National RADIO-TV NEWS

IN THIS ISSUE

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Transistors

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Friendship

IT MAY be old-fashioned to believe that success in business is dependent upon friendship but if it is, we plead guilty. For friendship is the watchword of the National Radio Institute.

I might amplify that a bit and say, friendly service is what has helped greatly to build the National Radio Institute into the largest institution of its kind in the world.

A friendly attitude toward those with whom we are associated and toward those with whom we do business brings handsome returns. I have new proof of this every day. The friendly tone of letters we receive from students and also from graduates of many years ago is a genuine inspiration to us.

In our relations with you we try, at all times, to do things in a friendly and cordial way. In turn you show the same attitude toward us. As a result we are brought closer together and there is better teamwork.

Friendship is one of the pillars upon which a business is built. Keep that in mind. Never forget it.

J. E. SMITH, **President.**

J. B. Straughn

A De Luxe Fringe Area TV Installation

By J. B. STRAUGHN
NRI Assistant Director of Instruction

ABOUT this time every year the Stripers and Bluefish start running in the surf and I get fishing fever. With a carload of kids, fishing tackle and Mom we head for the fabulous Eastern Shore, through Maryland and into the wilds of Delaware, finally coming to roost at Bethany Beach.

Everything on the trip invariably goes fine until we get across the new Bay Bridge and then the antennas start.

It is a gradual and insidious thing — first there are the lazy H antennas with high and low band sections, next there will be stacked conical antennas with a sprinkling of double Vees and Inlines.

The scenery slowly changes as we roll along with more and more of the four stacked jobs showing up. Scattered here and there are tall towers, replacing the more prosaic roof and chimney mounts. A few installations use telephone type poles and some tinsmith is evidently making a killing assembling long masts of downspout guttering.

My excitement grows as we speed along until we reach the six stacked Yagi's cut to channel 13 and perched dizzily atop a 75-foot stripped pine tree. At this point I am just about able to slow the car enough to make the sharp turn, so thoughtlessly located near this wondrous TV installation.

Having fought the family off all this time, I finally give up and complete the trip with my daughter at the wheel and my head out of the window, happily murmuring to myself the magic words "four stacked X, 12 element Yagi, mattress array, telephone pole mast, stacked lazy H, full-wave spacing, etc."

The family always stops at Bridgeville where they stuff themselves with some of the best pie ever. Being above such things, I go next door to this purveyor of pies to renew my acquaintance with NRI student Russell Hitchens. He is the proprietor of Hitchens Home Appliance and handles radios and TV's, in addition to stoves, refrigerators, and other useful gadgets. I have picked up some mighty good information from Russell on the performance of various TV antennas and receivers.

We eventually get on our way again after I have had my arm twisted into a piece of pie and finally pull up in Bethany, at Jim Barker's rooms and apartments. After a hurried greeting I take off, not to the surf with my trusty rod, but to the local dispenser of condensers and resistors, to see how TV reception has been since my last trip, and if the new boosters have helped on the New York stations.

Jim Barker, my genial host, is a year round resident of Bethany and tells me the winter evenings get mighty long.

Bethany is located about half way between Ocean City, Maryland and Rehoboth Beach, Delaware and, when the summer visitors have left, takes on the appearance of a ghost town. Even the radio is not much help due to the constant arcing across the insulators on the high voltage power lines.

Jim and I invariably get into a discussion on a Barker TV installation and whether the nearby water tower would help or interfere with reception. We try to decide whether we could get more and better pictures than the other TV hopefuls in this ultra fringe area and if a TV installation would really save Jim money. An evening's entertainment for Jim's family consists of a fifty mile round trip in the car to the movies with perhaps sodas, candy and popcorn and maybe a meal. We figured out that a TV installation would eventually save money so we made up a rough list of components and I got to work assembling the equipment prior to its installation.

For those who have not had the pleasure of observing TV reception at distances of fifty miles or more the following facts will be of interest.

Notes on Reception in TV Fringe Areas

Anyone who has seen TV pictures in the fringe areas will agree that they are, generally speaking, far inferior to those picked up within a few miles of a TV transmitter.

However, the fringe area enthusiast will sit for hours watching a play or wrestling match through the noise produced snow flakes on the screen. It is not that they don't know good TV reception when they see it, for at times excellent results are secured in the fringes. To those in remote areas, TV is still something of a miracle and a little miracle goes a long way!

If you sit back from the screen a reasonable distance the snow tends to disappear and you may be troubled only with noise, fading and occasional loss of sync. It has to get pretty bad before the set is turned off. Parents find one advantage in that the children don't glue their noses to the screen and are not apt to become nearsighted watching Hoppy or Super Circus.

At times reception is excellent—I have seen pictures over great distances that were just as good as locals.

Much depends on the ducts through which the TV signals are refracted. These ducts consist of alternate layers of warm and cold air and the signals are bent in passing through them in much the same manner as light rays are bent by a prism.

If the weather becomes unsettled, the ducts are dispersed and TV reception may cease or become very poor until they reform. In most cases excellent results are obtained early in the morning and late in the evening. Very often good reception is secured at such times while the early evening results may be poor. At other times everything within range comes in but co-channel interference may appear. This takes place when signals from two stations on the same channel are received. The result is black horizontal bars on the picture known as the venetian blind effect. This is unpleasant but will not make the fringe area viewer turn off the set if he wants to look at the particular program being transmitted. Of course, a good antenna will help in eliminating co-channel interference but in many cases it must either be endured or you must switch to channels on which only one station is picked up.

Best reception is usually obtained on the lower (2-6) channels. When good results are secured on channels 7 through 13 the low channels may be missing. Occasionally both highs and lows are received equally well. I have seen channel 13 in New York City deliver a picture every bit as good as that received in primary areas.

Everything is Important in a Fringe Area Installation

In a good TV fringe area installation every last db of signal is funneled into the receiver. This means the difference between success and failure, because if the signal strength just reaches the right level with respect to the locally picked up noise you will have a snow-free picture. The amount of snow depends upon the relative strength of the noise and picture signals entering the set. The receiver must also be a good one with a front end that does not manufacture noise in large amounts.

The new cascode circuit used in modern TV front ends does an excellent job in producing a noise-free i-f signal.

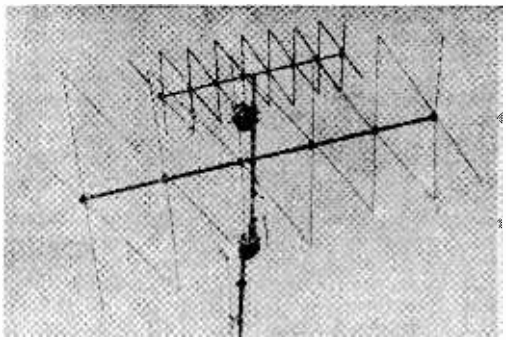
A weak point anywhere in the transmission system can ruin results which might otherwise be excellent. In any TV fringe area installation there are a number of factors that must be considered and which will be discussed here.

The Location of the Antenna

If there is a choice, the antenna should be located away from power lines and nearby reflective objects. Wherever possible, the lead-in should be the shortest distance between the antenna and the receiver. The location of the receiver in the home thus governs to some extent the location of the antenna on the roof. It is true that moving an antenna 10 or 15 feet may give an increase in signal strength but in most installations it is not possible to place the antenna at any desired point on the roof. Where it is possible to do this, a pre-search with the antenna on a portable mast might be of some value.

Antenna Height

The antenna in a fringe area should be as high



Close-up view showing Trio ZZ12L and ZZ16H zig-zag antennas, the Trio TR2M rotator. The Electro-Voice 3010 Tenna-Top booster is between the two antennas.

in the air as possible. However, it is wise to remember that doubling the height may result only in a slightly better picture when viewed on the screen. For this reason it would not be using good judgment to spend much money or effort to raise the antenna from 50 to 70 feet. In other words, an increase of only a few feet is not of sufficient value to repay the effort. However, it would be worthwhile to raise an antenna from 25 feet to 50 feet or from 50 feet to 100 feet.

The height at which the antenna may be placed depends upon the amount the set owner wishes to spend and to some extent upon his house. If the house is sturdy and well constructed, it may be possible to mount the mast on the roof, thus saving thirty or more feet of mast or tower which must otherwise be planted on the earth.

If a very high antenna is to be used it must be remembered that it will need servicing and that eventually a new lead-in will be required. It should be possible either to climb the tower, if one is used, or to lower the mast on the roof easily so the antenna can be serviced.

The Type of Antenna

There are almost as many types and brands of fringe antennas as there are receivers. Some antenna manufacturers make extravagant claims of long distance reception in their advertising while others are more conservative. All fringe antennas will work in fringe areas and all will at times give marvelous results but, when the signals fade out, no antenna will manufacture its own signal. Some look impressive enough to make their own signals but my researcher has yet to turn one up. Also when the signals really roll in and over-ride local noise even indoor "rabbit's ears" would probably work and a plain dipole definitely will work. However, for "day in and day out" reception, you will want the highest gain antenna that your pocketbook, muscle and tower or mast installation will handle.

Some of the more elaborate fringe antennas are, when resting on the ground, 12 feet high, 8 feet wide and 4 to 6 feet thick. The expense of the antenna isn't so bad, but it is a 3 or 4-man job to put one up and they need at least a 50 foot tower, solidly mounted on the ground with guy wires attached to buried anchors. The wind pressure on these antennas can be terrific, and of necessity they squat right on top of the tower with the rotator, when used, buried among the interlacing tower girders.

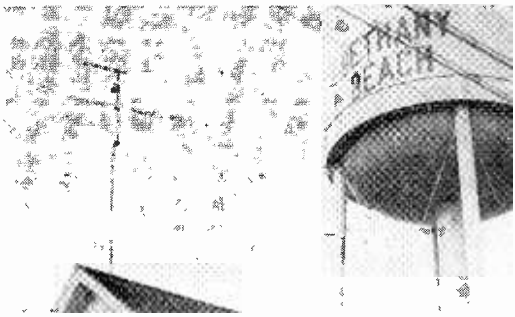
The ideal fringe area antenna is a lightweight, high gain, low wind-resistant unit which will pick up all the high band and all the low band TV stations operating in VHF. Also, it should not moan, howl or give out squeals when a high wind whistles through the elements.

A Yagi would be ideal except that it is limited to one or possibly two or three channels.

The Antenna Booster

The antenna booster or tenna-top booster is a newcomer to the field. It is usually an all-channel, untuned booster mounted right at the antenna. The antenna feeds into the booster where all signals picked up by it and lying within the VHF bands are amplified. These strengthened signals are then sent down the lead-in to the receiver. Usually the noise picked up by the lead-in is considerably weaker than the signals. Most of these boosters receive low voltage ac power over the lead-in and are equipped with filters so arranged that there is no interference between the TV signals and the ac power current. For best results in fringe areas the antenna top booster is a must. In those localities where you are limited to only one station, a booster of this type tuned to the desired channel may be used to advantage and the fact that its band width is relatively narrow will further limit the noise signal fed the lead-in.

Jim Barker at the ten-foot level. He recommends a pillow when seated on the ladder to pull up the extensions.



The antenna on Barker's apartments showing the high-voltage power lines and Bethany's radiating water tower.

