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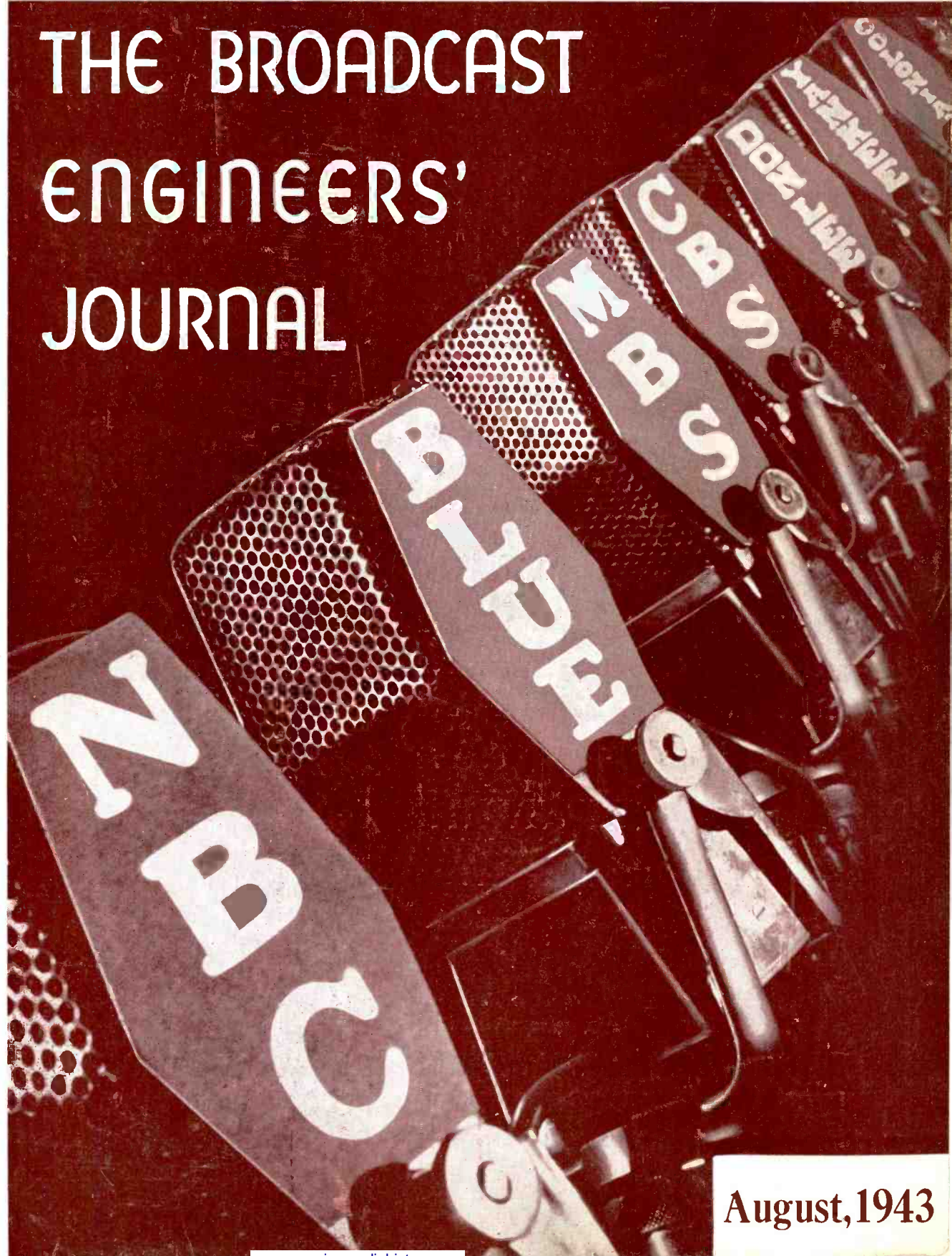
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How Little Do We Hear?

By W. A. Munson, Bell Telephone Laboratories

THE BROADCAST ENGINEERS' JOURNAL



August, 1943

—LIKE A HOT TODDY
ON A FREEZING DAY!



—LIKE A NEW CLIENT
WITH A FISTFUL
OF FOLDING MONEY!



—LIKE A WELL-AIMED
TORPEDO AT A
JAP BATTLESHIP!



