TECHNICAL SESSION NO. 2:
Microwave for CATV

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Participants:
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Dr. Joseph Vogelman
"Quasi-Laser Link Modulation Means for
Wide Spectrum Airlink CATV Services"

J. Walter Johnson
"Cars Band Microwave,
What It Is and What It Can Do For the CATV Operator"

Hubert J. Schlafly
"AML Report"

The Quasi-Laser Link System has been designed by Chromalloy American Corporation and conceived by Laser Link Corporation to meet the needs of the "superburgs" of the future. This system has vast implications to wide spectrum services in the home. The highlights of this system are:

1. Acceptable television reception when the signal-to-noise ratio is lower than: S/N=15 dB

2. 20-40 channels can be transmitted simultaneously on a single carrier

3. The modulation bandwidth can be as much as 25% of carrier frequency

4. 15 dB signal-to-noise means multiple uses of the same frequency in the same locality with suitable beam orientation siting, without co-channel interference. (See figures 1, 2 and 3)

5. Unaffected by normal rain, hail, snow, etc.

6. Economical to operate and maintain

The Quasi-Laser Link System has met the above requirements with a novel modulation technique on which multiple patents are pending. The modulation technique manifests itself as pulse modulation of the electromagnetic carrier in such a way as to vary both the pulse width and the spacing between pulses as a function of the information content. This system has a tremendous potential of airlinking all buildings in an area with 20-40 six megahertz channels, when required, from a single radiating source. The system functions independent of frequency and can work with carriers consisting of long wave, infra-red lasers, and other quasi-optical wavelengths including microwave.

The Quasi-Laser Link Communication System as described overcomes the high linearity problem inherent to microwave systems. The Quasi-Laser modulation techniques provide reliable short distance links through rain, fog and smog and also permits broadcasting in an uncluttered spectrum not susceptible to distortion from aircraft. The system will be operative under all atmospheric conditions and could even compensate for very rare periods of hurricane rain, of large particle size hail, and extremely dense fog. Overall the system will have a greater service reliability than a conventional CATV wired-system.

The reference articles show charts and measurements which validate performance under all weather conditions.

The role of the Quasi-Laser Link in the future of communications could be appreciable since data collected in experimentation

conducted under research licenses granted by the FCC to Chromalloy American Corporation, which is developing the system, indicate that it can operate on any assigned carrier frequency within the band of 10 to 10,000 GHz. The current state of the technology is such that maximum economies are associated with the lower frequencies closest to 10 GHz.

In instructional television, for example, a 20-channel instructional television broadcasting system operating under the Quasi-Laser Link principles could be made available at a cost approximately equivalent to that of a 4 channel service in the presently authorized 2,500 MHz ITFS band.

The Quasi-Laser Link channel capacity is so expansive and versatile, two or more electromagnetic carriers on the same frequency, each with a 20-channel capacity, can be utilized in contiguous areas and their beams diffused in different directions without interference as shown in Figure 1, 2 and 3. This versatility "removes the lid" on the number of services and applications possible in a locality, all beamed to roof-top, down-converters and thence, by intra-building cable into existing black and white or color television receivers.

This system which eliminates the need to make an unprofitable deal with the telephone companies opens new vistas for the CATV operator:

It provides a basis for the establishment of new types of low cost communication services at the purely local level.

It provides a supplementary arm for educational television that assures ultimate fulfillment of visual broadcasting as an important "teaching tool" at scholastic and collegiate levels and improves the image of the CATV franchise holder in providing this service.

It is an economic means of establishing Community Antenna Systems in urban areas by surmounting the obstacles of trenching through concrete, while "blending" its service into master antenna systems and coaxial cable installations.

It paves the way for expanded Community Antenna Systems in rural or suburban areas by joining contiguous small communities, jumping highways, crossing rivers, surmounting terrain barriers - and doing so economically in lieu of cable.

It makes possible channels for municipal and civic services; medical information for physicians and surgeons; community social service agencies; religious denominations - and more without affecting the basic entertainment function of CATV.

To understand how to install a Quasi-Laser System we will take you through the procedures of an actual planned installation.

