QST Looks at Television—1944

The "State of the Art" from an Amateur Viewpoint

BY CYRUS T. READ,* W9AA

For many years leading experimenters in the amateur ranks have interested themselves in television and some notable work has been accomplished. Since Pearl Harbor all amateur television has of course been discontinued, but the commercial broadcasters have continued to experiment and plan for the future. *QST* presents herewith an account of present-day television as it looks from the amateur viewpoint.

OF ALL the electronic miracles which have been promised to the postwar world the most widely anticipated probably is television. Ever since the early days of radio broadcasting the possibility of being able to see as well as hear by radio has intrigued the public's imagination and every faltering step forward in this new art has been eagerly hailed with the statement that "television is just around the corner." This great public interest, accompanied as it has been by many irresponsible predictions of immediate availability, has not been an unmixed blessing. There is no television equivalent for the crystal detector or simple one-tube receiver — even the crudest early attempts at video transmission by means of rotary scanning discs required comparatively complicated equipment — and most of the serious workers in the field have done their best to head off premature promotion.

The eventual place of television in amateur radio is not yet clear. As early as 1925 *QST* carried articles about the scanning disc systems of that day and since then has consistently presented the facts about new developments in the art when they seemed to offer possibilities for amateur use. At the same time the limitations and problems still to be overcome have been clearly set forth, a notable instance of "debunking" being the article, "Television — What About It?" which Ross Hull wrote in 1931.[1] Late in 1937 *QST* started on a systematic development program for amateur television. An introduction by James J. Lamb[2] was followed by a series of articles on modern cathode-ray television adapted for amateur use, which were discontinued only when war put a stop to most amateur experimentation. This report on today's television is not intended as a continuation of that series but, rather, is an appraisal of the present situation as a whole, an attempt to shed a little light on what has recently become a most controversial subject.

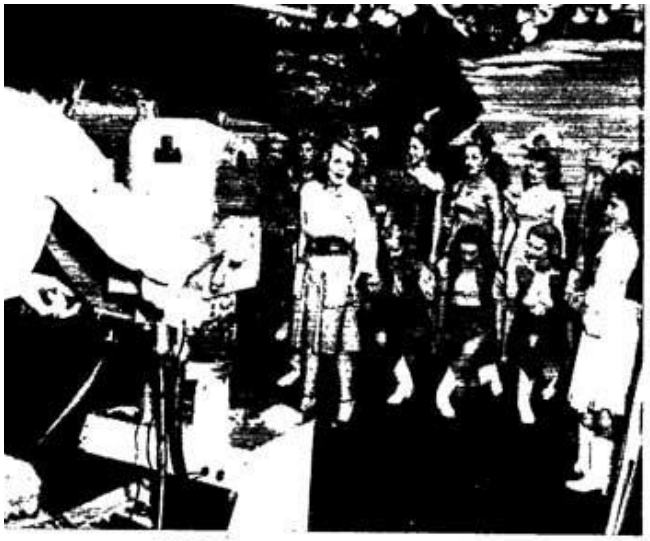
For the past many months the writer's principal duties have been to attend meetings and read voluminous reports, anything and everything that might conceivably have an impact on amateur frequencies. In the process he has been privileged to attend various panel and committee meetings of the Radio Technical Planning Board, meetings of the State Department's committee on radio allocations, and the recent hearings of the Federal Communications Commission. At many of these, television was the principal subject and the heated discussions between adherents of the present standards and frequencies and those who want to use more scanning lines and move to the u.h.f. region were strongly reminiscent of the 'phone-vs.-c.w. or high-vs.-low power arguments in amateur circles. *QST*, of course, is neutral regarding the television controversy as this is not an amateur matter. However, no dyed-in-the-wool ham can remain completely unmoved in the presence of a real good scrap over technical matters, so we determined to find out "what the shootin' was all about." Through the courtesy of Dr. Allen B. DuMont, ex-W2AYR/W2AHD, and Dr. T. T. Goldsmith, director of research for the DuMont Corp., we had the opportunity to visit WABD and inspect a modern television station.