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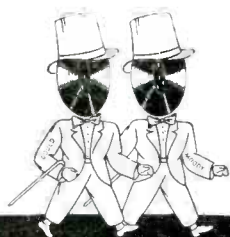
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THE BROADCAST ENGINEERS' JOURNAL

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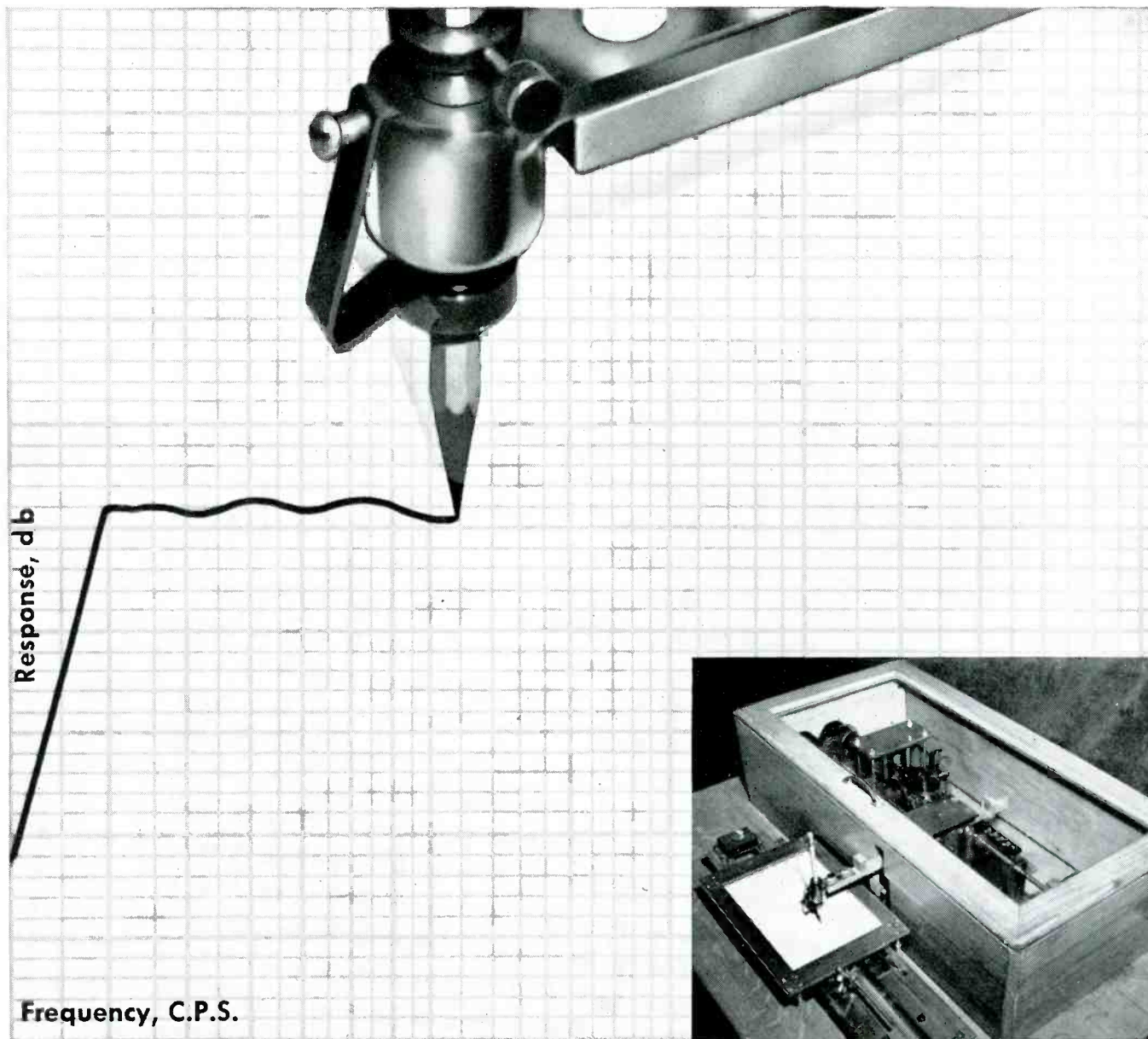
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How Little Do We Hear?

By W. A. Munson

Acoustical Research, Bell Telephone Laboratories

(This thought-provoking article, so important in the Broadcast and Recording fields, is reprinted here in its entirety, including illustrations, by permission of the BELL LABORATORIES RECORD, from the June, 1943, issue of BELL LABORATORIES RECORD.—Ed.)

HEARING is one of the five senses, and although it is distinct in name and sensation from the other four, its cause is of the same nature as that for the sense of touch. For both, the acting stimulus is pressure. While a simple steady pressure on the hand will result in a tactile sensation, however, the pressure on the eardrum must be vibratory if a sensation of sound is to result.

One of the fundamental studies in acoustics is that to determine the minimum stimulus that the ear can detect. Attempts to determine this basic stimulus have been made by many groups over a long period of time, and the results have varied widely. This divergency of results might be expected because there are physiological and psychological factors to be considered as well as the physical ones. A survey of all published results and a complete new set of measurements using the most modern and improved techniques was undertaken some time ago by L. J. Sivian and S. D. White of these laboratories.