The procedures required from initiation to operation can be grouped into the following general steps:

a. Location of origination point

   (1) Head End for off-the-air TV signals
   (2) Studio facilities for local generation

b. Location of market

   (1) Market survey
   (2) Economic evaluation of potential receiving sites
   (3) Comparative cost evaluation of various combinations of cable and Quasi-Laser Links

c. Mapping analysis to obtain optimum paths and site locations including a determination of required tower heights and relays to get line of sight paths

d. Field survey in accordance with the variables arrived at in item 'c' together with angular measurements from both terminals of all obstacles within the 20 dB points of the receiving beams

e. Optical survey to establish details of construction required, azimuth and elevation heading for all terminals

f. Radio survey to measure path losses over each transmission path at the required frequency

g. Elevation plotting of all paths to determine potential obstacles and placement of relays or reflectors

h. Systems engineering of layout of transmitter relays, reflectors, etc. for maximum cost effectiveness including computation of power requirements, amplification, antenna characteristics, reflector dimensions, etc. based on environmental and propagation analyses

i. Prepare specifications for power requirements, land acquisition and easements and shelters required

j. Provide detailed specifications for all transmitter and receiver components, channel amplifiers and local site cable distribution equipments

k. Install transmitting and receiving antennas for each site and make field strength measurements to confirm path losses and component criteria

l. Install transmitting equipment and relay transmitters and conduct propagation tests to determine signal-to-

noise margin under the required degree of reliability, greater than 98%

m. Tie in TV channels to Quasi-Laser Link modulation and transmitter and install receiving and demodulation equipment at each receiver site and measure and received signal level of each demodulated TV channel, i.e., TV Channel carrier levels

n. Adjust input levels of individual TV channels for equal output levels

o. Conduct system propagation and signal level tests while system is operating

Shown in figure 4 is the transmitter site of a Quasi-Laser Link in New York City. The site is in a location with a clear view of the Empire State Building which houses all the VHF TV station antennas. The site is so located that there are no sources of potential reflection within 30 degrees of line of sight to the Empire State Building and no sources of potential reflection behind the receiving antennas.

The three TV receiving antennas shown are used to pick up the TV channels for retransmission by the Quasi-Laser Link. The small building houses all the front-end channel amplifiers and the modulation and transmitter components.

The parabolic antenna is three feet in diameter and operates through the open door of the building and is set up well behind the door opening to protect it from the elements. In this configuration the building must be erected such that the face containing the door is perpendicular to the path of the beam.

The receiving site is located in the window of a building so situated that it is in the shadow of the Empire State Building amidst many other buildings of equal or greater height. The location is such that normal reception of TV signals shows the presence of many ghosts. The receiving site requires the Quasi-Laser Link receiving antenna to look between several buildings which fall well within one degree of the center link of the antenna pattern on either side and below it. The nature of this site is such that 20% of the beam's energy is intercepted by the buildings.

Since the location of this receiving site precludes the taking of good photographs, a photograph is included of a portable receiving terminal being tested in Carle Place, New York. This unit is shown in figure 5. The microwave portion of the receiver is mounted in a small box behind the 3 foot parabolic antennas and the final demodulator and amplifier is contained in the box at the side of the antenna mount. In this text configuration a small TV set is used to view the individual TV channels.

At the present time, a reflector is being fabricated for installation on one of the buildings which intercept part of the beam to reflect the transmitted signal at right angles to another receiving site. This reflector consists of a 4 ft. by 4 ft. polished aluminum sheet reinforced by aluminum angles.

Other Quasi-Laser Link systems currently being engineered include an 11 site configuration spread over three counties in very mountainous territory. In this situation towers of sufficient height to provide line of sight between origination point and receiving sites are prohibitive in size and cost. To obtain satisfactory results tower mounted relays are installed on the highest available ridges even though this requires irregular paths between sites. The relay is an 80 dB gain amplifier between receiving and transmitting antennas cross-polarized with respect to one another.