The studio staff at WABD during the televising of "Parisian Memories." It takes a full size crew to operate all of this paraphernalia. The man in the left foreground is manipulating the microphone boom to pick up the singer's voice without letting the mike show in the picture.

* Assistant Secretary, ARRL.

[1] Hull, "Television, What About It?" *QST*, November, 1931, p. 20.

[2] Lamb, "Radio Amateurs in the Television Picture," *QST*, December, 1937, p. 8.



WABD has presented many interesting shows. Here is a scene from "The Boys From Boise," broadway musicomedy that was transmitted complete with orchestra, chorus girls, and all the trimmings.

WABD in Operation

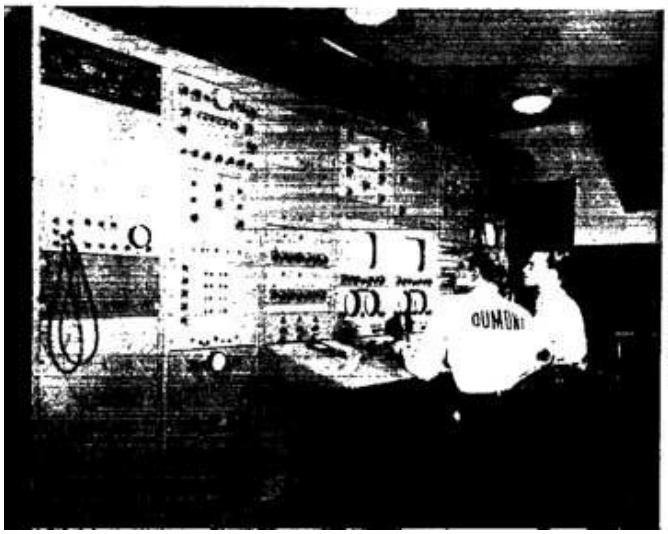
WABD is on the air three nights a week from 8 until usually about 11 P.M. Practically the entire staff of engineers and technicians is made up of regular DuMont employees who are operating this television station on an overtime basis in addition to their full-time job of war production in the plant at Passaic, N. J. As might be expected, most of them are amateurs or have an amateur background.

While WABD operates under a commercial license and many sponsored shows are regularly transmitted, the entire set-up is still of a more or less experimental nature. DuMont provides all of the technical facilities and personnel but programs are largely furnished by New York advertising agencies who have gladly accepted this opportunity to gain practical experience in the newest of advertising mediums. This coöperation has resulted in many interesting shows for the TVLs (television lookers), a notable example being the recent transmission of an entire Broadway musical comedy complete with orchestra, chorus girls, and all the trimmings.

Promptly at 7:30 P.M. we arrived at 515 Madison Avenue, New York City, and were greeted by Morris C. Barton, jr., ex-W4CRV, chief of operations.

WABD's transmitters, main control room, and studio A are located on the 42nd floor, while offices and studio B are on the 2nd floor. The studios are somewhat similar in arrangement to those used for standard broadcasting but they contain much more equipment. One wall is covered with scenery — back drops, stage furnishings, etc. Overhead are banks of incandescent flood lights, the type in which the reflector is a part of the bulb itself. Two camera dollies, small rubber tired trucks which carry iconoscope camera, preamplifier, power supplies, and camera man, trail a tangle of coaxial cables and power wires behind them across the floor while other cables run to an enormous spotlight and to the microphone which is suspended from an overhead boom, a la Hollywood. It takes a full size crew to operate all of this paraphernalia. In addition to the people normally used in any broadcast studio, such as sound effects men and announcer (in television a charming young lady), there are camera men, men to push the camera men around on their rubber tired mounts, spotlight operators, microphone boom swingers, property men to move scenery, announcement cards, etc., and a couple of assistant directors. Camera men and directors are "wired for sound" — they wear headphones through which they can receive orders from the principal director in the control room.