The difficulty in securing accurate values is great. In the first place there are differences in the hearing mechanisms of various individuals tested. Except for those with some definite hearing defect, these differences largely depend on age; as one grows older the response of the ear becomes less, chiefly at the higher frequencies. Measurements of minimum hearing stimulus thus vary with the age of those being tested. Another difficulty is in measuring the minimum stimulus. Two references have been widely used. One is the rms pressure of the sound wave at a point in a free sound field where the listener's ear will later be placed. This is the simpler of the two, and is particularly applicable to studies of the usual mode of hearing, that is without the use of telephone receivers or similar devices. The other is the pressure at the eardrum. This latter reference avoids uncertainty as to how the pressure, measured in the air previously to the listening test, would be modified at the eardrum by the head and ear of the listener, and is particularly useful in studying the mechanism of hearing. It involves great technical difficulties, however, since the space in front of the eardrum is small and almost inaccessible.

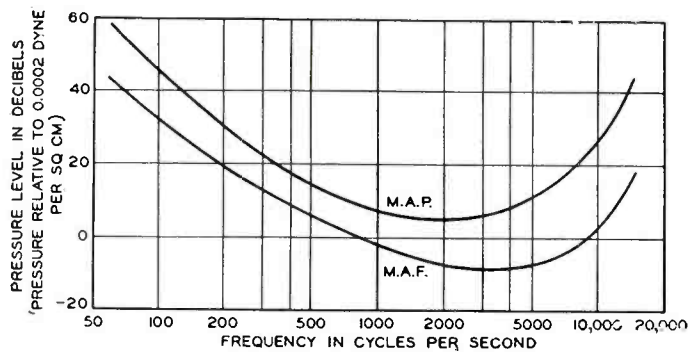


Fig. 1—Curves of minimum hearing stimulus as determined by Sivian and White

Based on their own measurements and on extensive analyses of measurements published by others, Sivian and White drew two curves to represent the minimum hearing stimulus. One, based on the pressure measured at the drum, is called the curve of minimum audible pressure—abbreviated M.A.P.; the other, based on measurements of the sound field at the point where the listener's head will subsequently be placed, is called the curve of minimum audible field, abbreviated M.A.F. These two curves are shown in Figure 1. The differences between them are attributed to distortion of the free sound field that takes place when the observer enters. His body forms a discontinuity in the impedance the wave encounters in free air, and whenever a change in impedance is met, a change in pressure results.

Regardless of which of these two curves is used, the pressure involved is very minute—less than a thousandth of a dyne per square centimeter. A pressure of this order of magnitude distributed over the eardrum results in a force of the order of only a hundred-millionth of an ounce. As an organ for detecting pressure changes, the ear is thus far more sensitive than our tactile organs, since a touch of this lightness would be imperceptible. Even at the upper limit of hearing, the force is only some thousandths of an ounce. Vibrating pressures greater than this become tactile rather than audible and result in the sensation of pain.

The ordinate scale of Figure 1, on which the stimulus of the sound is read, is pressure level in db referred to a pressure of 0.0002 dyne per square centimeter. A decibel, however, by definition is ten times the logarithm of the ratio of two powers. It is thus a unit of power ratio, and the incorporation of pressure with the decibel scale seems out of place. This seeming anomaly is readily accounted for by the fact that power under any given set of conditions is always proportional to the square of the pressure. Any one pressure under a given set of conditions defines one power. This relationship may be written in the form $w = kp^2$ where w stands for power, p for pressure, and k is a constant depending on the units used and on other conditions of the measurement. In expressing a power w_1 , with its corresponding pressure p_1 , in terms of db relative to some reference power w_0 , with its corresponding pressure p_0 , we write:

$$db = 10 \log \frac{w_1}{w_0} = 10 \log \frac{kp_1^2}{kp_0^2}$$

The k 's in the right-hand expression cancel, and since the log of the square of a number is two times the log of the number, the above expression finally becomes:

$$(2) \quad db = 10 \log \frac{w_1}{w_0} = 20 \log \frac{p_1}{p_0}$$

All sensory responses vary not directly as the stimulus but more nearly as the logarithm of the stimulus, and the use of a db scale, which is logarithmic, is thus very con-

venient. The fact that a db is proportional to the logarithm of a ratio of powers rather than of pressures is no particular objection since power and pressure are always interconvertible by means of equation (1). As a matter of fact, the stimulus of sound is frequently given in terms of the power of a wave in free air. From a source of sound, the waves spread in all directions, but since the only part of this total flux of energy that is effective in causing sound in a listener's ear is the small portion that strikes the drum, it is the intensity of the wave, or the power crossing a unit area such as a square centimeter, that is used as a measure of the stimulus. For air at a temperature of 20 degrees C. and a pressure of 76 cm. of mercury, k in equation (1) is 2.4×10^{-3} and the relationship between intensity and pressure becomes: (3) $i = 2.4 p^2 \times 10^{-3}$, where p is the rms pressure in dynes per square centimeter — and i the intensity in microwatts per square centimeter. This relationship solved for p is: (4) $p = 20 \times \sqrt{i}$.