Another installation uses two antennas on an existing head end tower fed from a single Quasi-Laser Link transmitter to connect four small towns to an existing CATV operation now carrying eight channels. The receiving sites feed cable distribution systems connecting to the homes of the subscribers. The Quasi-Laser Link provides an economical means for reaching widely separated areas over water obstacles.

In North America the most important fact about this development is that it links every building in the urban area via air and costs far less than trying to cable people for even partial TV service. It does take some business away from the telephone companies, will fragmentize some of the broadcaster's audience and bring back viewers who have the tuning out habit. However the FCC in their final decisions have always supported their responsibility to the people of the United States to make maximum use of the airwaves, and many of the frequencies needed from 10 to 40 GHz are unassigned. The system proponents are seeking the progressives in government to overcome the reluctance of those who do not recognize the growth of new communication services. It is time to overcome the fear of the future and break through the barriers and positively exercise governmental power.

It is anticipated that the synergistics of the Quasi-Laser Link system will open new entertainment, education and communications vistas for urban dwellers and businessmen who have the wit and the means to benefit from these Wide Spectrum Services.

This Quasi-Laser Community Antenna Television System opens a wide spectrum of services for multiple dwelling residents who may be airlinked by a grid of dispersed beams. The new air link systems will offer CATV, commercial and business subscribers all available TV and FM entertainment channels along with additional services associated with education, shop by television, business and computer data, continuous news and weather and for a host of other entertainment, industrial and educational purposes.

The application of this principle to satellites in the laser band will offer these services to all areas of the world on a very economical basis.

The new worlds the Chromalloy-Laser Link people believe they will create seem to confirm the words of Marshall McLuhan, the prophet of the media, who wrote two years ago, "The medium, or process, of our time - electric technology - is reshaping and restructuring patterns of social interdependence and every aspect of our personal life. It is forcing us to reconsider and re-evaluate practically every thought, every action and every institution formerly taken for granted." The hope is that this total involvement technology will create new understandings, new attitudes and make possible a new will for peace.

CATV is a new urban medium at this time and all of the development work to use this medium for the purposes outlined above are in process by industry, entertainment and service leaders. Urban support is expected as city leaders realize that CATV can inform, educate and entertain the citizenry and that the plus services of CATV can advance a city's growth pattern, aid in protection of life, property and ease transportation problems. Most important is that the installation and usage of a total involvement system will enrich a city's social and cultural life as well as permitting all to participate in the political process.

We must possess courage and vision if the communications world we talk about is to come to fruition. Those of us who participate in this NCTA conference will face our greatest test and challenges in the next decade. We cannot afford to make a wrong evaluation of the present, or in our prediction that the future of communications will transform our world into a new electronic environment. We must exploit and keep pace with change but not fall victim to it.

Reference articles on the Quasi-Laser Link System are:

"The Quasi-Laser Link CATV System", Dr. Vogelman, Ira Kamen, Electronic & Appliances Specialist, April 1968.

"A New Departure in Television Air Links", Dr. Vogelman, Ira Kamen, International Broadcast Conference IEEE LONDON, September 9/13, 1968.

"Novel Modulation Means Opens Wide Spectrum Air Link Communications in Unused Frequency Range", Dr. Vogelman, Ira Kamen, Laser Link Presentation to FCC, Washington, D. C., October 24, 1968.

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"A New Dimension in Television Air Links", Dr. Vogelman, Ira Kamen, IEEE Transactions on Broadcasting, March 1969.

"Tomorrow's Television -- Today", John Minor, Pageant Magazine, February 1969.

"The Congeneric Synergism of the Quasi Laser Link System", Dr. Vogelman, Ira Kamen, Broadcast Journal, March/April, 1969.

"Laser Link Modulation Means for Wide Spectrum Telemetry World Wide and Urban Communications Systems", Dr. Vogelman, Ira Kamen, NTC '69, Washington, D. C., April 23, 1969.

"Cabling without Cable", Ira Kamen, BME Magazine, June 1969.