Television employs many techniques of the theater but there are some rather startling differences. Because the monochrome camera does not respond well to red, the lovely girl singer who was about to go on appeared for work wearing



Above — The control room of Studio A. The small monitors on top use the familiar 5-inch oscilloscope tube. The picture is green but these tubes serve the purpose until new equipment is available. *Left* — The main control room at WABD. The large monitoring scopes have 14-inch screens and reproduce the picture in black and white.

Which is which? One of the above pictures is from an original 8 × 10 photograph and the other shows how it appears after having been transmitted by television. You pick 'em out.

dark brown lipstick. The scenery was painted in various shades of gray which have been found by experiment to give the most natural appearance on the screen. The nonchalance with which scenery was moved during the performance also was rather surprising until we realized that no stage curtain ever invented could conceal such activities as well as switching off the camera.

We did not get to see the whole show as we were far too busy asking questions of the engineers and trying to find out "what made the wheels go 'round." The part that we did see was highly interesting and well worth watching. There has been much argument of late about the quality of present day television pictures. We viewed the WABD show on the control room monitor which operates directly from the coaxial line running to the transmitter and on the main station monitor which picks up the program from the air.

Both of these use 14-inch tubes and the picture appears to be about 8 × 10 inches or slightly larger. This is not nearly as large as will be available on good home television receivers in the future — it is expected that a projection type set capable of producing a picture 18 × 24 inches in size will have been announced before this article appears in print. It is possible, of course, to get close enough to the screen so that the line structure becomes visible but the same is true of almost any kind of pictorial material. Moving pictures are very crude when seen from the front row and world famous oil paintings cannot be appreciated until viewed from far enough away so that the brush strokes are not predominant. From a normal viewing distance the 525 lines of present day television are not noticeable. This is in no sense an argument against a greater number of lines. If better television can be produced we are all for it, but the present version is good enough to make us put some of those war bonds into an envelope marked "television receiver."

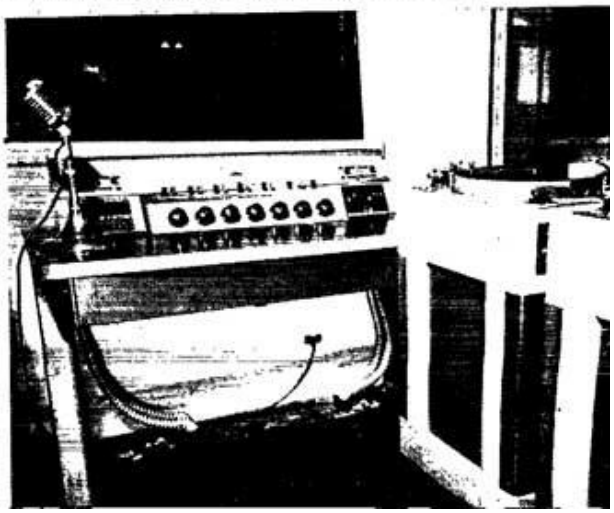
Control Room

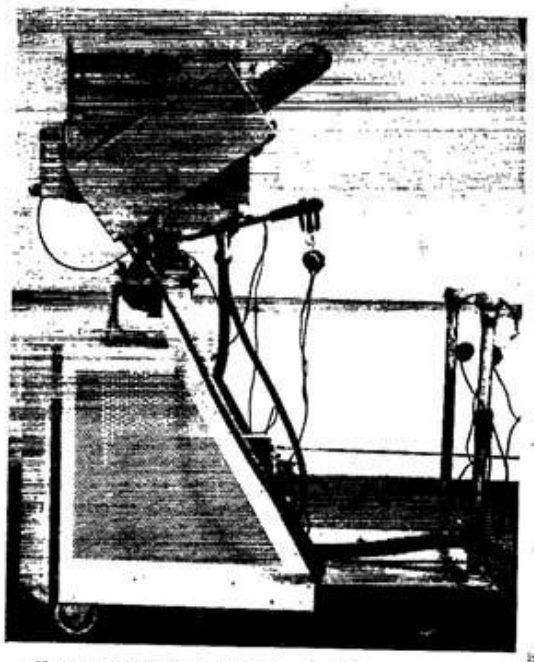
To get back to WABD. The studio control room also is much like the conventional b.c. type but with extra equipment and personnel. The sound control desk, which in ordinary broadcasting is the center of attraction, here is relegated to one side of the room. In its place before the plate glass window is a large console containing video controls, camera monitoring scopes, main studio monitoring scope, small scopes which show the detailed characteristics of the various video signals, scopes which show the "shading voltage" by means of which minor defects in lighting the picture may be corrected or special effects produced, and in fact more scopes than we had ever before seen in one place. In spite of the fact that Dumont manufactures these tubes WABD has to get along for the most part with prewar equipment, all new production being needed for war use at present.