The Rotator

In most fringe areas, TV stations which can be received are located in different directions. This means that there must be some way of turning the antenna so that it faces the desired station. An electrically operated antenna rotator with a control box mounted at the receiver should be used. The rotator should be rugged and weather-proof. There are many satisfactory rotators on the market.

The Lead-In

While it is important that the lead-in pick up as little noise as possible, coaxial cables and shielded lead-ins are not often found in fringe areas, since they have considerably more signal loss than the conventional ribbon type 300 ohm lead-in. Furthermore, the coaxial lead-ins need to be matched at the antenna and at the receiver for best results.

A high quality lead-in should be used and, if the location is in a beach area, it is worthwhile to coat the lead-in with a silicon compound made especially for this purpose. Not only will the antenna be protected from salt incrustation to some extent but the effect of water on the lead-in with a consequent change in impedance and signal loss will be greatly diminished.

Those lead-ins with part of the insulation cut away from between the wires are excellent and they have less loss than those using continuous insulation. A recent development is a lead-in with a plastic sheath to protect against salt incrustation and moisture. This lead-in must be handled and installed with great care—otherwise the sheath will break and in a heavy rain the lead-in will act like a water hose. The open line type lead-in is also excellent but can be hard to handle when used with rotators.

Lightning arresters and the correct number of standoffs should be used in bringing the lead-in down to the set. A sufficient number of stand offs is particularly important where the lead-in may be subject to twisting or flapping in high winds. Insufficient support in such a case will cause broken lead-ins.

The Receiver-located Booster

Although we have mentioned tenna-top boosters, it is necessary to have a booster at the receiver. In the early days of fringe area reception, two boosters were often used at the set. Frequently, oscillation between them occurred and the results were often very poor. With two boosters separated by the length of the lead-in, there is little danger of feed back and oscillation.

As is the case with antennas, there are a very large number of boosters on the market. Don't be misled by low prices. The best booster is none too good. Unfortunately, you may find that there is a variation between boosters of the same make and that one booster will work well on one set but not on another. Where your dealer has a number of boosters, it is worth while to arrange to try out several, using the one which works best with your installation.

I personally favor the untuned boosters both on the antenna and at the set. It is difficult to tune a booster, tune the set and manipulate the rotator controls all at the same time. With an untuned booster at the set, the operation of the TV receiver is about the same as it is in primary service areas. Only when considerable local interference is present would a tunable booster at the receiver be justified. However, where there is FM interference and other interference which is not at the same frequency of the desired sta-

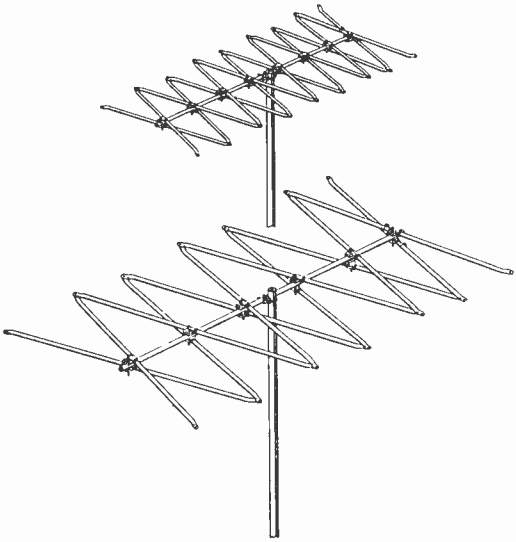
An unknown actor in an unknown play from 200 miles away.

tion, a tunable booster will help reject it and should be tried.

The Receiver

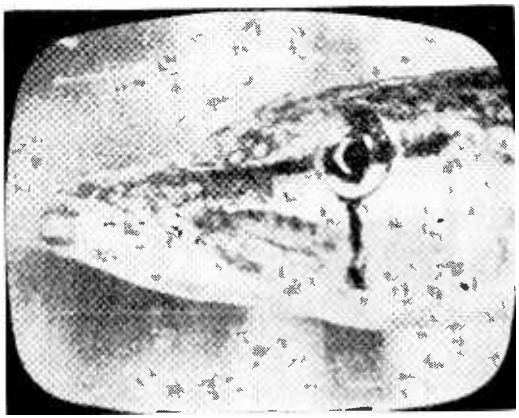
The receiver should be "hot." Most manufacturers make receivers especially for use in fringe areas and the more suitable models of the line are modified by the distributor before being sent out to the dealers. Sometimes this consists of slight circuit or alignment changes, a better front end or perhaps only the insertion of hot tubes in the video i-f amplifier.

You should choose a receiver which has real ability to hold sync on weak signals, uses a cascode type front-end and which has an agc control system designed with the idea that the receiver may be used in a fringe area. The above pointers on equipment to use in fringe area installations show that there are many types of sets, boosters, lead-ins and antennas. In this particular article, I chose certain equipment which has given excellent results. The use of their brand names does not mean that other equipment will not work satisfactorily but my own experience has shown that the items mentioned here give excellent results.



Courtesy of Trio Mfg. Co., Griggsville, Illinois

The ultra fringe, Zig-Zag, Trio High and Low Band VHF antennas. ZZ16H (above) covers channels 7-13 and ZZ12L (below) covers channels 2-6. A special harness is used to connect these antennas to the single lead-in. When used with the Electro-Voice Tenna-Top booster the harness is not required as each antenna feeds into a separate amplifier, and the signals are mixed electronically.



This 10-pound pickerel was caught on New York's channel 2 from Bethany Beach, Delaware. Not a bad 200-mile cast!

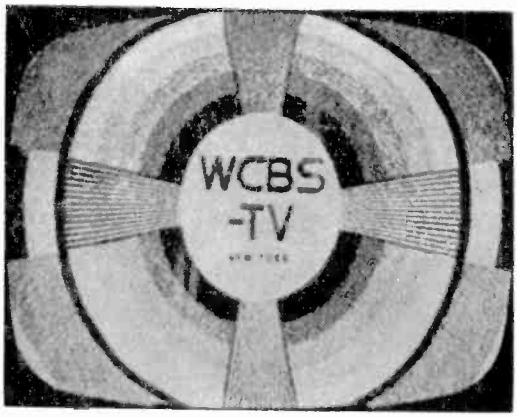
Equipment Used in Jim's Installation

Not just because the nearby 150 foot water tower would make a 50 foot mast or TV tower look so futile, but because of a good sturdy roof I decided to use a telescope mast. A 30 foot mast with three 10 foot telescoping sections was purchased. An arrangement for nine guy wires—3 at each 10-foot level was planned.

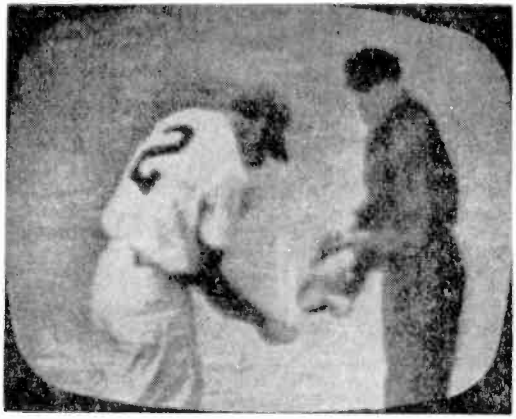
Due to sad experience with big fringe area antennas I decided on the new Trio Hi and Lo band antennas, models ZZ12L and ZZ16H made by the Trio Manufacturing Co. of Griggsville, Illinois. These antennas have a somewhat similar appearance to Yagis but are broad band devices —the Lo band covering channels 2 through 6 and the Hi band channels 7 through 13. Actually a pre-installation experiment showed that the Hi channel antenna, when mounted in the attic would pick up channel 3 and deliver a fair picture. A Trio rotator was also ordered, mainly because the antenna was obtained from Trio. However, I have never regretted this as the rotator has proven sturdy and dependable, noiseless in operation and extremely easy to manipulate from its control box.

Amphenol, high grade, 300 ohm lead-in was used and coated with Amphenol Silicone compound for waterproofing.

A 1953 17 inch table model Zenith receiver was chosen for this installation. This was a regular stock model which had not been hopped up in any way. It has an excellent agc system and will hold sync even when the video portions of the signal have disappeared into the snow. Its front end is not a noise maker.



WCBS New York with moderate snow.



Giant player hit on arm by a pitched ball. Picked up on Wilmington's channel 12 WDEL.

After Jim told me that the equipment, with the exception of the receiver, had arrived and that he was temporarily free to work on the installation I found that I had forgotten to order a booster. On my way to pick up the receiver I stopped at a local wholesaler and picked up an inexpensive tunable booster.

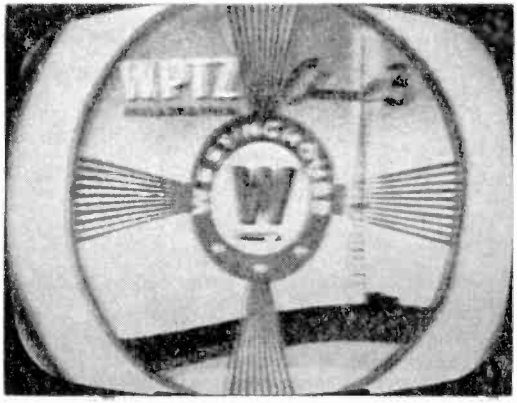
By the time that I arrived at Bethany I found that Jim had completely assembled the antennas and had even test mounted the mast on the roof.

We lowered the telescoped mast, attached the rotator to its top, inserted an eight-foot mast into the rotator and mounted the antennas on them, coupling them together with the special harness supplied by the manufacturer. The lead-in was soldered in place and the whole arrangement walked up to a vertical position. The first three guys were then made fast and we lashed a 10 foot ladder against the mast.

Jim, whose forearm is as big as the average man's bicep, agreed, much to my delight, to sit on the ladder and pull up the telescope sections of the mast. He did the job without difficulty and when the last section was extended we carefully tightened the guy wires. These had previously been put in place and reasonable slack left in them. If there had been any wind, one man at each guy wire would certainly have been necessary, since the unguyed mast performed wide gyrations even when being pulled up in a dead calm.

After fastening the lead-in firmly in place we

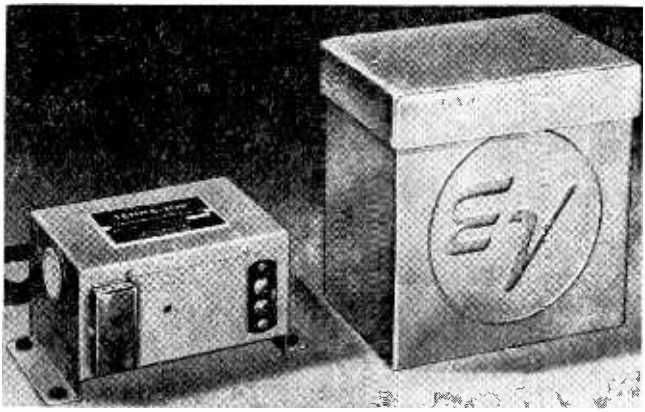
Since channel 6 in Philadelphia recently increased its power it is the most consistent performer in Bethany Beach.



WPTZ channel 3, Philadelphia. Blame some of this on your photographer's idea of camera focus. Yes, the set linearity has since been adjusted!

led it over the roof and through the window frame to the receiver. I might mention here that when climbing around on a wet, wooden shingle roof, you should wear a pair of track shoes with spikes. There is nothing more slippery than the wet moss such roofs will accumulate.