20-CHANNEL ITFS QUASI-LASER SYSTEMS IN LOCAL SCHOOL DISTRICTS TO SUPPLEMENT ONE-CHANNEL VHF OR UHF ETV STATION INSTRUCTIONAL PROGRAMS AND CONFORM WITH "BELL SCHEDULE" OF GRAMMAR, INTERMEDIATE AND HIGH SCHOOLS

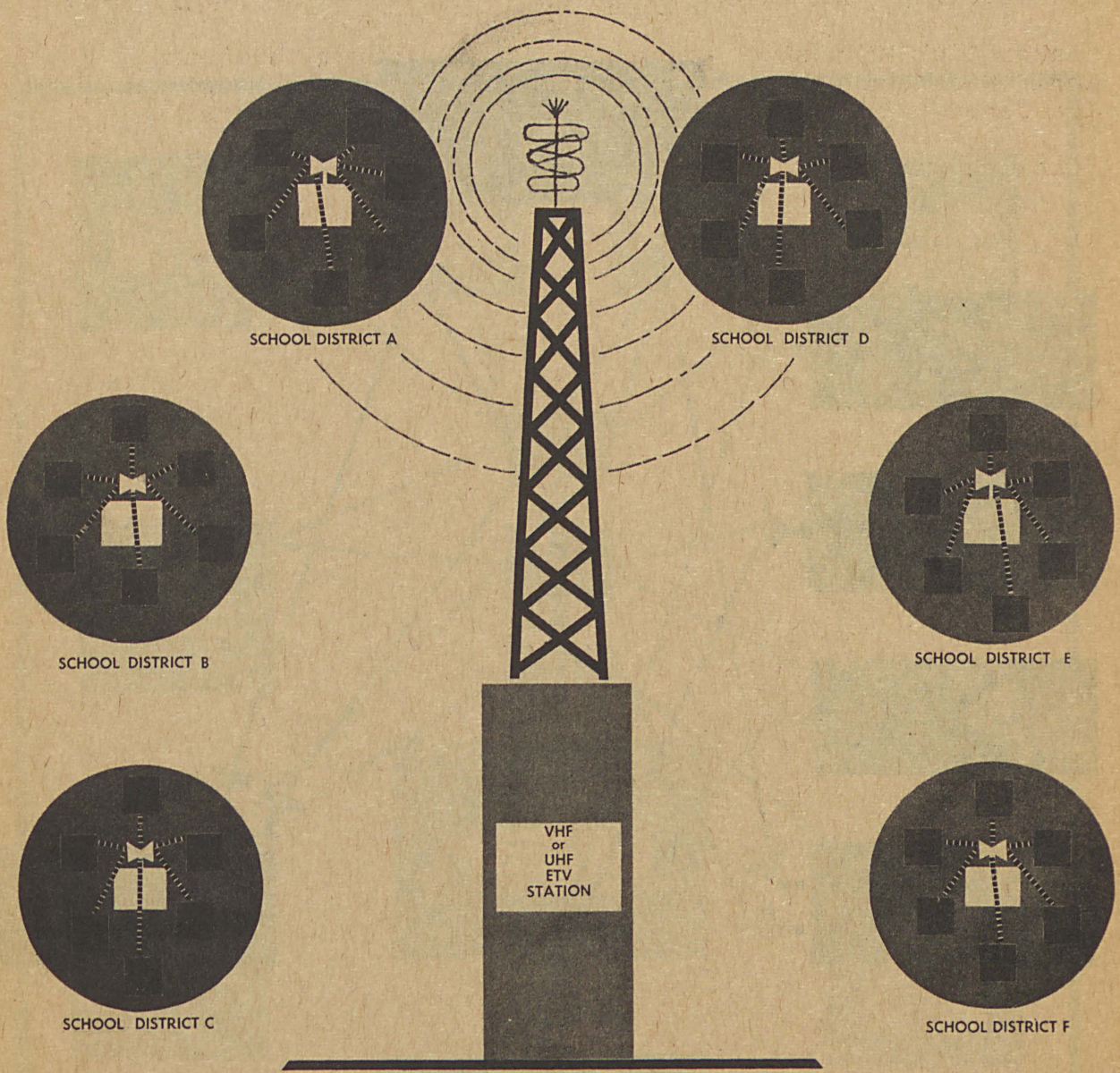

Figure 1

TYPICAL LAYOUT SHOWING USE
OF SAME FREQUENCY BY 3 DIFFERENT
BROAD BAND QUASI-LASER TRANSMITTING SITES
IN SAME LOCATION.