For any value of pressure, therefore, there corresponds a power intensity, which may be calculated from equation 3. These intensities are very small, however. That for a pressure of 0.001 dyne per sq. cm. is 2.4 thousandths of a millionth (2.4×10^{-9}) of a microwatt per square centimeter. To avoid using such small exponential fractions as 10^{-9} , it is customary in acoustical work to use a reference intensity of 10^{-10} microwatts per square centimeter for which the corresponding pressure is 0.0002 dyne per sq. cm.

The intensity level of an acoustic wave is defined as ten times the logarithm of the ratio of the given intensity to the reference intensity, and is expressed in db, which is the accepted unit for expressing ten times the logarithm of a ratio of two powers. An intensity level, strictly speaking, is thus a measure of the power intensity of an acoustic wave, but it is also a measure of the pressure because of the relationship between power and pressure given above. The power intensity and pressure corresponding to various intensity levels are shown in Figure 2. The curve for pressure has a slope of twice that of the curve for power because it is the square of the pressure that is proportional to power.

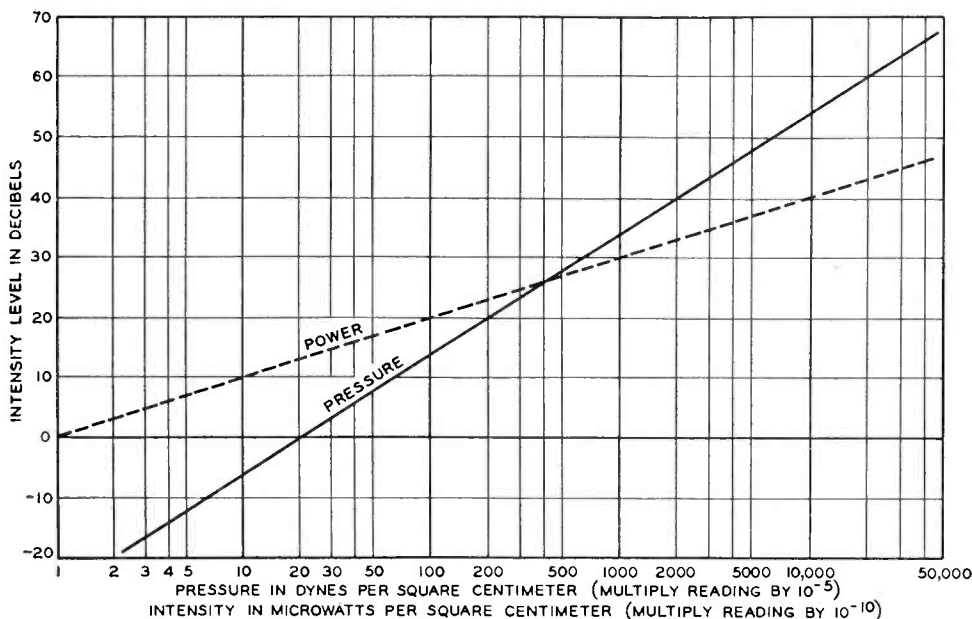


Fig. 2 — Power and pressure levels corresponding to various intensity levels

The intensities derived from the ordinate scale of Figure 1 are thus the intensities of a sound wave in free air. They are not necessarily a measure of the power actually absorbed by the ear mechanisms. Power is a function of both pressure and impedance, and equation (3) incorporates the impedance of free air. The same pressure acting against the impedance of the ear mechanism might result in an entirely different power. This situation is true of all power applications. There may be an electric potential of 110 volts at a particular socket, but the amount of energy used depends on the resistance of the lamps inserted. A larger lamp, having a lower resistance, will consume more power than a smaller one with high resistance. Since for any one person the ear mechanism is fixed, the pressure alone is a sufficient indication of sound stimulus under any given set of conditions.

The curves of Figure 1 represent the so-called threshold of hearing, since any air wave with an rms pressure above the threshold value enters our consciousness as sound, and the sound becomes louder, the higher the pressure. Since it is the loudness rather than the pressure that we are directly conscious of, some scale for measuring loudness is also desirable. Loudness, however, is not a simple physical quantity like pressure. Between it and pressure there is interposed the complex mechanism of the ear, the system of acoustic nerves, and our psychological response to nerve stimulation. Much study has been devoted to the subject, and many suggestions were made and tried out before a satisfactory solution was reached. Because of the curved characteristic of the threshold, it seemed possible from the first that the loudness of sounds of different frequencies might not correspond directly with the pressure.