After connecting the booster we tried out the set. All that we were able to pick up was good sound and large snow flakes. After adjusting the age control, (which had been set for local reception), pictures started to come in through the snow. As the evening wore on very good results were obtained and when I finally left for home everyone was highly satisfied.



Courtesy of Electro-Voice, Buchanan, Mich.

The Electro-Voice Tenna-Top booster. The weather-proofed unit at the right contains the amplifier and is equipped with brackets (not shown) which make mast mounting easy. The unit at the left contains the step-down transformer and filters which separate the line frequency from the TV signals.

On subsequent trips and by long distance phone calls I learned that the booster was not performing satisfactorily, at times cutting out the picture although producing good sound. This was verified by turning off the booster to prove that both picture and sound could be received. Also the booster developed a tendency toward oscillation unless positioned very carefully with respect to the receiver. Little study was required to decide that improved results could be obtained by using a better booster at the receiver and perhaps one of the recently announced Tenna-Top antenna boosters.

These items were secured and installed. The change in reception was truly remarkable. Pictures came right up out of the snow and gave more entertainment value than I believed possible, in such a remote area. The fact that neither booster was tuned made operating the receiver a simple task.

The Tenna-Top booster is the Model 3010 made by Electro-voice while the booster at the receiver is the Blonder-Tongue Model HA3.

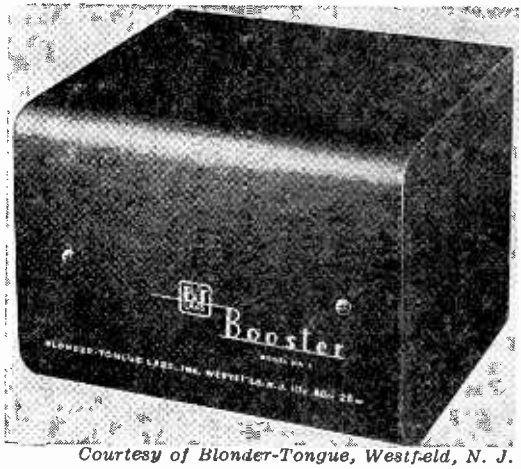
The installation of the Tenna-Top booster made it necessary to lower the antenna to the roof and to run a long extension line for operation of the soldering iron. This was done in February and all concerned were very happy that it was dry and there was no ice on the roof.

After the new boosters were installed Jim's wife kept a day-by-day log of the results which were obtained. This is reproduced in Table I and shows the date of reception, the picture entertainment value both in the morning and in the evening, the picture quality and the weather. You will note that periods of high winds coincided with bad-to-poor reception.

Bad reception means that it was not worthwhile to look at the picture. Fair reception means that a fringe area resident would watch the picture but that a primary area resident might call a service man to clear up the snow.

Good and excellent reception actually compare favorably with that received in some primary areas.

The nearby water tower at times creates some strange effects. One may find that New York



Courtesy of Blonder-Tongue, Westfield, N. J.

Look—no hands! Put in an untuned booster, such as this Blonder-Tongue HA-3, and forget about it.

TABLE I

Partial Log of Bethany Beach TV Installation

Date	Entertainment Value		Picture Quality	Weather
	A.M.	P.M.		
2/21/53	Excellent	Excellent	Little snow	Very cold, windy
2/22/53	Excellent	Bad	Heavy snow, noise	Cold—high winds
2/23/53	Bad	Fair	Heavy snow, loses sync	Cold—high winds
2/24/53	Bad	Fair	Snow, loses sync	Cold—high winds
2/25/53	Fair	Fair	Snow, fading	Cold—high winds
2/26/53	Very bad	Clearing	Snow, fading	Cold—high winds
2/27/53	Very bad	Very bad	Snow, fading	Cold—high winds
3/22/53	Very good	Perfect	No snow	Clear and settled
3/23/53	Very good	Good	Snow, light	Clear and warm
3/24/53	Good	Good	Snow and noise	Cloudy and rain
3/25/53	Very good	Fair	Snow, becoming heavy	Storm later
3/26/53	Very bad	Bad	Heavy snow and noise	Cloudy and windy
3/27/53	Bad	Bad	Heavy snow and noise	Cloudy and misty
3/31/53	Fair	Fair	Snow	Clear and settled
4/28/53	Good	Fair	Snow and noise	Cloudy
4/29/53	Very good	Fair	Snow and noise	Cloudy—later rain
4/30/53	Good	Fair	Snow and noise	Rain
5/ 1/53	Excellent	Very good	Snow, light	Clear and warm
5/ 2/53	Excellent	Good	Snow, light	Misty and light wind
5/ 3/53	Excellent	Good	Snow, light	Cloudy and foggy
5/ 4/53	Excellent	Good	Snow, light	Cloudy and foggy
6/23/53	Fair	Fair	Snow and noise	Clear and warm
6/24/53	Very good	Good	Snow, light	Clear and warm
6/25/53	Good	Good	Snow, light	Clear and warm
6/26/53	Good	Good	Snow, light	Clear and warm
6/27/53	Very good	Very good	Snow, light	Clear and warm
6/28/53	Poor	Poor	Heavy snow and noise	Stormy and cloudy
6/29/53	Poor	Poor	Heavy snow and noise	Stormy and cloudy

comes in better when the antenna is pointed toward Washington. This definitely shows that signals are bouncing off the tower and are being picked up by the antenna.

Jim and I talk a lot about putting the antenna on top of the tower (we couldn't get away with it) but as I have never picked signals which I could identify as coming from the tower without picking up the same signals from the right direction I doubt if the increased height would make too much difference. The high voltage power lines which pass within 20 feet or so of the lead-in create some interference and I have thought of trying a shielded lead-in—we may get around to it yet!

Evelyn Barker, Jim's wife, looks in on TV every morning — something which people in fringe areas do more frequently than their city cousins. The results have paid off on this practice since she has logged Kansas City and on a number of occasions channel 2 in Santiago, Cuba, a distance of 1280 miles. Kansas City is a mere 1060 miles away. Of course this is freak reception and cannot be picked up with any consistency. If you fish for such stations try the low channels in the morning.

At this particular receiving point we get stations in the following cities regularly. Incidentally, all stations in each city have been picked up at one time or another.

	Airline Distance
Bethany Beach Delaware	0 miles
New York	200 miles
Wilmington, Delaware	90 miles
Philadelphia, Pennsylvania	150 miles
Washington, D. C.	110 miles
Baltimore, Maryland	100 miles
Richmond, Virginia	140 miles
Norfolk, Virginia	130 miles

With the above array of transmitting points to choose from it is little wonder that Jim usually gets TV reception. If a storm comes up and knocks out New York he can swing the antenna around and pick up Norfolk. By the time the unsettled condition reaches the Norfolk area New York is coming in again.

Our biggest complaint so far is summer visitors,

since, with their arrival, the noise and interference level increases appreciably. However, since Jim is in the apartment and room renting business, he doesn't take their arrival too badly.

The illustrations in this article of scenes and test patterns were taken by the author who is strictly an amateur photographer. A lens setting of F4.5 with an exposure time of 1/25th of a second was used. Super XX film was employed and the lights in the room turned out and the shades pulled. One of my professional friends tells me that a larger lens opening might have resulted in sharper pictures, assuming plenty of light was available from the picture tube.

Some of the long distance fiends in the vicinity have been putting up UHF corner antennas with the hope of picking up Atlantic City, which has such an installation. Results so far have been very sporadic. Salisbury, Maryland, however, is going to have a UHF transmitter this fall so, if everything goes well Jim and I will probably be putting up a Bow Tie below the Zig-Zags, before too many months pass.

I must apologize to our readers for not bringing them a picture of the Santiago test pattern. This was on the air just before the snaps shown were taken, but I was unfortunately on the beach taking a swim and just as I returned Cuba's channel 2 faded away as I will now do.

———*n r i*———

Excellent Opportunities Open for Qualified Men in Mobile Radio Communications

One of the foremost manufacturers of mobile radio communications equipment recently contacted NRI in search of qualified men for sales engineers, technicians, and independent franchised service stations. This work requires a second class radio telephone license. Of course men who have completed NRI's Radio and Television Communications course have an advantage. However, men with a servicing background frequently wish to specialize in this field, too.

This is a new, growing field. The opportunities at present seem to be almost unlimited for ambitious, well trained men. If you would like additional information, please write a brief letter to NRI. Give your age, education, experience, and other details about your background. Letters should be well written, as letters from those who appear qualified will be turned directly over to the company interested for consideration.

Address your letter to L. L. Menne, Editor, National Radio-TV News, 16th and U Streets, N. W. Washington 9, D. C.

Our Cover Photo

Graduate William R. Channer.

The charming couple shown on our front cover are Mr. and Mrs. William R. Channer, of Kelso, Washington. They are chatting at the service desk of the Channer Radio and Television Sales and Service. The letter below tells the story of this graduate's progress and success.

Dear Mr. Smith:

"I have been in business now for about five years and have one of the leading Radio-Television Sales and Service Shops in the Kelso-Longview area. My business is steadily growing and the prospects for the future are excellent. Now employ two full-time service men in addition to myself, and expect to need more help this fall.

"TV sales are quite good, running fifteen to twenty sets a month. However, the real money today is in TV installation and service. Installations in this fringe area run from $65 each on up. We also do installation and service work for several department stores in our area, plus a good Radio service business. I advertise on our local Radio station using the sales argument that it is wise to buy from an organization which can supply reliable service.

"Before enrolling with NRI, I was a hand in a saw-mill, work which I did not like. NRI training enabled me to start my own business. I never really enjoyed working at any job before. Now I am able to take a vacation each year and my income has more than doubled since I began my NRI course. Training at home for Radio-Television did it."

WILLIAM R. CHANNER,
5th and Grade,
Kelso, Washington.

Leo M. Conner

TRANSISTORS

By LEO M. CONNER

NRI Consultant

WHEN the Bell Laboratories announced the development of the Transistor, several years ago, there was considerable comment regarding the effect on electronic devices.

As is usual, when such announcements are made, there were rumors that tubes would be made obsolete and that present theory would be changed completely.

Time has proven that tubes will still be with us and that theory is comparatively unchanged.

The special features and characteristics of transistors can be expected, however, to have considerable effect on the design of future electronic equipment.

Both the point-contact and junction transistors are hardly larger than a kernel of corn, and four of them can be placed inside a sewing thimble. Yet, in some applications, they can out-perform larger electron tubes.

RCA has a number of transistors available at this time. Approximate prices and suggested applications for each type are listed below.

Type 2N32: point-contact transistor intended for large-signal applications such as in pulse or switching service, in electronic computers and counters and on-off control devices. Price is approximately $15.00.

Type 2N33: point-contact transistor intended for use as an oscillator at frequencies up to 50 megacycles. Price is approximately $23.00.

Type 2N34: P-N-P junction transistor designed for low-power, audio frequency applications. Price is approximately $13.00.

