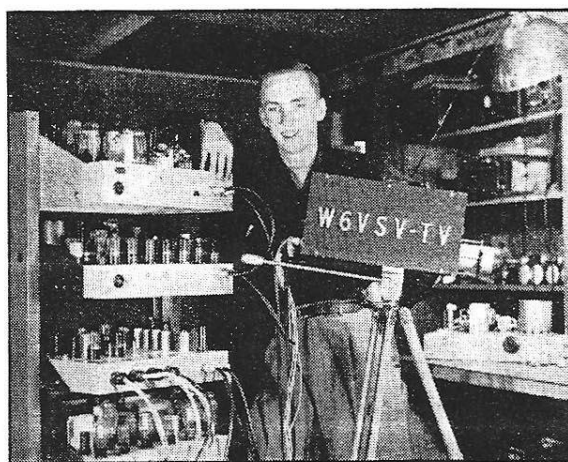
By January, 1929, The Old Man was ready to write "finis" to the story of television by mechanical means, and he did just that in one of his terse classics called "Rotten Television." With his faith in man's ability to accomplish anything he sets out to do, Hiram Percy Maxim was sure that television would be made practical, but his keen insight in such matters told him almost at once that mechanical scanning was not the way to do it, and he said so, in no uncertain terms!

But predicting the coming of electronic television and bringing it about were two quite different matters. The cathode-ray tube was a laboratory curiosity, and it was to remain so for some years to come, so far as most of us were concerned. Though it had become fashionable, by 1931, to say that "Television is just around the corner," a careful survey by Technical Editor Lamb and Associate Editor Hull resulted in a statement by the latter² that cathode-ray technique was promising, that higher-definition television was on the way, but that the "corner" was still a long hike away, for the average amateur or potential home-receiver owner.

Not until 1937 was the heading "Television" to appear again in the *QST* yearly index. By then the problems involved in electronic television were gradually being solved. Usable components were beginning to appear, and television



This is the way Robert Sutherland, W6UOV, Oakland, Calif., handles TV transmission and reception. His hand rests on the monitor 'scope in the top section. Camera control and power supplies occupy the next two decks, with an APS-13 receiver just visible at the bottom of the picture. The camera in the foreground has its case removed to facilitate test and adjustment. A coaxial amplifier unit for higher power output is now being tested. It appears in the photo at the right.



Bob Melvin, W6VSV, Berkeley, Calif., with his TV set-up. The top deck is the 420-Mc. transmitter, with an 832-A in the final stage. Next below is a sync generator, with the camera control and power supplies, in that order. Bob says that this is a more elaborate set-up than is necessary for good amateur picture transmission. The sync generator, with its 30 tubes, has been found dispensable, for all practical purposes. On the shelf at the right is the 4X-150-A coaxial amplifier of W6UOV.

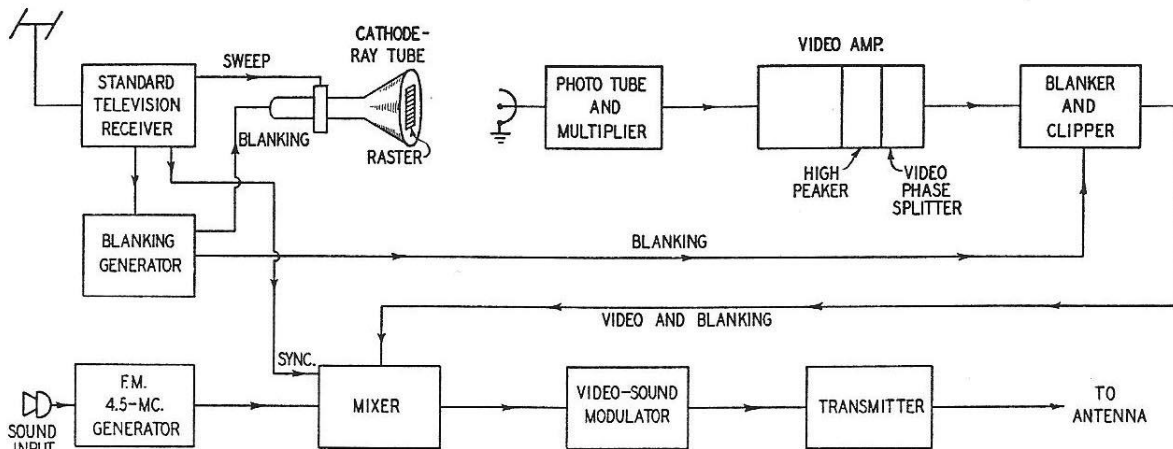


Fig. 1 — Block diagram of the television system used by W2LNP.

experimental work loomed as a possible field for the more advanced (and financially well-fixed) amateur. Again, *QST* devoted considerable space to television articles, leading off with a memorable series of seven by Marshall Wilder, W2KJL, beginning in December, 1937. For more than two years almost every issue of *QST* carried something on television, but it was mostly concerned with the receiving end. The generation of a television picture for transmission was still considered to be beyond the radio amateur, until moderately-priced iconoscope tubes were introduced for amateur use in 1940.