The results of a large amount of work was summarized some years ago by Harvey Fletcher and the author. It was decided to use the loudness of a 1000-cycle tone as a reference. This frequency is widely used as a test tone throughout the Bell System, and it has the advantage of being very close to the frequency range for which the ear is most sensitive. Since in general the relationship between the magnitude of a sensory response and its stimulus is logarithmic, it seemed desirable to use a logarithmic scale, and for convenience the loudness level of a 1000-cycle tone was arbitrarily taken to be the intensity level. Loudness level at any other frequency or combination of frequencies is taken to be equal to the intensity level of a 1000-cycle tone that sounds equally loud. Although loudness level is measured on a logarithmic scale, and thus corresponds in magnitude to a db scale, the unit is called a phon instead of a db to indicate that the thing measured is basically different from power.

At 1000 cycles the threshold of hearing in a free field is just about at 0 intensity level, which also justifies making the loudness level and intensity level equal by definition at this frequency. At 1000 cycles, therefore, an increase in intensity level results in an equal increase in loudness level. This equality is found not to exist at other frequencies, however. This is obvious from Figure 1. A 100-cycle tone, for example, at an intensity level of 32 db is just at the M. A. F. threshold, and is thus of 0 loudness level, while at 1000 cycles a tone of 32 db intensity level is

(Continued on Page Six)



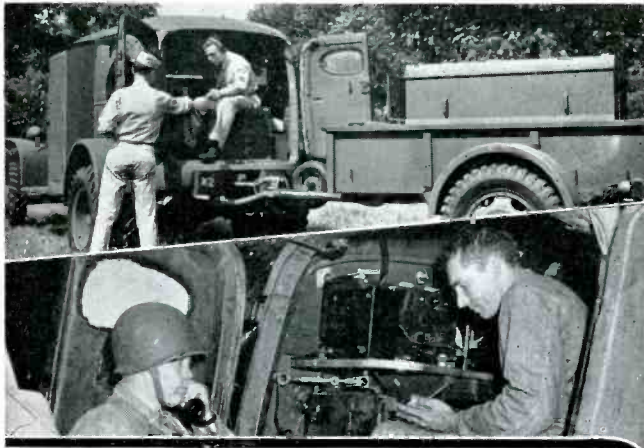
The attraction lingers on

On a pleasant island in the sea lived three sisters called the sirens. They amused themselves by singing tunes that magnetically drew all who heard them to the island, only to be dashed to death on the surrounding rocks. Certain precautions could be exercised, but only the clever sailors like Odysseus, who filled the ears of his crew with wax, and had himself strapped to the mast, escaped.

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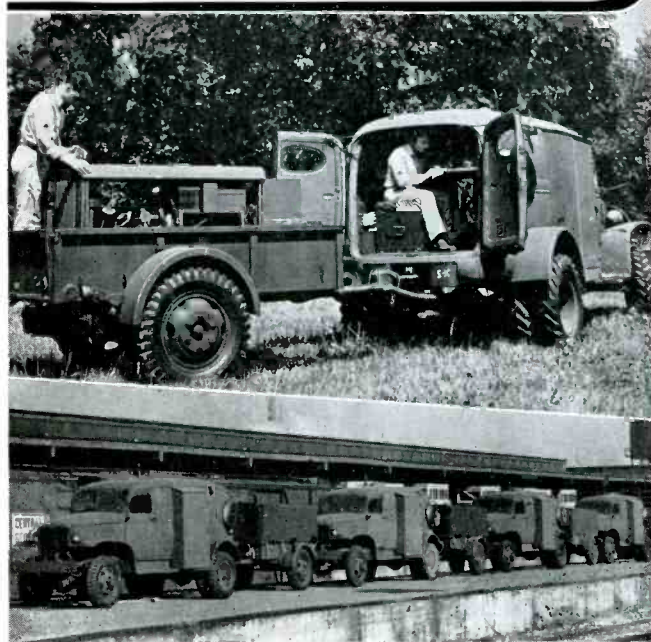
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How Little Do We Hear?

(Continued from Page Four)

at 32 loudness level. In comparing loudness with intensity, therefore, and in most other acoustic work, it is preferable to refer the intensity to that at the threshold for the particular frequency involved. If the intensities above threshold are compared with the corresponding loudness level, the results found are those indicated on Figure 3. At 1000 cycles, the curve expressing the relationship between the two levels is a 45-degree straight line because of the definition of loudness level. At other frequencies, however, the relationship is a curved line, and may be either above or below the 1000-cycle line. The departure is the greatest at the low frequencies. At 60 cycles, for example, a tone 60 db above the threshold in intensity is at 109 loudness level. At 5000 cycles, on the other hand, a tone 60 db above threshold in intensity is at a loudness level of