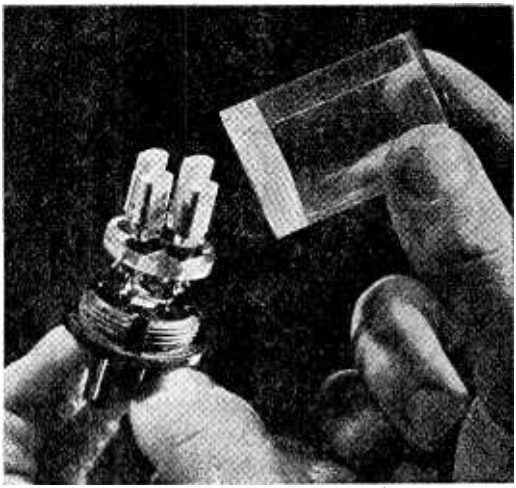
Type 2N35: N-P-N junction transistor also designed for low-power, audio frequency applications. Price is approximately $18.00.

Editors Note: Raytheon is in production on a number of transistors similar to those listed above. Their price at the time of this writing is about half of the quotation given above. The Raytheon transistors are available from most radio parts jobbers.

It should be kept in mind that today there exists little commercial equipment which employs transistors. Furthermore, transistors cannot be used in equipment designed for electron tubes without extensive changes in circuit design. The cost will decrease as manufacturers learn more short cuts and increase manufacturing efficiency.

The heart of the point-contact and junction type transistors is the element germanium. Although fairly plentiful, germanium must be extracted, at heavy cost, from such germanium bearing materials as zinc and the residual products of coal. In the processed form, it is germanium dioxide, a snow white powder, which costs about $140.00 per pound.

The production of transistors begins with germanium dioxide. The powder is placed in a mold and then in a special hydrogen furnace which converts it to metal at temperatures of up to 1,050 degrees centigrade. The result is a cigar



Courtesy RCA

Complete experimental audio amplifier stage in which four junction transistors, mounted on a small plug-in base, perform the combined functions of two or more electron tubes, an output transformer and other components. Operating off a small low voltage battery, this transformerless and tubeless audio amplifier, developed at the David Sarnoff Research Center of RCA at Princeton, N. J., can provide sufficient amplification to operate a loudspeaker.

shaped, silvery ingot which has one part impurity in ten million. The ingot is then subjected to further heat treatments until the germanium has only one foreign atom for each billion atoms.

At this point, germanium is in a virtually pure state. However, germanium in its purest state behaves like an insulator! Now comes a very critical operation in the manufacture of a transistor.

The conductivity is increased by the addition of exact but infinitesimal amounts of specified impurities. The manner in which the germanium crystal will conduct can be changed by the choice of impurity. The trace of impurity in any one transistor is microscopic, yet it provides some one hundred billion excess electrons for transistor action.

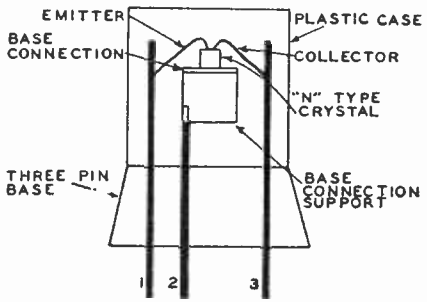


Fig. 1. A point-contact transistor.

After the ingot has been treated, it is ready for what is known as the "slice-and-dice" process. For use in point-contact transistors, the germanium is sawed into pellets the size of a pinhead. For use in junction transistors, it is cut into wafers not much thicker than a human hair.

Skilled workers then mount the wafers and pellets on glass stems and connect the contact wires. The working parts are then encased in plastic for protection against shock, vibration, and the effects of moisture.

At this stage the plastic-encased transistors are placed in special ovens where they bake for a specified number of hours. The baking hardens and "cures" the plastic cases. The transistors are then ready for the specification tests.

Transistor Considerations

The foregoing discussion has gone into the manufacturing process and the types of transistors. Now let us look at other considerations.

Transistors are a new form of electron device. They can perform many of the functions of an electron tube, and, in addition, can do some things better and more efficiently than tubes. Unlike electron tubes which depend for their functioning on the flow of electrons through a vacuum, gas, or vapor, transistors make use of the flow of electrons in a solid—a semiconductor.

A semiconductor is a material having a conductivity lower than that of metals but higher than that of insulators. There are many varieties of semiconductors, but the one presently employed for transistors is germanium.

The introductory discussion explained how a controlled amount of impurity was introduced to control the conductivity. With increased conductivity the surplus of electrons can migrate freely. A conducting germanium crystal is identified as N-type because it depends on negative particles of electricity, electrons, for conduction.

On the other hand, the addition of other impurities provides a deficiency of electrons which effectively behave like positive particles of electricity. This deficiency of electrons leaves vacancies, or "holes," in the crystal structure. These holes are free to migrate and can carry current in a direction opposite to that of the N-type crystal. Because these carriers of the

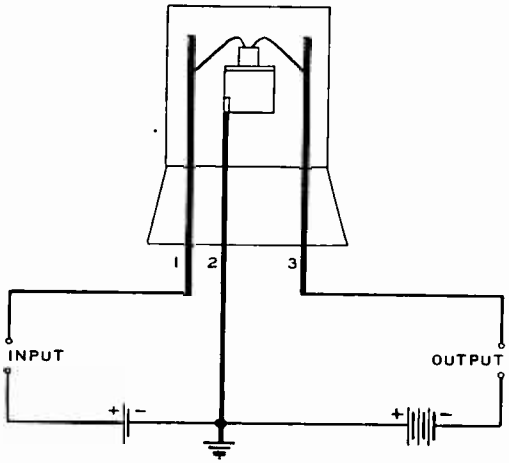


Fig. 2.

conduction current are positive in nature, a germanium crystal of this type is known as a P-type.

It should be noted that whereas electron tubes depend ordinarily on electrons for conduction, transistors not only make use of electrons but also of "holes" for obtaining conduction.

The transistors described in this article make use of both kinds of conduction and employ two different types of structures. The two types of structures are known as "point-contact" and "junction."

Figure 1 shows the structure of a point-contact transistor. It consists of a crystal of N-type germanium having three electrical contacts. Two of these are point contacts and are known as the emitter and collector. A third, the base, makes area contact with the germanium crystal.

Figure 2 shows a point-contact transistor connected in a simple circuit in which the base connection (Pin #2) serves as the common return for the input circuit and the output circuit.

The input circuit on the left is completed through the battery, the emitter, and the germanium crystal to the base connection. When a positive voltage is applied to the emitter, electrons will be drawn from the crystal into the emitter and thus leave "holes" in the crystal structure. Under the influence of the negative field of the collector, these positively charged "holes" flow to the collector and thereby increase the collector current appreciably. Or as is sometimes stated, the emitter electrode injects "holes" into the germanium crystal. "Holes" near the collector allow electrons to pass into the crystal. Some of these

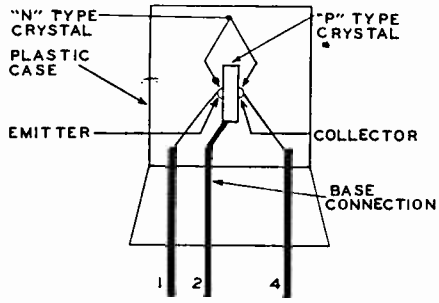


Fig. 3.

electrons neutralize the "holes"; others flow to the base connection and thus complete the circuit.

If the assumption is made that every unit of "hole" current which leaves the emitter reaches the collector, it follows that a small change in emitter current will result in an equivalent change in collector current, and consequently produce a current amplification factor of one. The current amplification factor or "alpha" of a transistor is defined as the ratio of change in collector current to the change in emitter current when the collector voltage is maintained constant. In point contact transistors "alpha" is greater than unity; in junction-type transistors, it is less than but approaches unity.

If the germanium crystal used in Fig. 2 is of the P-type, a negative voltage is applied to the emitter and "holes" will be drawn from the crystal into the emitter and thus leave an excess of electrons in the crystal structure. Under the influence of the positive field of the collector, these electrons flow through the crystal to the collector. In general, the P-type germanium crystal has characteristics similar to the N-type except that in operation all battery polarities are reversed.

Figure 3 shows the structure of a junction transistor of the N-P-N type. It is composed of a wafer of P-type germanium between two smaller layers of N-type germanium. Low-resistance connections are made to the N-layers, one of which serves as the emitter and the other as the collector. A third low-resistance connection to the P-layer is the base connection. The complete assembly is encased in plastic.

The principle of operation of the junction transistor is somewhat different from that of the point-contact transistor. In the N-P-N junction transistor, electrons from the N layer diffuse through the P layer and are attracted to the collector. The P layer has a surplus of "holes." Because the P layer is very thin, most of the electrons

Fig. 4A.

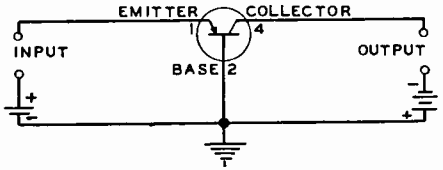


Fig. 4B.

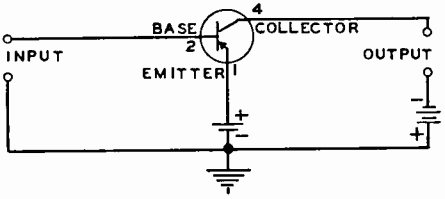
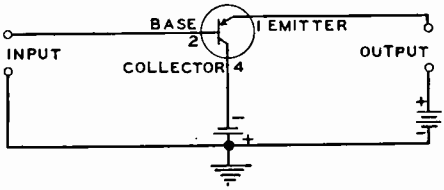


Fig. 4C.



entering the base region from the emitter will reach the collector region without recombining to neutralize the "holes." Practically all of the electrons leaving the emitter reach the collector, thus resulting in a current amplification factor approaching unity.

The action of the P-N-P type of junction transistor is similar to that of the N-P-N type except that the polarities of the battery voltages are reversed and conduction is caused by "holes" instead of electrons.

Fig. 4 shows some typical amplifier circuits. Circuit 4a is recommended for point-contact transistors; and all three circuits may be used for junction transistors of the P-N-P type. These circuits may also be used for junction transistors of the N-P-N type provided the polarities are reversed.

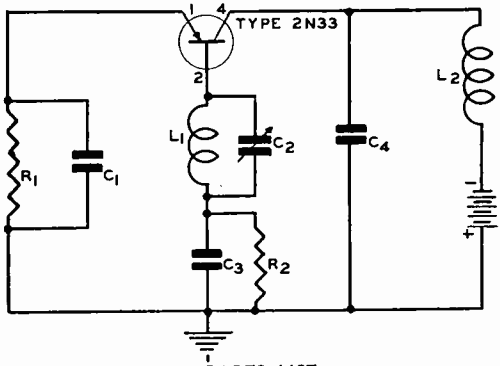


Fig. 5.

PARTS LIST

C_1: 1 mmfd, ceramic, 25 volts.
C_2: 4 to 30 mmfd, ceramic adjustable.
C_3: 270 mmfd, mica.
C_4: 470 mmfd, mica.
L_1: 0.46 mh. tank inductance.
L_2: 1 mh. r.f. choke.
R_1: 5100-ohm, 1/2 watt.
R_2: 1000-ohm, 1/2 watt.

Figure 5 shows the circuit and parts values for a point contact transistor in a 50 mc. Oscillator test circuit.

From this discussion it can be seen that there is a place in electronics for tubes and transistors. Instead of eliminating tubes the development of the transistor has provided new methods of approach.