Television transmitter and camera design were treated extensively in *QST* for 1940, and on September 27th of that year what is believed to have been the first two-way television communication between amateur stations took place. W2USA, operating from the Communications Building in the New York World's Fair, maintained simultaneous sight and sound contact with W2DKJ/2, in the Daily News Building in New York City, the stations operating on 56 and 112 Mc. Ten major television articles appeared in *QST* in 1940, but they failed to stir appreciable response within amateur ranks, except on the part of a few exceptionally well-qualified engineer-amateurs, and the balance of the prewar period saw interest lagging.

The highly-involved and expensive process involved in getting on the air for actual television communication was just too much for most of us, and progress in amateur television slowed to a standstill until well into the postwar period. Meanwhile, thousands of amateurs and would-be amateurs had been exposed to cathode-ray techniques in one form or another during the war, and another generation of hams, brought up on radio and electronics, was coming along. Television receivers were becoming commonplace fixtures in many homes, and electronics schools were grinding out TV technicians by the hundreds. These factors, combined with the availability of most of the needed components on the surplus market, gave amateur television the push

that it had always needed, and the period since 1948 has seen more amateur TV activity than existed in all previous years combined.

From several cities in this country and abroad has come news of progress in amateur television, and, unlike the prewar work, much of the effort has been concerned with transmitting. The trend, in this country, has been to use transmitting systems that would tie in with those employed in commercial services, so that ordinary home television receivers could be used for amateur work by the addition of a simple converter. In this country amateur TV is limited to the frequencies from 420 Mc. up, because of the bandwidth involved, but in some European countries there has been experimentation with the r.f. sections operating in the 2-meter band. So that interested parties may know how the problem is being attacked in various places, we present a summary of the work now going on and the methods being used.

TV in the Bay Area

Perhaps the first amateur to put a standard RMA television image on the air was W6JDI, Burlingame, Calif., who was transmitting a monoscope test pattern as far back as May, 1948. In November of that year he was received successfully by Bob Melvin, W6VSV, Berkeley, a distance of 25 miles or so. The W6JDI transmitter was a pair of 8012s operating on about 423 Mc., modulated with the RMA standard 525-line picture, interlaced 2 to 1, making it receivable on a standard home television receiver with a 420-Mc. converter.

The work of W6JDI was featured in the San Francisco *Call-Bulletin* of December 16, 1948, with the operator, Clarence Wolfe, jr., receiving attention as the first person to transmit television successfully in the Bay area. His work antedated the appearance of commercial television in that region by about 9 months.

He was followed in December, 1948, by W6WCD, San Francisco, who was also being received in Berkeley by W6VSV. W6WCD was

transmitting a 262½-line noninterlaced signal, 60 frames per second. He started with a modulated-oscillator r.f. section, changing soon to crystal control.

The first live pictures were transmitted by W6VSV, in March, 1949, using an RCA 5527 iconoscope and an *f* 1.9 lens in the camera equipment. Bob also started with a 6J6 oscillator, changing to an 832 tripler, with crystal control, eventually followed by an 832 amplifier, on 423 Mc. He uses 262½-line noninterlaced scanning, at 15,750 and 60 cycles. The picture is receivable on home TV sets equipped with 420-Mc. converters.

Pictures are clear and stable, despite the lack of a sync generator. Bob has built a sync generator, but he feels that this complex equipment (his has some 30 tubes) is not required in amateur work, the receiver locking nicely on the blanking pulses. Indoor shots are made easily using two No. 2 photoflood lights. Best DX for W6VSV-TV is W6GCG, San Mateo, who receives the picture over a path of some 25 miles.

A particularly interesting feature of W6VSV's transmissions is the combination of sound and video on the same frequency. His transmitter oscillator is frequency-modulated slightly, to give an f.m. deviation of about 20 kc. at 420 Mc. The video is grid-modulated a.m. Using a standard TV receiver there is no ill effect on the picture quality from the frequency modulation for the sound. The audio is picked up by a separate 420-Mc. receiver having f.m. detection. A 923-A surplus job is used for receiving the sound, and no video modulation is present in any type of f.m. receiver that has a satisfactory limiter to remove the video a.m. Alternatively, the sound is transmitted separately on 144 Mc. The equipment of W6VSV has been used in a number of successful demonstrations at hamfests, schools, and public meetings of various kinds.