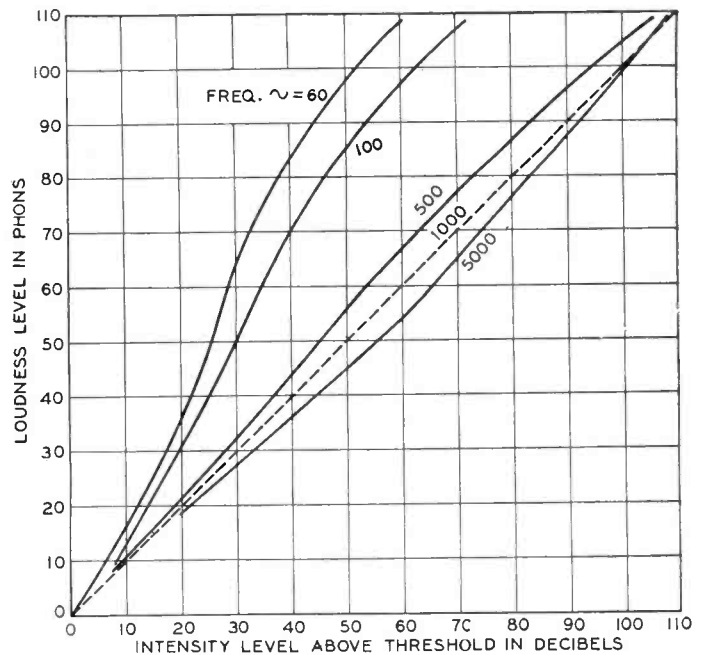


Fig. 3—Relationships between loudness level in phons and intensity level above the threshold for various frequencies

only 54. For all frequencies above 500 cycles, the curves lie between those for 500 and 5000 cycles.

To the question "How Little Do We Hear?" the only safe answer is: "It all depends." What we hear is a sequence of periodic pressure changes in the air, but how small the pressure changes may be, given a normal young ear, depends on the rapidity of the changes. The ear is most sensitive when the pressure cycles are occurring at rates between 1000 and 5000 times per second, since we can then detect changes less than a thousandth of a dyne per square centimeter. At both higher and lower frequencies, the sensitivity falls off. The studies that have determined these minimum perceptible pressure changes, and the many others that have established units of measurement and adequate techniques and apparatus, have provided the foundations for the extensive studies of hearing that have been carried on in the Laboratories.



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WLW

(Continued from Page Seven)

Pixie" didn't have all the information thereon. Rather than a tersely-worded memo, Earp received this tender little bit of rhyme:

"I'm herewith returning your B application;

I trust that you get your justified ration.
You failed to put 'X' just opposite
the 'B';

But this little chore was cared for by
me.

The speedometer reading is also re-
quested;

This little job to you is invested.

To deal with such figures would turn
my hair grey,

So I feel it's a job for a good C.P.A."

Now you know why we like it here.
Pass the lilac-water, Hortense. I feel
I'm about to swoon!

* * *

No column would be complete without a story about Glenn Merriam's "house-of-magic." Regular readers of these words will know that it was Glenn who rigged up the wonderful garage door opener, among many other mechanical contrivances which makes running the household practically automatic. The General Electric version of the house-of-magic looks slightly west of Denver compared to the push-button paradise that is Merriam's. Recently, Glenn was cutting out holes in the baseboard in preparation to installing some gadgets. He was using the builder's blueprints to guide him and he noticed that behind the wall he was cutting was an unassigned space large enough for a secret room. After he completed his cutting operations, he noticed something white on the other side of the wall. He called to his good wife to come and look because the carpenters had sealed something in the space on the other side of the wall. Glenn reached through the opening and discovered the white object to be cloth, so he pulled it through the wall a foot at a time. Not until it was all the way out did Mrs. Merriam discover that it was one of her best sheets. Glenn had cut through into the linen closet!

* * *

The above story was fetched to us by Merriam's brother of the dog watch, Phil Underwood. To even the score, we feel we should mention some of the doings of Philip. He recently was given an assignment that was worthy enough to have the Underwood portrait in one of the daily papers. Although we have

(Continued on Page Nine)

Broadcasting Comes 'Of Age'

1922 - 1943

(Right) August, 1922, 24 Walker Street, New York City. WBAY's first studio. S.L. Ross at piano. Helen Hann at condenser microphone



24 Walker Street, August, 1922.
WBAY's towers and flat top.

Then
W
B
A
Y

Now
W
E
A
F



October, 1922, 24 Walker Street, New York City.
WBAY's (now WEAF) first radio transmitter.

WLW

(Continued from Page Eight)

been scooped by Broadcasting, Radio Daily and Godey's Ladies' Book, maybe you haven't heard that Phil is teaching a class in aircraft radio at the Y.M.C.A.

* * *

We are happy to report that Al Schwerling is on the mend following a bad fall out at his Elkton Place home. Al was spending the first part of his vacation doing a little work on the house perched on the top of an extension ladder. Al stepped where the ladder wasn't and spent the balance of his vacation recovering from injuries sustained. Luckily, they weren't serious and by the time you read this Al will

have been back to work at the Crosley Square studios.