———*n r i*———

Faith

When you think your heart is broken
And your very soul seems crushed,
When life's darkness closes 'round you
And the voice of God seems hushed,
Lift your eyes toward the heavens;
Toward the vastness that is there,
Tell your troubles to your Maker,
He will understand and care.
Others, too, have dreamed their sorrow,
Struggled onward to success.
There's hope with each tomorrow,
Just trust God. He'll do the rest.

———*n r i*———

Compensation

If I were standing to be judged,
Before the great white throne,
Where I could hear the righteous sing
And hear the sinners moan,
I'd want no greater advocate to make my final plea
Than just a boy who'd say "Gee" he did a lot for me.

———*n r i*———

We should be careful to get out of an experience only the wisdom that is in it—and stop there; lest we be like the cat that sits down on the hot stovelid. She will never sit down on a hot stovelid again—and that is well; but also she will never sit down on a cold one anymore.

—Mark Twain.

NRI GRADUATE TELLS OF PROBLEMS MET IN UHF-TV INSTALLATIONS

Dear Mr. Smith:

"I will do my best to pass on what few experiences we have found with our UHF, TV installations. Of course, I have nothing with which to compare it; as we have no other station and our nearest VHF station is 200 miles away. The transmitter is a 1 kw. RCA unit. Good signals are reported about 50 miles in all directions.

"We are handling four makes of receivers. Those with the continuous tuner seem to be most popular. I note that most all the manufacturers will have a continuous tuner in the new 1954 models. The 21" open-face consoles are our most in demand models.

"Our standard UHF installation consists of a 'Mi-tee Ray' Fretco antenna, 5-foot mast, strapped to a chimney or roof peak mount, oval lead in, and uses a lightning arrestor wherever we have greater than 500 micro-volts at the antenna. Although there is no local code requiring arrestors, we like to use them for what little protection they might give. We have a great number of thunder storms here and I always worry about a piece of pipe sticking up in the air.

"We find we must keep our lead-in very short. Actually, that is more important than the height or positioning of the antenna. We have measured up to 60 micro-volts loss pulling the lead-in through an 8" wall, and practically lost the signal dropping the lead-in down between partitions. Loss at the antenna terminal connection on some sets was enough so that snow was too prevalent. We are now soldering our lead-in directly to the tuner leads.

Albert M. Patrick

"The sets, so far, have required very little maintenance. Defective tubes account for 90 percent of set failures—most of them being the new type of tubes used in UHF tuners.

"It is yet too early in UHF history to draw any valid and hard rules, but one thing is certain—installation is most important and no two similar installations work the same way. Apparently, the industry doesn't know the answers yet. Every trade magazine that I skim through is filled with ads on type after type of UHF antennas."

A. M. PATRICK,
6106 Branch Ave.,
Tampa, Fla.

———*n r i*———

"I Can"

Figure it out for yourself, my lad
You've all that the greatest men have had;
Two arms, two hands, two legs, two eyes,
And a brain to use if you would be wise.
With this equipment they all began
So start for the top and say, I can.

Look them over, the wise and great,
They take their food from a common plate,
And similar knives and forks they use
With similar laces they tie their shoes.
The world considers them brave and smart
But you've all they had when they made their start.

You are the handicap you must face,
You are the one who must choose your place.
You must say where you want to go,
How much you will study the truth to know.
God has equipped you for life, but He
Lets you decide what you want to be.

Courage must come from the soul within,
The man must furnish the will to win.
So figure it out for yourself my lad,
You were born with all that the great have had.
With your equipment they all began,
Get hold of yourself and say, I can.

—Author Unknown.

New "A" Battery Eliminator for Testing Auto Radios—6-volt or 12-volt—Now Available!

- Eliminates storage batteries and battery chargers.
- Delivers filtered direct current at the correct voltage for proper operation.
- Equipped with Voltmeter, Ammeter and Voltage Control.
- Choice of 6 volt or 12 volt output by means of simple switching arrangement.
- This battery eliminator is recommended to you by NRI Engineers.
- Specially designed for testing and operating auto radios or other DC equipment from reguluar AC lines, 105-125 volts, 50-60 cycles.

AS a result of many requests received from NRI men as to where a good battery eliminator can be obtained, we arranged to offer this new ATR Model. We chose this model because it has all the features which you will need for auto radio servicing work including provisions for operating the new 12 volt auto radios. And, the price is right. This is the finest and most complete instrument of its type which we know of in this price range.

Other Uses

As a power supply for radio sets, aircraft instruments, relays, motors and other electrical and electronic equipment. Also may be used as a battery charger.

Specifications

TYPE 610C-ELIC—Rated output 6 volts at 10 amperes continuous or 12 volts at 6 amperes continuous. Either output obtainable by means of simple output terminal switching arrangement.

Equipped with Full-Wave Dry Disc Selenium Rectifier, Assuring Noiseless, Interference-Free Operation and Extreme Long Life and Reliability.

On-Off Switch, 8-Position Voltage Control, Meters, Fuse Protection, Rubber Mounting Feet, 6-ft. All-Rubber Cord Set, and Cabinet of heavy gauge metal having attractive grey-hammerloid finish. Size 6½" x 9¼" x 8½". Shipping weight, 22 lbs. Instructions and warranty included.

This rugged, heavy-duty "A" Battery Eliminator is manufactured by ATR, a recognized leader in its field. NRI men can purchase this fine piece of equipment through NRI at the Dealer's net price of only $33.50.

USE THIS BLANK TO ORDER YOUR BATTERY ELIMINATOR

NATIONAL RADIO INSTITUTE
16th and You Streets, N. W.
Washington 9, D. C.

I enclose $33.50 (certified check, money order or bank draft) for which send me, express collect, one "A" Battery Eliminator.

Name ..... Student No. .....

Address .....

City ..... Zone.... State.....

Express Office .....

If you live in Washington, D. C., add 2% for D. C. Sales Tax.

Quick Facts About Color Television

Condensed from the talk—

COLOR TELEVISION — ITS STATUS TODAY AND A LOOK INTO THE FUTURE

By W. R. G. Baker, Vice President, General Electric Co.
Chairman, National Television System Committee
Chairman, RTMA Television Committee

What is Meant by a Compatible Color TV System?

1. Under a compatible Color TV system any and every Black and White receiver in the home will be able to receive future Color broadcasts in Black and White without any alteration or expense.

2. In order to protect the public investment in receivers and prevent complete chaos in broadcasting, such a system must be legally approved by the Government. This duty and responsibility has been delegated to the Federal Communications Committee.

3. In 1950, the FCC approved a field sequential system of Color Television. The principal objection to this system lay in the fact that it was not compatible to the system under which Black and White television was operating which meant that the 8,000,000 Black and White receivers then in American homes could not receive color broadcasts either in Color or Black and White, without extensive alterations and expense to the owner.

4. The importance of that major shortcoming is evidenced and magnified by the fact that, today, the public has invested over seven billion dollars in some 25-million Black and White receivers, that would not be able to receive such Color broadcasts in Black and White without such expensive alterations.

5. Obviously, the solution of the problem lay in the possibility of developing an all electronic system that would be "compatible." The development of this electronic system was the task undertaken by the National Television System Committee (NTSC), formed under the auspices of the Radio-Television Manufacturers Association.

6. In the development of the standards for a compatible color system the NTSC had the full and complete cooperation of the companies comprising our industry. The source of an idea was completely disregarded. The only question was—Is this the best idea—Is this the best way to do the job?

7. Ninety-one companies in the industry contributed the skill and services of over 200 of its leading scientists and engineers toward the color assignment. The NTSC has now been in operation the better part of two years. It has produced a number of very significant contributions not only on a system basis, but also in details.

(*Editor's Note:* John H. Battison, NRI Director of Education, is serving as a member of this committee.)

How Does the NTSC Color System Work?

1. First—it fulfills its primary function the transmission of excellent pictures in full color to color receivers. The detail of these images is equal to that of monochrome telecasts. In chromatic quality, that is fidelity of color reproduction, the color television images match or excel color movies.

2. Second—the NTSC system fulfills the compatibility requirements. It reproduces the program on black and white receivers, producing images in monochrome which are virtually indistinguishable from those provided by standard monochrome broadcasts. No modification of the receivers is required; in fact—no adjustments whatever are needed except the normal operation of the front panel controls used in monochrome reception.

3. Reception by the present-day audience has been checked, for example, by transmissions over channel 4 in New York, channel 3 in Philadelphia, and channel 2 in Syracuse. Reports from viewers are overwhelmingly favorable; many report that the Color broadcasts, viewed in Black and White on present-day standard television receivers are superior in pictorial quality to the regular broadcasts. These latter reports are not imagination. The broadcaster's equipment, having been "spruced up" for color programs, actually can do a better job of rendering the shades of the gray in the monochrome picture.

4. The standard Black and White television transmitter sends out two signals, one carrying the picture, the other the sound. The picture signal, is produced in the television camera which views the scene in full color and transforms it into a representation in shades of gray. In so doing, the camera removes the "color" aspect of the image.

5. In transmitting a full-color image, then, it is necessary to take into account the missing elements of hue and saturation. In the NTSC system, these are transmitted by a third signal, known as the color carrier, which is fitted into the channel between the picture signal and the sound signal.

6. The NTSC Color system is thus founded on the principle that a color image may be reproduced from two signals, one of which carries a monochrome version of the image in shades of gray, while the second super-imposes on the monochrome image the missing hues and saturations.

7. This principle is well suited to compatible operation of monochrome receivers. It is merely necessary so to arrange the transmissions that monochrome receivers respond only to the monochrome signal, ignoring the color signal. Color receivers, on the other hand, are designed to accept and make use of both signals.

8. The NTSC system achieves compatible color transmission by building on the existing monochrome system. No basic changes are required in the existing FCC regulations governing Black and White broadcasting beyond tightening of tolerances which has the effect of improving the performance of receivers now in the hands of the public and making a minor addition to the synchronizing pulse. To these regulations must be added a group of supplementary standards, which set up the color signal, specify its frequency, and outline the techniques by which the hue and saturation values are transmitted.

9. On April 14, 1953, this NTSC system was formally demonstrated, to the Wolverton Committee and to the Industry on April 16, 1953. It was acclaimed as highly successful. It is now undergoing final and extensive field tests, preparatory to formal submission to FCC for consideration.

(*Editor's Note:* Formal submission to FCC was made on July 21, 1953, and the industry allowed up to Sept. 8, 1953 to submit briefs concerning the pros and cons of the NTSC system.)

10. A television transmitter broadcasting a monochrome signal will accommodate the Color signal without change. Precautions necessary to insure satisfactory monochrome transmission are, in general, the only precautions necessary to insure proper Color transmission, although misadustment will be more objectionable in the picture when transmitting color.

11. Transmitters which will take Color signals from the network will probably be required to utilize an additional piece of equipment known as a "synchlock" to insure the adequacy of the received synchronizing pulse. This, fortunately, is a rather simple and inexpensive piece of equipment and could be supplied quickly to any station then on the air with Black and White.

What Will Color Mean to TV Programs?

1. Limited color programs will be on the air generally, on a national basis, in the last half of 1954. During 1955 we can foresee that the number of Color programs on the air will gradually increase.