Another Berkeley TV enthusiast is Milton Cooper, W6QT. Milt also uses a camera with a 5527, using circuits provided with the tube, but with minor changes. His camera design is similar to that of W6VSV, except that the latter has his in several units, while the W6QT camera is a single assembly. The transmitter r.f. section is an

Photographed in a darkened room to show the equipment in actual operation, J. R. Popkin-Clurman, W2LNP, demonstrates his system for transmitting and receiving amateur TV on 420 Mc. Ray is adjusting the pick-up unit containing the photo tube and video amplifier. Opposite this is the cathode-ray tube with a transparency mounted on its face. At the upper right is the receiver tube, showing the system fidelity. The 420-Mc. transmitter and converter are in the foreground. The video modulator blanking, sync and sound mixers (shown as three units in the block diagram) are combined on the small chassis at the left front. At the rear are power supplies and a unit containing sweep circuits, high-voltage supply, and sync and blanking generators. This is not required if a television receiver is used as outlined in the text.

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SCR-522, with the output stage tripling to 432 Mc. This drives two additional 832s as cascaded amplifiers. The second 832 straight amplifier adds considerably to the output, and the stability is good. This is occasionally used to drive an APT-5 cavity oscillator which has been converted to amplifier service, running 100 watts input.

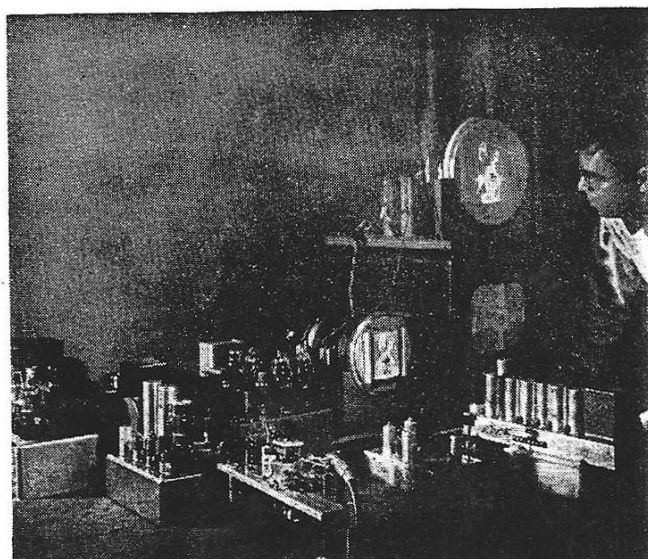
Other TV stations actually on the air in the Bay area include W6RXW, W6UOV, and W6VQV. W6MTJ, W6AQV, and W6WGM are working on TV gear, and others are expected soon. W6UOV is working on a tripler-amplifier using 4-X150-A tetrodes, with the hope of putting out a more powerful TV signal. Antenna systems used in the TV work are mostly 16-element jobs, with horizontal polarization.

A Novel Way To Get Started

The cost and complexity of TV gear has so far left most amateurs convinced that television is not for them, but ways are gradually being found to cut corners. While not even the most rabid video enthusiast would yet say that TV technique has reached the beginner stage, there have been several ideas developed recently for bringing the transmission of television nearer to the abilities of the average experienced ham. One such simplified system has been developed by J. R. Popkin-Clurman, W2LNP. It was demonstrated by him, to a capacity crowd, at a recent meeting of the Amateur V.H.F. Institute of New York.

Ray simplifies matters for the ham who would like to transmit transparencies (film negatives or positives, movies, diagrams, visual messages) without going into the complexities of camera design and construction. He also lets a local TV station, and a standard TV receiver, do some of the work. The system used by W2LNP is shown in block-diagram form in Fig. 1. The photograph shows the complete set-up under actual operating conditions. A standard TV receiver is tuned to a local station and the lead from the receiver video amplifier to the cathode-ray tube is disconnected and the output of the amplifier is fed to a blanking generator. The output of the blanking generator is applied to the receiver cathode-ray tube, the raster of which is used as a light source.

In the simplest form of picture transmission a



transparency is placed directly on the face of the cathode-ray tube, which for this purpose can be almost any type, including the war-surplus P-7 phosphor radar jobs. Light from the raster, passing through the transparency, is picked up by a photo tube and multiplier and fed to a video-amplifier unit that includes a high-frequency peaker and possibly a video phase inverter. The latter is used only if it is desired to transmit negatives in positive form. After a clipper and blanking inserter and a mixer the signal is ready for the modulator and transmitter. Sound and video are transmitted on the same channel by frequency modulating a 4.5-Mc. oscillator and modulating the 420-Mc. transmitter simultaneously with this and the video, by means of the video-sound modulator.