* * *

SHORT NOTES AND BLUE NOTES. Now that Studio A is open for business, Bernie Cook and Leonard Clift can bask in the glory of a job well done. Bernie and Len installed all the studio equipment at the Crosley Square plant. While speaking of solder-slingers, we must not forget that the Master Control layout, which picture adorns this column each month, is the brain-child of Richard Schenk . . . The Crosley Square military experts predict a quick termination of the war now that Studio Engineer John Mitchell has "joined" up with the mechanized warfare branch of the Army . . .

Our operative in Mt. Washington reports that Warner Hartman is spending all of his spare time in his Victory Garden; first, he sends the boy over to the neighborhood pub with the growler and as soon as the boy returns, WH has the hoe all ready and he shows the youngster where to use it . . . Jack Chenoweth had a unique program with the mobile unit recently—he cut a record for the Rubel Baking Co. over at the Tastee Bread Co. auditorium. Jackson stayed close to the Buick so that he wouldn't be caught in the line of fire in case the rival bakers started pitching ovens at each other . . . Famous last words: "Gimme another card; I'll stay and outdraw you."

CHICAGO

By A. W. Hjorth

WITH nearly ninety members in this NABET Chapter, ye columnist will confine his efforts to the doin's of our gang.

R. S. "Parlay" Davis, NBC Recording Supervisor, witnessed the running of horses around a racetrack for the first time on every day of his three-week vacation . . . and nary a buck did he bet!!!! (true or false?)

Charles Townsend, formerly NBC Chicago and now of NBC Engineering Development, was a recent welcome visitor at NBC Control, Chicago. Charles was a Chicago studio engineer from '30 to '36, and is best remembered for his outstanding contribution to the advancement of studio control room technique by his invention and use of "The Townsend Arm Rest for Tired Twirlers." This device was not patented and a letter of inquiry to Charles will result in a complete drawing of this complex electronic improvement! (Ah! An article from Townsend.—Ed.)

As the light of day broke and splattered o'er Chicago Monday morn, July 26th, a concentrated caravan left civilization for Twin Lakes, Wis. This was no ordinary vacation junket. Never before (or again) will one ordinary automobile contain **Charlie Butler** and his boss **Gertrude**, their offspring **Bruce** and **Marilyn**, **Harold Jackson** and his wife **Edna** and little **Helen**, **Ronald** and **Larry**. Oh yes, and two dogs plus sundry luggage. They accomplished this modern miracle without witnesses so you'll have to ask these NBC Chicago wizards just how **Harold Jackson's** sardine can was packed.

W. K. "Bill" Cole, NBC Chicago Supervisor, spent his July vacation repainting his home. Tired of its former color, chocolate brown, his wife **Ruth** spent many months planning the color scheme for 1943. As a result, "Bill" finished the job and it is now a beautiful shade of chocolate brown. Next year "Bill" will again paint his home . . . yes, chocolate brown.

Visited **WMAQ** transmitter last month and found a cooperative **Victory Garden** of gigantic dimensions. Nearly two acres divided into plots with each engineer working his share. Some sections had more weeds than crops and a few had no weeds. Since I may want to visit out there again some time ('bout harvest time), I refuse to divulge who has the best farmette (pint size farm).

Councilman **D. "Roy" Glanton** (re-elected), **WOW** transmitter supervisor, writes that they're operating on a twenty-four-hour sked now with but three and one-half hours every eight days for maintenance!

WOW staff have had no new "blessed events" and none are anticipated. Most of the vacations have been spent in **Victory Gardens** and just being lazy. "Roy" Glanton claims he caught an "oversize" fish while vacationing in **Minnesota**, though. For the information of his local ration board, the trip was made by train.

Belated greetings to **A. H. "Al" Maller** of **WOW** studio group. He became one of the gang last February.

Although **Catherine** joined **W. H. "Bill" Cummings**, his wife **Mildred** and older daughter **JoAnn** last June as a

happy addition to a busy **BLUE** field man's home, she broke some sort of a record by weighing-in at ten pounds, three ounces and seven grams on her arrival. Has or can any NABET member better that poundage?

Also June saw the need of many diapers in the "**Chuck**" **Ostler** home. **Kathleen** weighed more than seven pounds (before a diaper was attached) and her mother **Della** now sings . . . and baby makes three. **WLS** studio crew complain that no cigars were forthcoming.

"**Harry**" **Johnson**, NBC studio, excitedly announced that **Gail Elizabeth** arrived at 11:38:03 (exactly) Friday, July 17, weighing in at seven pounds eleven ounces.

M. J. "Maurey" Donnelly, **WLS** studio, was very unhappy when leaving to start his vacation. Wanted to fish at **Fox Lake** but too far to walk, so wound up digging worms from **Victory Garden** and just wishing.