2. All programs broadcast in Color can be received in Black and White on present-day standard television receivers.

3. Color alone cannot make a good program out of a poor one. This has been proven in the motion picture industry. It has been 31 years since full color movies have been available, yet today monochrome movies are still the backbone of the business. Many black and white pictures continue to be the box office hits, while many "color" films are among the "flops."

4. The cost of programming represents a real economic problem to television as an advertising medium. Color will add to these costs—of this, there can be little doubt. How many advertisers will consider that Color will add enough "sell" to their programs to justify these extra costs?

5. Color will add little to the basic entertainment value of most of the highly popular shows on television today—the situation comedies; the prize fights, and wrestling matches; the newscasts and most of the popular plays. However, some programs, like the variety shows, will be greatly enhanced.

Are the Broadcasters Ready for Color?

1. Signals have been satisfactorily transmitted over the Telephone Company's networks. The Telephone Company's engineers have taken a very active part in the affairs of the NTSC, and are thoroughly familiar with the NTSC proposal.

2. These two factors mean that a Color program originated at a network key station and put on the network, could, for a minor capital investment and at practically no extra operating expense, be taken off the network and rebroadcast by any local station.

3. Thus, Color programs on a national basis could be available a few months after the system is approved.

4. It is in the Color television studio that the most extensive changes will be required. A three-tube camera initially will be used, although development now intensively underway, may result in a single camera tube which, if successful, will materially reduce the bulk and complexity of the

Color television camera used in the studio.

5. The signal from the camera is directed to a system of rack mounted equipment, where the signal is dissected and each of the signal components is then optimized and dealt with individually. At this point, also, the special synchronizing pulse is generated. From this equipment then, there is delivered a complete signal which is ready to modulate a standard transmitter or to be fed to the networks.

6. Enough studio gear, much of it now only in prototype stages, is available to equip at least several key network stations. This equipment, however, could be used to put a small percentage of Color programs through the networks in parallel with the standard Black and White programs. And, as we see the situation, that is exactly what we may expect.

Why is the Color Tube a Major Problem?

1. All tri-color tubes have in common the requirements that the phosphor surface utilizes not a homogeneous deposit, as in the case in monochrome, but three separate phosphors for red, green and blue, deposited as hundreds of thousands of dots, or, as fine vertical or horizontal stripes. Here the similarity ends and development is progressing in the two general directions described below.

2. One type of tube uses a single electron beam with a change in beam direction at the front of the tube to provide color selection. Such approaches are exemplified by the Lawrence tube of Chromatic Laboratories, and by the Lafferty tube of General Electric.

3. Such tubes, in general, are simpler and cheaper than the ones next to be described, but depend upon complicated chassis and require greater circuit precision in order to insure color fidelity. Furthermore, the beam bending operation requires an appreciable amount of power at high frequency, which raises the problem of interference radiation.

4. The second general category of tube comprises those utilizing three separate electron beams whose possible paths are restricted physically so that the green gun, for instance, can only reproduce green, etc. The use of these tubes permits a reduction in chassis and circuit precision and complication, but the tube complexity and cost is increased. The radiation problem, of course, does not exist. Several laboratories are known to be working in this direction.

Will it be Possible to Purchase a Color Converter To be Used with a Black and White Receiver?

1. This is possible but hardly practical when you consider you must add a special color tube plus perhaps 20 additional receiving tubes and the associated circuitry.

2. This would mean an additional cabinet about the same size as a standard receiver which would hardly be acceptable in the average home.

3. The wiring between the two cabinets would be complex, and long connecting leads would tend to deteriorate the color picture.

4. Such a converter would be high in cost, initially at least $300 more than a standard black and white receiver, due to the picture tube cost alone.

5. Only a very small portion of the black and white receiver would be in use when color would be received. Therefore, the so-called "color" converter would practically represent a complete color receiver and cost almost as much.

6. The public does not want outside converters, even when small, inexpensive and compact. This has been proven time and again with short-wave converters, FM converters and most recently with UHF converters.

7. Therefore, we are convinced that color converters will be impractical, expensive and not acceptable to the public.

———————*n r i*———————

Financial headaches are bad. Severe pain extends as far down as the pants pockets!

———————*n r i*———————

It's my new deal. No more drummer drudgery!

Are Any of These Yours?

Do you live in the vicinity of Nassau, Bahamas? Did you recently send the following equipment to NRI for repair: NRI Electronic Multitester with 3V4 tube, AC-RF Head with 1A3 tube and assembly of Experiment 23 with ac voltage divider? The only clues to the identity of the sender are "Philips," the name of the appliance store whose carton was used for packing, the stamp of Nassau, Bahamas on the parcel and the notation "Passed Free, U. S. Customs at Miami, Fla."

Did you send in your answers to Lessons Nos. 21 and 22FR for grading early in July, 1953 and fail to receive them back? We have these answers graded A+ but no name, address or student for identification.

An Express Money Order NY—6955940 for $7 dated December 26, 1952 issued by Preferred Coal Co., New York, N. Y.? We have no way of knowing whose account should be credited with this remittance.

A Postal Money Order No. 7—81,293,336 for $2.75 issued July 24, 1953 at Lakeview Station, Chicago, Ill.? The name of the remitter, Walter L. Scott, is given but without an address or student number we do not know how to apply this payment.

IF ANY OF THESE ITEMS ARE YOURS, PLEASE WRITE US AT ONCE GIVING FULL NAME, ADDRESS AND STUDENT NUMBER.

———*n r i*———

Look at What These NRI Graduates Are Doing in Radio and Television!

Making Good Money in Spare-Time Servicing

"May I thank you for the wonderful start on the road to success in Radio and Electronics. Right now I am doing spare time repair work on radios and television, averaging from $8 to $23 a week. In the near future I intend to go into full-time servicing.

"I cannot praise your school and your staff enough for the splendid guidance you gave me throughout the course. The entire staff was standing by with a helping hand."

CLYDE HIGGINS
82 Prospect St.
Waltham 54, Mass.

———n r i———

Dealer for RCA Victor Radios And Television

"I am still employed by the city of Pensacola as police captain, and also have a very good spare time Radio and Television service business. Am dealer for RCA Victor Radios and Television.

"Have just had the formal opening of my new show rooms and shop under the name 'Lewis Radio and TV Service.'

"I think that NRI has the best plan for home study and servicing that anyone could find."

C. W. LEWIS
615 E. Belmont St.
Pensacola, Fla.

Found Factory Work Dull— Now Eight Hours Seem Like Four

"I work for Welles Radio and TV Sales and Service. My weekly salary is well into three figures. In addition I have a well established part-time business in my home with Radio and TV coming in faster than I can repair them. My spare time work brings in about $65 a week additional.

"Before I took your course I was a $50 a week laborer in a factory and my work was very dull. Now my day at work passes so swiftly that eight hours seem like four. Soon I expect a promotion to manager in charge of four servicemen. I cannot stress my thanks enough for your excellent schooling which enabled me to find my career in life."

EDWARD M. DUDEK
1954 N. Byron, 1st Fl.
Chicago 13, Ill.

———n r i———

Recently Promoted To New Position

"I was recently promoted to the position of electrician on the job, which pays $4400 a year.

"I am sure glad that I took the NRI course. Thanks for everything."

JOHN J. HOLLAND
1145 3rd Ave., Apt. 22
New York 21, N. Y.

———n r i———

Operates Successful Communications Maintenance Business From Home

"I operate an authorized Motorola service station here at my home. This includes the maintenance on seven base stations and sixty-five mobile units.

"I have made progress since graduating from NRI. Purchased my own home, paying cash for it. My business has shown a substantial increase each year since completing the NRI course. My advice to a young fellow is to specialize in some branch of Radio Service work."

S. W. DINWIDDIE
1215 So. East St.
Jacksonville, Ill.

———n r i———

Spare-Time Earnings Buy Complete Line of Test Instruments

"When I started your course, I didn't know a resistor from a condenser. I was just looking through a magazine and read your ad. The first thing I knew, I was very much interested.

"I do a lot of spare-time radio and TV Servicing —just evenings and Saturdays, as my steady job is a warehouse foreman at the canning factory. My earnings from spare time servicing have been used to buy the equipment which you see in my photo.

"I don't know how to thank you for a wonderful course. I recommend it highly. It was fun learning from you."

BRUNO GOEDE
Box 115
Plainview, Minn.

As space permits, from time to time, we plan to devote a page or two in NR-TV News to short success stories such as above. They are taken from testimonial letters we have on file. Photographs and letters of this kind are always greatly appreciated by us. We feel we should pass them on to our readers for the inspiration to be gained from a reading of them.

SCIENCE QUESTION BOX

By Scientists of the General Electric Company

Q: I saw a reference the other day to an "atmospheric clock" which never had to be wound. How did this work?

A: Probably it referred to a clock in which changing atmospheric pressure provides the energy required for running. The general idea is to use a closed and collapsible box, like that in an aneroid barometer. As the air pressure increases the box is collapsed, and as the pressure goes down the box expands. In the barometer, this is connected through a series of levers to the needle which moves around the dial, indicating air pressure. To operate a clock, the alternate contraction and expansion of the box would drive a series of gears, through a ratchet mechanism, thus winding up the spring that actually drives the clock.

Q: Can a submarine operate its radio while submerged?

A: Yes, it can transmit and receive over short distance even when under water but, on account of the conductive properties of sea water, low frequencies must be used, 500 kilocycles and below. Ordinary AM broadcasting is on frequencies from 500 to 1500 kilocycles. A submarine can receive from fairly long distances on frequencies around 50 kilocycles.

Q: When a man climbs up a rope, the lower end of the rope dangles below, but when a spider climbs up a long strand of web, hanging down from the ceiling, nothing remains underneath. What happens to the strand?

A: In crawling up the silkened thread that it has spun, the spider winds it around the tips of its two front feet. Then the spider either drops it, or perhaps swallows it, so it can be used over again. The thread is a product of a saliva-type of material secreted by certain glands in the spider's "tail." It comes out as a liquid and hardens to a silken thread on exposure to air.

Q: How can astronomers tell when an eclipse of the Sun will occur when the light of a star takes so many years to reach us?

A: While it is true that the stars we see in the night-time sky are so far away that their light, travelling 186,000 miles every second, takes many years to reach us, the Sun is much closer, and its light takes only about eight minutes to get to us. However, an eclipse of the Sun is caused when the Moon comes in front of it. Since the Moon's distance is about 240,000 miles light only takes about 1.3 seconds to get from it to us. That is the extent of the delay in seeing a solar eclipse, due to the time it takes the light to travel. Because astronomers know quite accurately how the Earth, Sun and Moon are moving, they can figure out long in advance when the three bodies will be in such a position as to cause an eclipse. In predicting them, of course, proper allowance may be made for the time it takes the light to travel.

Q: How does an X-ray machine work?

A: Inside a glass (sometimes metal) tube from which the air has been evacuated, there is a tungsten filament like that of a small electric lamp, and an electric current flows through this to heat it. As it is heated, electrons are given off in large quantities. High voltage electricity gives energy to these electrons so that they are hurled at high speed against a heavy target, also made of tungsten, in most cases. As the electrons are stopped by the target X-rays are given off, and emerge from the tube, so that they may be utilized. X-rays are similar to waves of visible light, but are thousands of times shorter.

Q: Does a magnet pull on a piece of iron, or the iron on a magnet?