The signal thus transmitted has all the characteristics of a commercial video transmission, and may be received on any standard home television receiver equipped with a 420-Mc. converter. In the absence of a local TV station it is merely necessary to derive the sync and blanking from the receiver's own sweep circuits. In this case the picture will have only 262 lines, noninterlaced. It retains the same horizontal resolution, but the vertical resolution is reduced. In this type of operation it is desirable to sync the vertical to the 60-cycle power supply, to reduce hum effects.

The photo tube is the 931-A multiplier type widely used as a noise source in radar jammers such as the APT-5, and thus available on the surplus market. In the noise-generator applications use is made of the extreme amplification capabilities of the tube, but in this case the maximum gain is not employed. If the tube's noise level is reached it will show up as snow in the picture. The output of the photo tube is fed into a series of video amplifiers, one of which is a high-frequency peaker. This is necessary to compensate for the build-up and decay times of the cathode-ray tube's phosphor screen.

The r.f. section of the transmitter used by W2LNP is a crystal-controlled job with an 832 amplifier in the final stage. The receiver has a crystal mixer and a 6J6 oscillator, followed by a cascade amplifier working into a home television receiver operating on Channel 3. The channel used for the i.f. should be one that is not in use

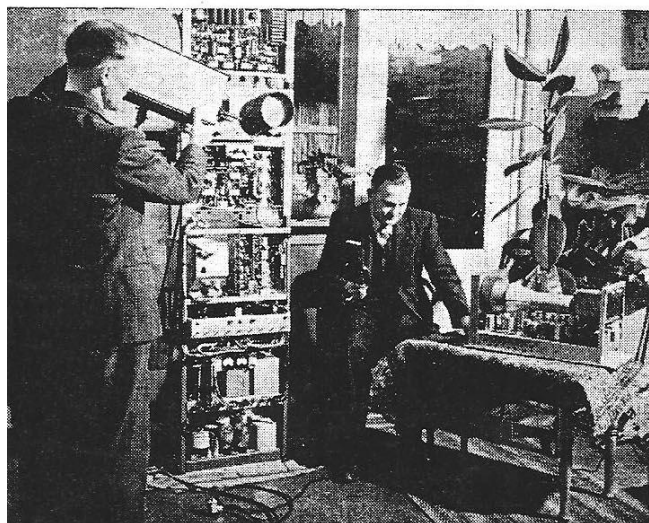
locally, and should be in the low TV band for best results.

This system may be adapted for transmission of movies. A film-projector light source is removed, and the photo tube installed in its place. A 60-cycle synchronous motor is used to drive the film sprocket and the film is run at 30 frames per second instead of 24. It is necessary to blank the raster during the film pull-down time. Pictures of live subjects may also be transmitted by projecting the light from the raster on the subject and collecting the reflected light with a condensing-lens system for the photo tube. Considerably greater light is needed than for transparencies, and a 5TP4 or a 5WP15 projection cathode-ray tube, with its associated high voltage, is suitable.

The British Amateur Television Club

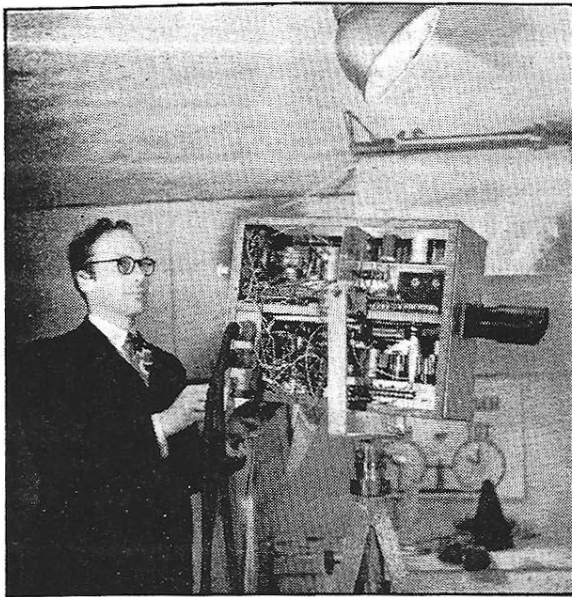
Ham TV activity in England is being coordinated through an informal organization known as the British Amateur Television Club, Mike Barlow, G3CVO, secretary. Standardization of equipment to tie in with BBC transmissions (405 lines, double interlaced, 200 lines, noninterlaced, positive modulation, sound transmitted separately) is urged. Permission for use of the 420-Mc. band for TV is being requested of the GPO at this writing.