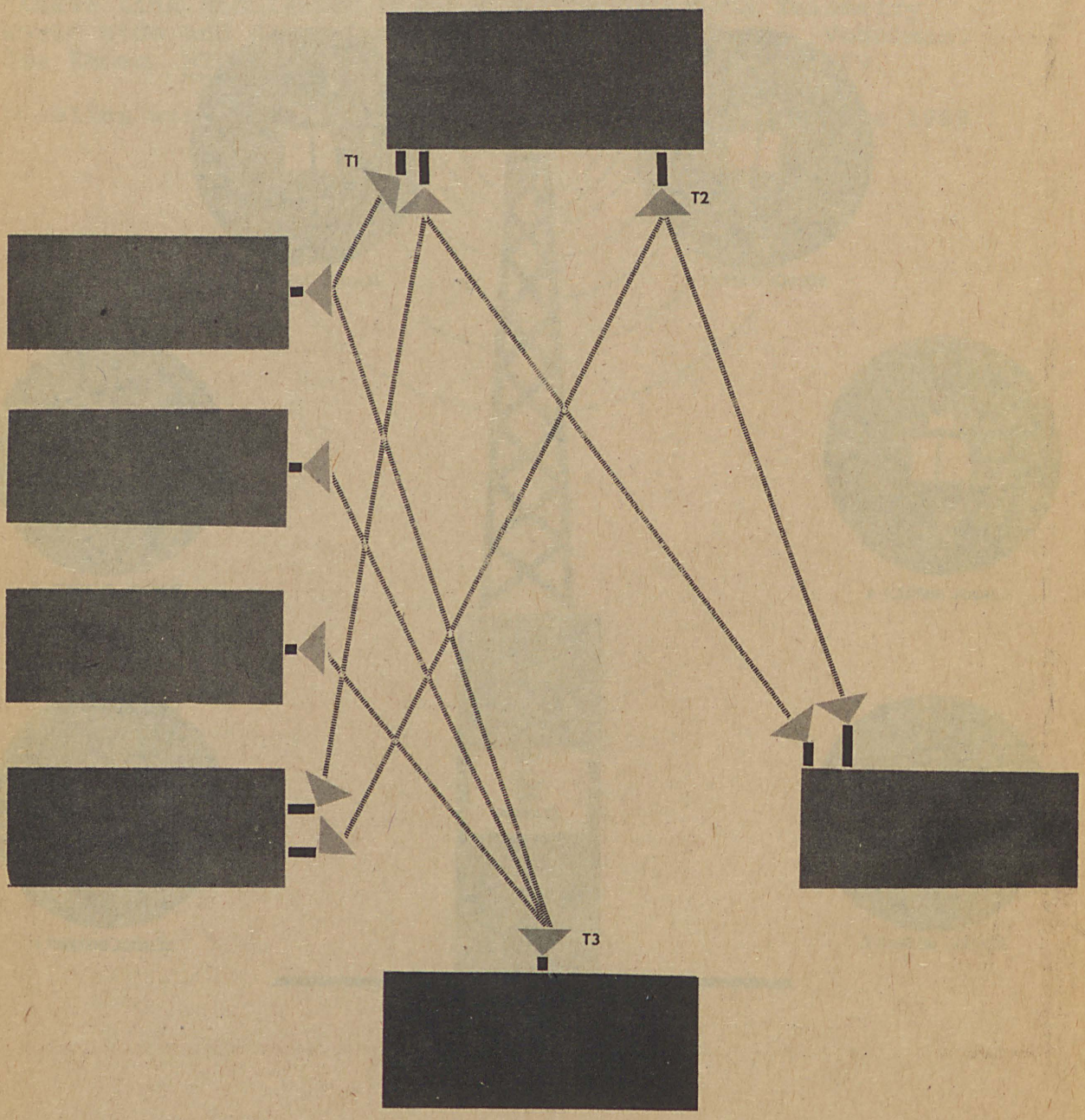

Figure 2

EDUCATIONAL, MUNICIPAL, CIVIC, RELIGIOUS