As in the studio itself, the control room requires a large staff. One sound engineer is sufficient but there are video engineers for each camera, a principal video engineer at the main monitoring scope, and the program director who supervises the entire production. By means of two simple gain controls the principal control engineer is able to make "lap dissolves," that is, fade from one scene to another, which would be the envy of any Hollywood technician.

At the rear of the control room a large panel contains amplifiers and the synchronizing pulse generator which is the heart of the entire system. This generator provides the timing, vertical and horizontal sawtooth voltages, blanking voltages, and synchronizing pulses.

Turntables and main sound control panels at WABD.





Above — A camera dolly carrying iconoscope camera, electronic viewfinder (using another green 5-inch tube) and power supplies for iconoscope, preamplifier, etc. *Right* — Television camera opened to show arrangement of parts. The iconoscope tube is at the upper left with base including electron gun slanting down to the right. Lens equipment for focusing picture on the screen of iconoscope is at the upper right. The bottom cabinet contains the preamplifier with the input tube placed as close to the Ike screen as possible.

At WABD the camera man never lines up the picture by visual means. Instead his viewfinder is entirely electronic, a five-inch scope in a viewing hood mounted on the side of the camera and fed by a coaxial line from the control room amplifier. For this reason he makes no allowance for parallax and there is no danger that he will cut off the heroine's head in a close-up. It is as though the operator of a movie camera could watch the scene he was taking through the camera's lens system instead of through a separate optical viewfinder, certainly a very real advantage. At present the camera viewfinders and the individual camera monitors in the control room use standard 5-inch tubes which show the picture in varying shades of green, only the large tubes make use of the new

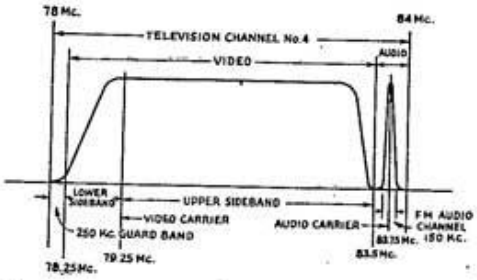
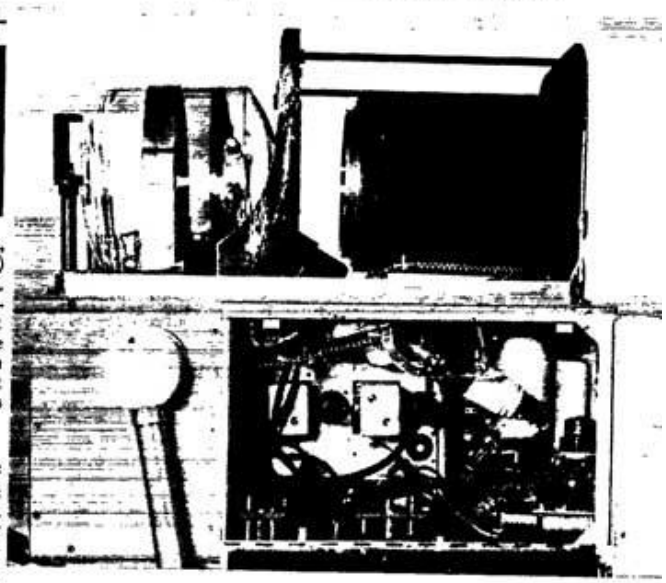