A: The attraction between a piece of iron and a magnet is mutual; each pulls on the other. Which one moves the most depends on its weight, or mass. The heavier an object is, the greater is its inertia, which makes it harder to start moving when it is stationary. Thus, with a heavy piece of iron and a magnet that is much smaller, the principal movement would be of the magnet to the iron. If the magnet is the more massive, it would tend to move relatively little, and the iron would move toward it. A similar effect occurs with the gravitational attraction of the Earth. Theoretically, when a pin drops, the Earth comes up a little to meet it. However, because its mass is so vastly greater than that of the pin, the Earth's movement is so very small that it is far beyond the possibility of being measured.

Q: How can tubing of brass, copper and other metals be bent without kinking?

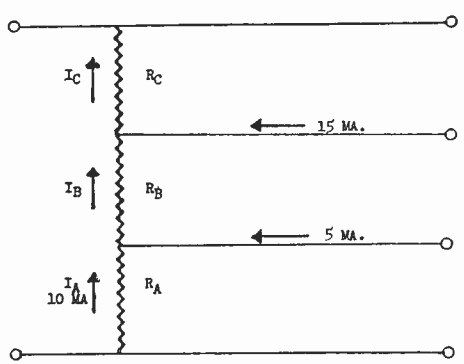
A: In order to bend copper and brass tubing without kinking, it is often filled with sand, pinching in the ends so the sand will not fall out. This provides support for the tube walls during the bending process. Afterwards, the tube is opened and the sand removed. A low-melting solder may be used instead of the sand, then melted out afterwards, although it may be difficult to remove completely all traces of solder. In addition, there are bending machines, hand-operated for small sized tubing, which make a very satisfactory bend without filling the tube.

Voltage Divider Calculations

By JOHN G. DODGSON
NRI Consultant

VOLTAGE divider circuits are found in various types of receivers, transmitters, control devices, test instruments, and in many other electrical devices. Service men often run into some trouble in replacing the damaged resistors or in determining the required resistances and wattages when building their own voltage dividers.

The method of calculating the voltage divider resistors and their required wattages is best explained by means of a typical example. The circuit illustrated is for the assumed case of a voltage divider for either a test instrument or receiver. The maximum rectifier voltage across the divider is 300 volts. Taps are required at 250 volts, 15 milliamperes, and 100 volts at 5 milliamperes while the bleeder current is to be 10 milliamperes. The first step is to make a sketch showing the voltages and current as illustrated. Begin with Section A, which carries only the bleeder current I_a.



By Ohms Law:

$$R_A = \frac{100}{.01} = 10{,}000 \text{ ohms.}$$

Wattage $= 100 \times .01 = 1$ watt.

Section B carries the bleeder current I_a plus the current returned at the 100 volt tap or:

$$I_B = 10 + 5 = 15 \text{ Ma.}$$

$$R_B = \frac{150}{.015} = 10{,}000 \text{ ohms.}$$

Wattage $= 150 \times .015 = 2.25$ watts.

Section C carries the current in Section B, the bleeder current in Section A plus the current returned at the 250 volt tap or:

$$I_c = 15 + 5 + 10 = 30 \text{ Ma.}$$

$$R_c = \frac{50}{.03} = 1666 \text{ ohms.}$$

Wattage $= 50 \times .03 = 1.5$ watts.

Note that in the above calculations in finding the resistance of Section R_B, we divide 150 volts by the current flowing through the section. 150 volts exists between the 250 volt tap and the 100 volt tap. In calculating R_C we divide 50 volts by the current flowing through the section. 50 volts exists between the 300 volt tap and the 250 volt tap. It is important to remember that the voltage between the taps of a voltage divider will change if the current drawn from the various taps changes. Also, the bleeder current (Section A) is increased under no load conditions (nothing connected to the voltage supply taps) and is then equal to the supply voltage divided by the total voltage divider resistance. Of course, all sections should be designed to carry the maximum current which would occur under the different conditions of use without overheating the resistors involved.

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A Little More Than Expected

We've all smiled at the story of the small boy who was last in a long line of applicants for a position as office boy. Fearful that one of the earlier applicants would be employed before he was interviewed, he sent the prospective employer the following note:

Dear Sir:
If you just want an office boy, hire that first fellow. If you want someone to be office boy, sweep the floors, empty the waste baskets, dust and answer the phone as well—wait for me!

. . . He got the job, because he gave more than was expected of him.

n r i

Modern Education

"You must be keen on the movies, old boy, to go twice a week."
"It's not that exactly. You see, if I don't go regularly, I can't understand what my grandchildren are saying."

N.R.I. ALUMNI NEWS

Oliver B. Hill of Burbank, Calif., and Floyd Buehler of Detroit, Mich., are Candidates for President to Serve Our Alumni Association During 1954

AT long last the honor of being nominated for President of the NRI Alumni Association has come to two of our most loyal and hard-working members. At the close of the polls on August 24 the vote showed that our Alumni members have nominated for President for 1954, Mr. Oliver B. Hill of Burbank, California, and Mr. Floyd Buehler of Detroit, Michigan.

It is very gratifying to have this distinction go to one of our very fine members on the West Coast where we have no chapter affiliations. Mr. Oliver B. Hill was strongly supported with much of his vote coming from West of the Mississippi.

Equally pleasing is the nomination of Mr. Floyd Buehler of Detroit, Michigan. Mr. Buehler is a real authority in the field of Electronics. For years he was Chief Instructor in a well-known school in Michigan. While in the Army he made many valuable contributions in the teaching of Electronics to our servicemen.

Oliver B. Hill or Floyd Buehler—either one—we are sure of an excellent president for 1954.

For vice presidents we have eight nominees. Please vote for four. The candidates are as follows: Harvey Morris of Philadelphia; F. Earl Oliver of Detroit; Thos. Hull, Jr., of New York; Claude W. Longstreet of Westfield, New Jersey; Louis E. Grossman of New Orleans; John B. Gough of Baltimore; Chas. W. Dussing of Syracuse, New York; and Chas. H. Mills of Detroit.

Morris, Oliver, Hull and Longstreet are well-known to our members. Each has held the office of vice president for one or more years and all are well qualified for the job.

Louis E. Grossman of New Orleans is making quite a record for himself. He is chairman of our New Orleans Chapter which organization he has really put on the map. Grossman is strictly the business-man type who wants results and knows what it takes to get them.

John B. Gough, that likeable gentleman who has so long been a member of our Baltimore chapter, is not a young man but is ripe in experience and organizing ability. He would be a real credit to our staff of officers if he should be elected a vice president.

Charles W. Dussing of Syracuse, New York has been getting some votes every year but this year he has stronger support than ever. He has no chapter connections which is all the more credit to him for his popularity in his area.

Charley Mills, that popular fellow in Detroit Chapter, rounds out our field of eight candidates for vice presidents. Charley insists he will retire this year—probably has by the time this news gets to him. He will, nevertheless, continue his deep interest in Alumni affairs.

Those of our members who know Norman Kraft, our retiring president, know how sincerely he has served as president during 1953. From these men —from all of our members—a big vote of thanks to retiring president Kraft.

Please use ballot on page 27. Vote for one man for president and four men for vice presidents. Your participation in this election is earnestly solicited. It will take but a few minutes to mark and mail your ballot. It will be very much appreciated if you will do so promptly. The polls close at midnight October 24. Results of the balloting will be announced in the next issue of NATIONAL RADIO-TV NEWS.

CHAPTER CHATTER

Pittsburgh Chapter is doing very nicely with Chairman Skolnik, Secretary Olejar, Treasurer Kyler and Vice-Chairman Benes, all giving generously of their time to give our members worthwhile meetings. Ken Shipley gave a short talk on the performance of the NRI Radio. This talk proved very interesting especially to those of our members who are doing the experimental part of the NRI Course.

A total of fifty-one attended our last regular meeting, including ten students as our guests. Seven new members were admitted.

H. A. Tate gave a brief talk on signal tracing on the Admiral TV Set with T. D. Schnader servicing the set for demonstration. Joseph S. Kyler explained the use of a VTVM and a 5-inch scope. Plenty of questions were asked on the use of the 5-inch scope. This seemed to be a very interesting subject and we hope to have more of it.

William Lundy discussed the use of a sweep signal generator. He placed special emphasis upon the use of probes in connection with the sweep signal generator.

Our program committee is arranging for speakers from manufacturers to give lectures and demonstrations during the Fall and Winter months. Pittsburgh Chapter meets on the first Thursday of each month at 134 Market Place. Meetings begin at 8:00 P.M. NRI students and graduates are cordially invited to attend.

Baltimore Chapter goes along serenely meeting on the Second Tuesday of each month at 8:00 P.M., at Redmen's Hall, 745 West Baltimore Street.

E. Shue gave a talk on power supplies and E. Kaminski gave a talk on oscillators. H. J. Rathbun continues to hold our very interesting open forum. Please remember—second Tuesday of each month—come and join us.

Philadelphia-Camden Chapter, instead of meeting twice a month as is customary, during the summer months held only one meeting. However, they are now back on full schedule with two meetings a month.

At the next regular meeting, Mr. Floyd Meyers, Service Manager for the Stuart Louchheim Company, Distributors of the Zenith TV is scheduled to give a talk on trouble shooting. This should be very interesting. All members should be sure to attend every meeting during the Fall and Winter.

New members, since our last report, are Carlton Bennett of Haddonfield, New Jersey; Otto C.

Election Ballot

All NRI Alumni members are urged to fill in this ballot carefully. Mail your ballot to National Headquarters immediatey.

FOR PRESIDENT (Vote for one man)

- ☐ Oliver B. Hill, Burbank, Calif.
- ☐ Floyd Buehler, Detroit, Mich.

FOR VICE PRESIDENT (Vote for four men)

- ☐ Harvey Morris, Philadelphia, Penna.
- ☐ F. Earl Oliver, Detroit, Mich.
- ☐ Thomas Hull, Jr., New York, N. Y.
- ☐ Claude W. Longstreet, Westfield, N. J.
- ☐ Louis E. Grossman, New Orleans, La.
- ☐ John B. Gough, Baltimore, Md.
- ☐ Charles W. Dussing, Syracuse, N. Y.
- ☐ Charles H. Mills, Detroit, Mich.

SIGN HERE:

Your Name .....

Your Address .....

City ..... State .....

Polls close October 24, 1953. Mail your Completed Ballot to:

L. L. MENNE, *Executive Secretary*
NRI ALUMNI ASSOCIATION
16th and U Streets, N.W.
WASHINGTON 9, D. C.

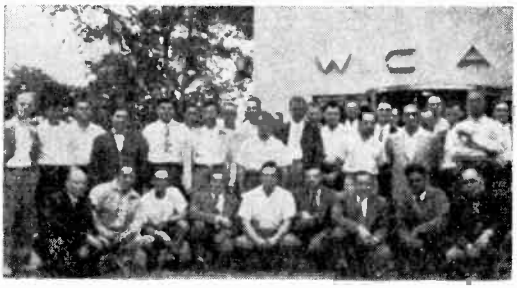
Phila.-Camden chapter members at top. Time out for refreshments. In center—chapter officers. Bottom—Chairman Seganti trouble-shooting a TV set for the boys.

Hoinkis and Fred Oberkehr, both of Philadelphia.

Bill Rodham, of our Chapter, was given quite a promotion by the Bell Telephone Company. Bill is cashing in on his knowledge of electronics.