AND INFORMATION SERVICES POSSIBLE ON MULTI-CHANNEL, QUASI-LASER LINK TV SYSTEM

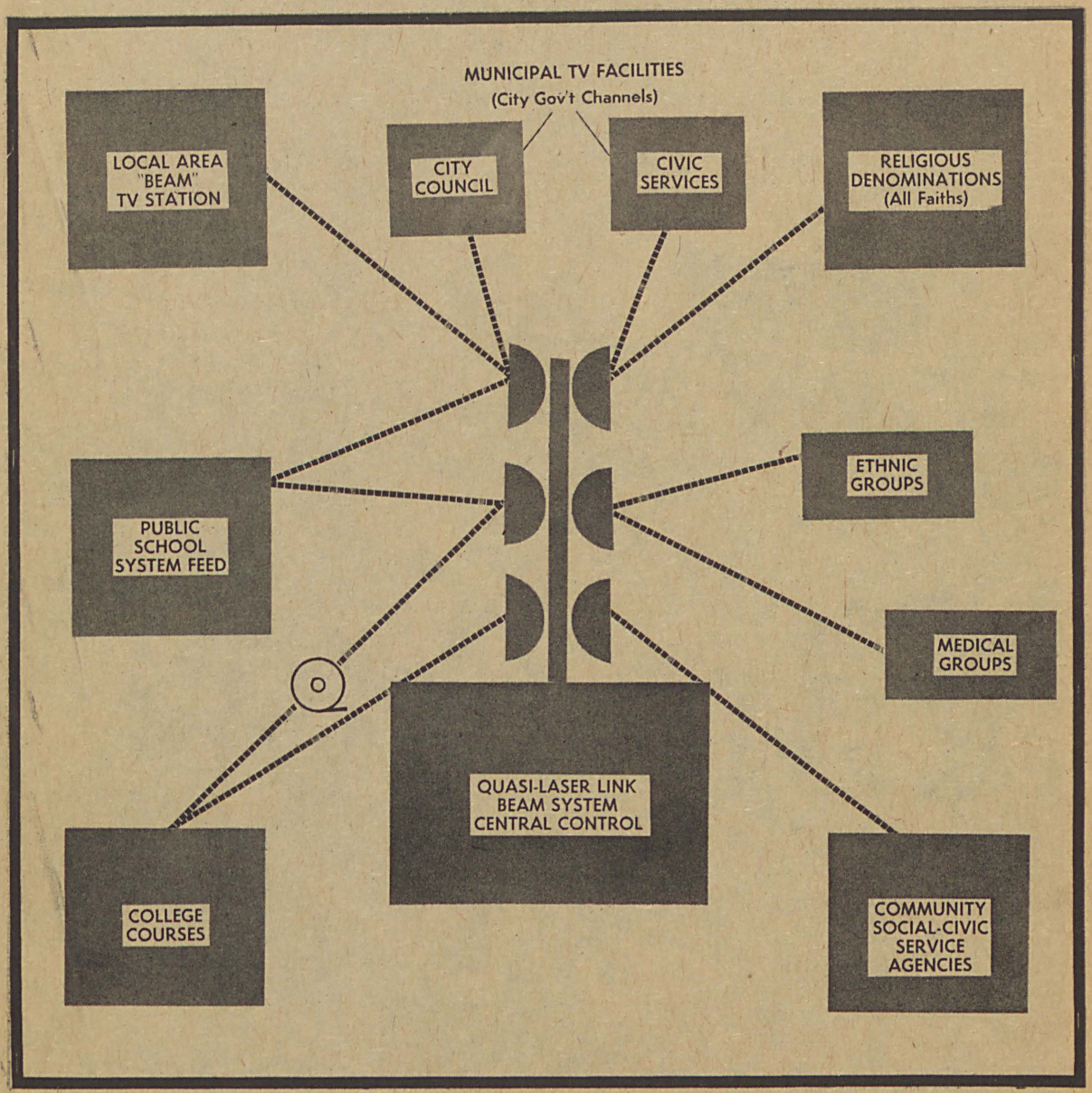

Figure 3