Fig. 1 — Television channel No. 4, showing how the six megacycles between 78 and 84 are used by WABD. The video carrier is amplitude modulated and has its lower side band partially suppressed.

type of fluorescent material which responds in black and white. Incidentally, the contrast and brilliance of the pictures on these black and white tubes was much better than we had anticipated, although it is claimed there is still room for improvement. As is also true of moving pictures, black and white are purely relative terms, the unilluminated screen of the scope itself being white. However, the variations of brilliance between the illuminated and unilluminated portions of the screen do produce a very satisfactory degree of contrast.

From the studio control room the program goes to the master control room located next to the transmitter room on the 42nd floor. All video signals are carried by coaxial cables while the sound



goes over an ordinary wire system. In the master control room the program is monitored again before being fed to the transmitter. In addition, master control switches between studios connect the special equipment which permits movie film to be televised.

Transmitters

The transmitters themselves are mounted in typical broadcast fashion in a large steel console extending the length of the room. Behind this imposing exterior, however, the rig looks strangely familiar, particularly to anyone who has done much work on the v.h.f. ham bands.

In the transmitter console the f.m. audio rig occupies the sections at either end and the video equipment fills the other five sections. WABD operates on channel four — 78 to 84 Mc. The audio channel starts off with a crystal on 129.244 kc. and multiplies by means of quadruplers, etc., to reach 41.875 Mc. in the f.m. exciter unit. Modulation is introduced through a compressor and a pre-emphasis amplifier and is accomplished by means of a phase shift method similar to the Armstrong system. After leaving the exciter the audio signal goes through an 807 doubler, an 829

buffer, a pair of 100THs, and into the final pair of 450THs. The output, approximately one and a half kilowatts, goes to a ring antenna mounted on top of the tower. The center frequency of the audio channel is 83.75 Mc. and the deviation is 75 kc. plus or minus.

The video channel starts with a 4953.125 kc. crystal in a Pierce oscillator using a 7C5. After quadrupling twice the signal is amplified and applied to the modulated stage, a pair of 100THs. Grid modulation is used and the modulator consists of two HK257s. Three broad-band Class-B linear amplifier stages follow the modulated stage. The first is a pair of 152Ts using a coil and capacitor in the grid circuit while the plates go to a linear tank. The following two stages use linear tanks throughout with hairpin coupling loops, all on a rather massive scale judged by amateur standards. The driver consists of two water-cooled type 8002 tubes and the final of two 889s which are water cooled and in addition have a blast of air blowing on the glass seals. The final stage operates as a grounded grid amplifier, excitation being applied to the filaments while the grids are by-passed to ground. This arrangement is much easier to drive at these frequencies than the usual system and nearly eliminates the need for neutralization. The antenna for the video signal consists of folded dipoles arranged in a cross just below the doughnut which radiates the audio signal.

The unmodulated video carrier is at 79.25 Mc. with an output power of approximately 6 kilowatts and has one side band partially suppressed. All of the video amplifying equipment in the station is essentially flat to 5 Mc. but the signal that finally goes out is cut off at 4.25 Mc. The disposition of the two carriers in the 6 Mc. channel is shown in Fig. 1.

QST has published many articles dealing with the theory and operation of television equipment so no attempt will be made to cover the same ground here. The most recent of these, an explanation of iconoscope operation, appeared in July, 1944.[3] However, one feature of modern television transmission which has mystified many hams is the method by which moving picture film of 24 frames per second is transmitted over a system employing 30 frames and an explanation of the method may prove interesting. Actually this is not as complicated as it sounds. Because of the interlacing action of the television scanning beam the picture is covered by 60 fields per second, that is, the beam starts at the upper left-hand corner of the picture and scans alternate lines and then returns to the top of the picture and scans the other half, filling in the vacancies left the first time through. Thus two of the 60 fields are required to completely fill in a single picture or frame. As this scanning action is continuous there is nothing in video transmission which exactly

[3] Southwell, "The Iconoscope," *QST*, July, 1944, p. 26.