Meetings are held at Knights of Columbus Hall, Tulip and Tyson Streets in Philadelphia every second and fourth Monday of the month. We have some nice programs coming up with uhf and vhf on the schedule. We are arranging for good speakers. You are always welcome at our meetings.

Detroit Chapter, after suspending meetings during the summer months, is back in full stride with meetings being held at St. Andrews Society Hall, 431 East Congress on the second and fourth Friday of each month. Students and graduates in the Detroit area who wish information regarding meetings should contact Chairman Kenneth Kacel, 5700 St. Clair in Detroit. Mr. Kacel, assisted by Secretary Bob Kinney and Vice-President Earl Oliver, have great things in store for Detroit members during the current season.



Phila.-Camden Chapter members visit station WCAU.

New Orleans Chapter has had the benefit of some fine lectures and demonstrations on the use of instruments in TV alignment. These talks were given by Mr. Mike Suchanek, a TV Engineer.

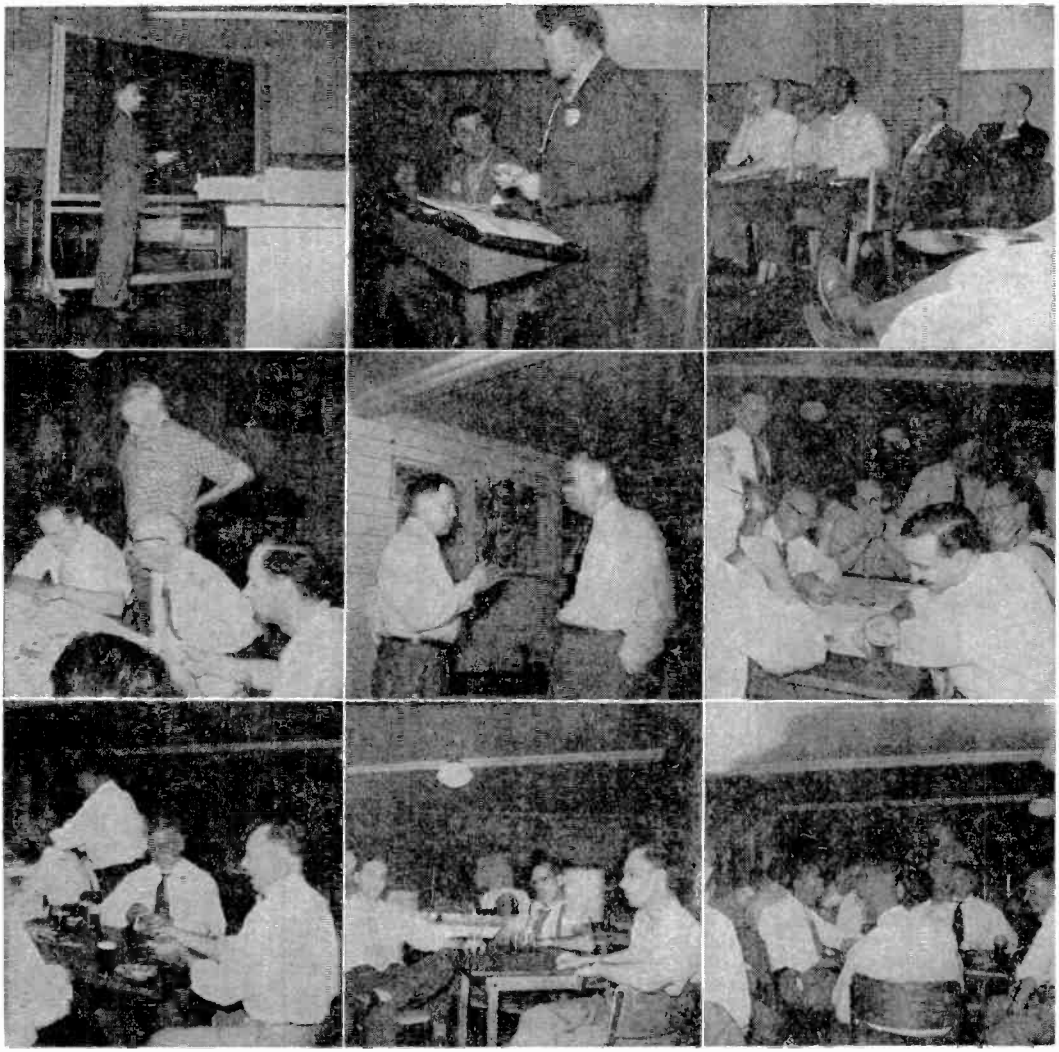
Chairman Louis E. Grossman can be contacted at 2229 Napoleon Avenue in New Orleans It is hoped that a permanent meeting place may soon be announced so that mention of it may be made in this column as a convenience to students and graduates in the New Orleans area.

The fine cooperation extended by Assistant Secretary Anthony H. Buckley, who supplies regular reports to headquarters, is very much appreciated.

Chicago Chapter is made up of a very chummy group who bring Radios and Television sets to meetings and go right to work. There are also some good talks by Chairman Mead, Secretary Ziecina and some outside speakers.

Arrangements are being made for a picnic this fall. Formerly this was an annual event of great interest to members.

Meetings are held on the second Wednesday of each month in the Tower Space, American Furniture Mart, 666 Lakeshore Dr. (West entrance.)



Detroit Chapter at work and at play. (Top, left) Harold Heiple, TV expert of Chase Television Service, lecturing at Detroit Chapter Meeting. (Center) Steve Novasel, who acts as a one-man committee in arranging for refreshments, and Vice President F. Earl Oliver, discussing an important point. (Right) A group of the members who show great interest in Harold Heiple's lecture. (Center row, left) Everybody is helping Secretary McKinney play 5 and 10 cent limit. The big loser? McKinney, of course. (Center) Larry Upham trying to convince Harry Stephens. Harry seems skeptical. (Right) The 5 and 10 game at Detroit Chapter stag. "I'll call your bluff and raise you a dime." (Bottom row, left) Just one more hand. (Center) Time out for a picture. (Right) Set 'em up again boys.

An interested group at New York Chapter meeting. The speaker, not shown here, was Thomas Hull, Jr.

Wm. Fox of N. Y. Chapter, whose humorous accounts of his experiences are always entertaining, as well as informative.

Here is Tommy Hull, one of our vice presidents. Notice the lapel microphone.

New York Chapter is back in full swing with ding-dong meetings planned for the Fall and Winter. The last meeting of the season, just before summer vacations, from all reports was something to be remembered. Chairman Wappler wishes to extend thanks for all the members to Miss Marie McKernen, Mr. and Mrs. Edward A. J. McAdams, and William J. Fox, for the many contributions in time and effort to make our last meeting such a huge success. We are grateful to Mr. McAdams for obtaining such splendid refreshments for us and to Mr. Fox for aiding Mr. McAdams in preparing this food so appropriately for the benefit of our members.

Meetings are held on the first and third Thursday of each month at St. Marks Community Center, 12 St. Marks Place, between 2nd and 3rd Avenues in New York City. All students and graduates in the New York area are invited to attend our meetings. You will enjoy the social contacts with our members.

Crez Gomez of N. Y. Chapter presenting Merne with a big box of candy —of all things!

Work of NRI Alumni Association Is Applauded by NBC and IRE

New York, N. Y.

Gentlemen:

"In the light of the development and growth of the electronics industry, I believe that encouragement of organizations such as the National Radio Institute Alumni Association is most important.

"The need for such organizations of servicemen and technicians in the field and their usefulness in encouraging the self-improvement and raising the standards and ethics of their members can not be over-emphasized.

"I would like to extend my congratulations to the National Radio Institute upon its fine program which is reflected not only in the advancement of its students, but also in its contributions to the industry, and to the Institute's Alumni association which encourages the self-improvement of its members and thereby contributes both to their welfare and to that of the industry."

Very truly yours,

GEORGE W. BAILEY, Executive Secretary
The Institute of Radio Engineers, Inc.

New York, N. Y.

Gentlemen:

"I have, of course, known of the existence of your school and something about its operation over a period of many years, but have not formerly been aware that the Institute was continuing its good work among its graduates to encourage and advance ethical business practices, the interchange of technical information for the common good and to promote by constructive and inspired guidance the continued growth and welfare of the radio, television, and electronics industry. Many of these activities are beyond the normal aims and functions of an alumni association and the National Radio Institute is to be congratulated on conceiving and executing this worthwhile effort.

"Our industry has advanced in gigantic strides in recent years, particularly the radio and electronics field, and the need for rapid training and indoctrination of competent technical people is great. You are taking practical and effective steps to help meet the need. More power to you."

Sincerely yours,

RAYMOND F. GUY
National Broadcasting Company, Inc.

HERE AND THERE AMONG ALUMNI MEMBERS

An Oakland, California, graduate, David D. Perry, writes that his spare time servicing business is getting almost too big to handle. A mighty profitable hobby. Perry is a machinist with the U. S. Navy, with 16 years' service.

———n r i———

Norman C. Thompson, of Bowie, Md., is doing well as owner of Bowie TV and Appliance Co. Employs three servicemen, and is largest Admiral dealer in his locality.

———n r i———

Graduate Mirle Thompson, of Midland, Mich., is very happily employed in TV servicing for a local General Electric dealer.

———n r i———

Alumnus M. D. Varner, of Portsmouth, Virginia, stopped for a visit at NRI. Busy with TV, grossing $100 per month spare time.

———n r i———

Pvt. Paul W. Oliver is now stationed at the Ft. Monmouth, N. J., Signal Corps School, studying Radar. Says thanks to NRI for this opportunity, as it resulted from his NRI training.

———n r i———

Graduate J. W. Sims is now settled in Clarksville, Ga., being just recently retired from the U. S. Army Signal Corps. Mr. Sims has returned from Korea, where he was in charge of a large radio repair facility. He plans to open a Radio-TV business soon.

———n r i———

Elmer Amlingmeier, an NRI Graduate of 1934, stopped at NRI while in Washington. He is service manager for May Stern Co., Cincinnati, Ohio.

———n r i———

Graduate Harold Schaefer, of Columbus, Wisc., tells us that he has finished his basic training and is now attending the Army Signal Corps School at Fort Monmouth, N. J. By coincidence, his bunk mate is Gerald Droesch, an NRI Graduate from St. Henry, Ohio.

———n r i———

Leo O. Voien, of Sioux City, Iowa, has just obtained his first-class radiotelephone license. He has been a technician with Wincharger Corporation for the past several years.

———n r i———

Congratulations to Harry M. Andrew, of Easton, Penna., who has been made service manager of Coastal Radio Service Co.

———n r i———

A late report from New Orleans Chapter, received at press time, tells us several bus loads of members visited the WDSU-TV studios and transmitter. They saw a live TV show in progress, saw the monitors at work, and how the show was sent out on the air-waves by the engineers. Our thanks to Mr. Lindsey Riddle Chief Engineer and to Mr. Joe Hertzel of the engineering staff for their courtesies to our members.

NATIONAL RADIO-TV NEWS

16th & U Sts., N.W. Washington 9, D. C.

For:

Mr. Francis H. Fingate 25236
611 17th St.
Denver 2, Colo.

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H. L. EMERSON, ASSOCIATE EDITOR
J. B. STRAUGHN, TECHNICAL EDITOR

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