The club publishes a small mimeographed magazine, *CQ TV*, containing the latest news and technical information. Members are active on many ham bands, and schedules are kept on 3780 kc. each Saturday at 9 and 10 P.M. for the express purpose of discussing TV problems. Two issues of *CQ TV* we have at hand contain news of the doings of Gs 3GBO, 3CVO, 2DUS, 2FXA, 5ZT, 3ETI, and numerous TV experimenters who do not have transmitting licenses as yet. Several are reported ready to go on the air when 420-Mc. TV permission is granted. A suggestion contained in their paper might well be followed in this country: that amateur TV work be carried on in that part of the 420-Mc. band not harmonically related to the 144-Mc. band. The 420 band is certainly wide enough for all of us, and this division (TV below 432 Mc., regular communication above) would help to make full use of the assignment, and keep us out of each other's hair.



A late addition to our file of amateur TV photographs is this shot of PA0XN-TV, Haarlem, Netherlands. The operator at the left is A. F. van Aggelen, PA0XN, making adjustments while an assistant checks the received picture. The rig is on 144 Mc., running 100 watts to a pair of 4-65As, driven by an ARC-5 exciter. Racks, from bottom to top: high-voltage power supply, regulated supply, switchboard with filament transformers, exciter and sync unit, pulse mixer and shaper, control tubes, line-amplifier mixer and modulator, and final stage.

QST for



TV camera built by members of the Groningen, Netherlands, section of the VERON, contains an electronic view-finder, video preamplifier, 5527 iconoscope, pulse and sawtooth generators, and a blanking and sync mixing unit. The camera operator is Lou Foreman, PAØVT.

Amateur Television in the Netherlands

In early 1948 a group of members of the Groningen section of the Amateur Radio Society of the Netherlands (VERON) started construction of a television station. This project was undertaken in order to provide a demonstration set-up for a large fair held in Groningen in September of that year. As the result of considerable effort on the part of PAØs BE, BF, GWT, VT, TB, WL, and ZX the job was done on time, and 15,000 visitors saw the amateur television station in actual on-the-air operation, many of them being given an opportunity to see and talk with friends who were at the camera position.

Duplex radiotelephone communication was maintained on 2 and 80 meters, between the camera and receiver positions, separated by 400 yards, and at times when no live talent was available the camera was left focused on an exhibit housed in a huge coffee pot, one of the landmarks of the fair.

The camera equipment used an RCA 5527 iconoscope, with sequential scanning, 250-line definition, 50 frames per second. Associated circuits and controls (shading, blanking, sync generator, and mixing) and an electronic view-finder, all at the camera position, enabled one operator to handle the job at that end. The transmitter was a 100-watt job, operated on 59 Mc. by special permission of the Netherlands licensing authority. The receiver was a converted Gee navigational-aid set.

Picture quality was good under sunlight conditions, and fair at night, when spotlight illumina-



Grouped around a homebuilt amateur TV receiver at Groningen are Henry de Waard, PAØZX, Harry Beenen, PAØBE, and Dick Lemstra, PAØTB. With this unit the 144-Mc. television transmissions from PAØVT have been received over distances up to 23 miles. (Photos by PAØUSA)

tion was used. Work on the equipment after the exhibition improved the nighttime picture quality, and the range was extended to as much as 25 miles. The gear was demonstrated at the annual PAØ conference at Utrecht later in the year.

In January, 1949, it was necessary to change over to 145 Mc. for transmitting, as the 59-Mc. frequency was discontinued as an amateur assignment. The 145-Mc. rig using an 829 final, grid-modulated, was used for a demonstration at another fair in August, 1949, this time at Winschoten, and has since been in operation at PAØVT. He has added a control unit containing three cathode-ray tubes, permitting monitoring of the signal before and after transmission, and inspection of the r.f. envelope.

Transmissions are made each Saturday evening between 2000 and 2230 local time. Talks and demonstrations by visiting amateurs are featured, and test patterns are transmitted at other times. Reception is good at distances up to 30 miles, and a number of receivers have been built especially to pick up these transmissions. Sound is transmitted on 29.6 Mc.

Thus, it appears that amateur television is now well under way, the moves in this direction having been made more or less simultaneously in many widely-separated areas. The necessary equipment is now available, interest is growing, and a new chapter in the history of amateur radio is being written. If you are helping to write it let us know what you are doing in the TV field, and how you are doing it, in order that the story of ham TV can be properly told in *QST*.