Antennas of WABD, station of the Dumont Television Corporation atop the 515 Madison Ave. Bldg., New York City. The folded dipole is the video antenna, the doughnut is for the accompanying sound.

corresponds to the shutter action of a moving picture projector.

The conversion of 24 frame-per-second movies to 60 field-per-second television is accomplished by scanning one frame of film for 2 fields and the next for 3. In this way half of the frames are scanned twice, 12 frames — 24 fields, and the other half three times, 12 frames — 36 fields, making a total of 60 fields or 30 television frames. With the high-speed continuous action of the electron scanning beam this process gives results that are as smooth as could be desired.

Future Prospects

Disregarding for the moment the postwar use of television by amateurs let us consider its probable commercial form. In the very nature of things television programming will have to be far different from the practices which have grown up in the broadcasting industry. Ordinary broadcasting has come to be, in many homes, a normal background accompaniment to all household activities, the day-long parade of soap operas, shopping advice, and the like, constituting a gentle obligato to the song of the vacuum cleaner. Such cannot be the case with television. Once admitted to the home this new medium will prove far more exacting — demanding as it does, our complete and undivided attention. Unless the

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The transmitters at WABD. Panel at extreme left contains exciter and modulator for f.m. sound channel. Unit at the right contains final amplifier for sound. The rest of the equipment is all video.

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housewife can develop eyes in the back of her head and a dual personality she will certainly be unable to peel the potatoes, mind the baby, and do the week's washing while raptly listening to *and watching* the adventures of "somebody's other wife."

The pioneers in this new industry are well aware of these difficulties in program planning and are prepared to take appropriate action. It is very doubtful if continuous programs of the type now offered by standard broadcasting will be available, certainly not until a real demand arises. For the immediate future it appears that television broadcasting will take place during two well-defined periods of the day, a few hours in the afternoon devoted mainly to educational subjects, perhaps actually presented in coöperation with local school or college classes, and an evening program of entertainment running from 7 to 11 or 12 P.M. The costs of television programming are much higher than comparable sound broadcasts and this factor, combined with the inability of the TVL to sit still and look for more than a few hours at a time, seems reason enough to expect that our postwar television programs will be furnished

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only at those times when a comparatively large audience may be reasonably expected. In the event that this prediction turns out to be all wrong and we find that the "viewies" run night and day without even time out to polish our glasses we will have to admit that we grossly underestimated both the commercial possibilities of this new art and the ability of the American public to "take it."

Now for the amateur possibilities.

During our visit to WABD we met Chief Engineer S. R. Patremio, W2ITL, to whom we are indebted for taking time out in an extremely busy evening to describe the various circuits and explain their operation. We also met Howard Schubert, W2JUO, in master control; Melvin Stagg, W2CNO, and Otis Freeman, W4HGN, video engineers, and Richard Adler, W2NPB, sound engineer. In addition to the hams just mentioned, the following are members of the Dumont staff: W1ISI, W2AHU, W2EBU, W2ENY, W2GZA, W2HOD, W2HRZ, W2KCN, W2LNT, W2LT, W2LMA, W2LYS, W2MOH, W2NYY, W2OMI, W8TNC, ex-1RJ, ex-1SS/1RI, ex-W2HEI, ex-2XC/2XD, ex-W6CRM, and ex-W9KHG. A similar group probably can be found at other television stations. Knowing the proclivities of amateurs who work in broadcast stations to take a busman's holiday and sit up half the night pounding brass or yelling into a mike after having done a full day's work at practically the same thing, we think it highly probable that the operators of television stations will likewise go in for ham television.

It now appears that postwar amateur bands will include not only our traditional long-distance frequencies but will have in addition lots of room on the ultrahighs — what better use can we make of these frequencies than to plunge wholeheartedly into experimentation and research in this newest of communication mediums. Who can tell — the day may soon come when CUL will mean exactly what it says.