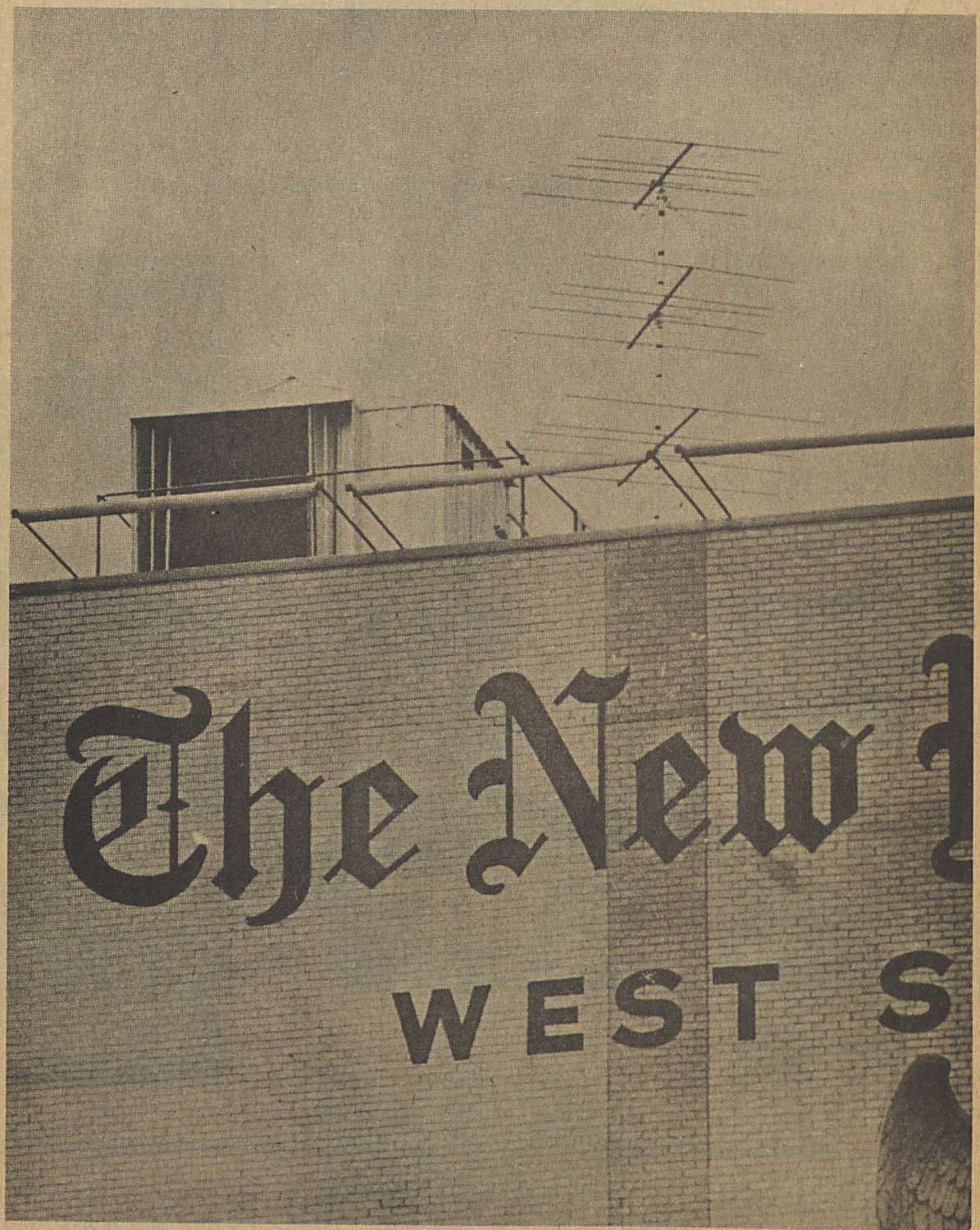

Figure 4

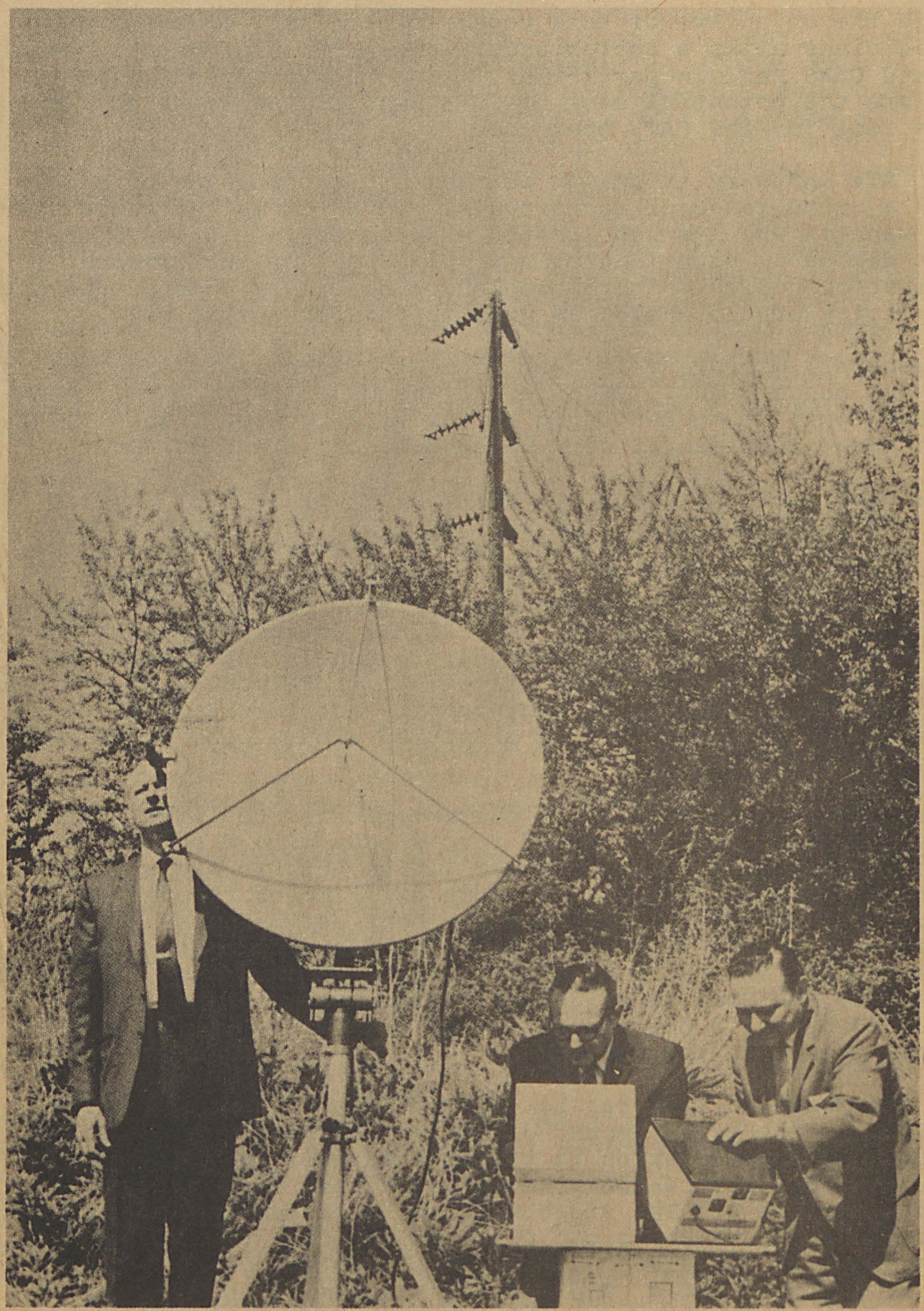

Figure 5