C. P. Lonnie, **WMAQ** transmitter, raising hundreds (or was it thousands?) of chickens for market on his seven-acre ranch. (Unconfirmed.)

K. A. "Kermit" Slobb, **BLUE** studio, fined himself 10 cents last week. Caught himself cheating at solitaire again. Twirler of dials on the new **BLUE** show **HOT COPY**, he aspires to be a radio actor. Also recently broadcasted from a station in **Honolulu**. **Hula gals** and **grass skirts** just "ain't", he sez.

E. G. "Al" Eisenmenger, pioneer NABET chairman of this chapter, spent his July vacation at **Ludington, Mich.**, with fond wife **Phyllis** and very young daughter, **Deborah**. Fishing? No. Golfing? No. Swimming? No. Just sleeping and being lazy, sez **Al**.

A. J. Schroeder vacationed to **Milwaukee** via lake steamer, there to golf and then back to keep ahead of the weeds in his **Victory Garden**. This news via **WMAQ** transmitter grapevine.

Each month we'll try and have a brief biography of a Chicago Chapter NABET member. Going through our roster alphabetically, we start with **A. D. Aldred**, **WMAQ** transmitter. Arrived this world at **Paulding, Ohio**, September 17, 1905. Fabricated and nursed the then powerful (1500 watts) **WEBH** in Chicago, atop the **Edgewater Beach Hotel** where **Joe Gallicchio** (no hair even then) and his umteen-piece orchestra was a headliner on **WEBH**. At **WEBH** from '25 to '28; then he did research and development work for a Chicago radio receiver manufacturer 'til '29. Next to old **WMAQ** when it was owned by the **Chicago Daily News** with studios and transmitter in the **Hotel LaSalle**. Also found time to evolve **W9XAP** television station using a 48-hole revolving disc! Remember? In '32 came with **WGES**, then owned by **Guyons Paradise Ballroom**, with 500 watts on weekdays and a special treat on Sundays of 1000 watts. Returned to **WMAQ** June, '37. Has many photos of early Chicago broadcast equipment and the then radio stars. Ask to see them. They're in the attic but his lovely wife **Pearl** will dig them out for you. Married one cold day of February, '31, they have two swell boys, **Aryl, Jr.**, eight, and **Dennis**, six. Lives in **Elmhurst**

and very busy modernizing an old mansion with just the help of his wife. They've moved walls and windows and added rooms and changed stairways until the original builder wouldn't recognize the improvements.

J. H. "Jim" Platz, NBC-BLUE Supervisor, vacationed at home and accomplished much in laying a concrete driveway to his fourteen-car garage. The driveway is seven feet wide and nineteen miles long. At least it seemed that long to Jim, toiling in the hot sun. He also spent much time admiring his wife Ellen's Victory Garden.

Lieut. Thurber Bombaugh, USNR, announced the arrival of a boy baby on the 17th of July. Agnes, Mrs. Thurber, and junior getting along fine.

W. C. "Woody" Lahman with his wife Dorothy and daughters, Ann and Nancy, spent most of July at their three hundred-acre ranch. As to their activities, Woody's only statement was, "I cut thistle and stuff." It is very unusual for him to make a statement of such length.

J. A. Felthouse, newest member of WENR-WLS transmitter staff, wedded the former Miss Catherine Koehler. Big events are expected to be announced by Mr. and Mrs. Felthouse . . . sometime.

W. T. "Bill" Anderson has been crowned "Potato King" of Will County. Agronomist Anderson grew less potatoes with more water on the lowest part of the county. Bill is also an engineer at WENR-WLS transmitter.

H. R. Rawson, Councilman, WENR-WLS, advises that letters from **Captain Ahlgrim** written somewhere, tell of meeting fellow engineers from NBC-BLUE, but gives no names or places.

J. R. Miller, NBC-BLUE Supervisor, spent the last week of his vacation in Boston meeting with the Gideon Victory Conference, as one of nine representatives from Indiana. Made a tour of Boston in a horse-drawn covered wagon and ate swordfish at the Hotel Statler. His wife Nancy with children Nancy and Charles kept the home fires burning for papa at Homewood.

B. F. "Bev" Fredendall just completed instructing a course in **Control Room Technique** with a bevy of Northwestern beauties as students. Professor Fredendall is being persuaded to write an article on this little known subject. Are you interested? (YES!!—Ed.)

H. F. "Harvey" Kohnitz, WLS-WENR transmitter, has two sons and a daughter. Harvey, Jr., is a fighter pilot cadet in the U. S. Air Force. Daughter Hazel is a U. S. Army nurse in training, and son Lowell reported July 29th to the U. S. Air Force. Harvey and Edna are justly proud of their kids.

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Broadcast Engineers' **11** Journal - August, 1943

Cleveland News By F. C. Everett

DON'T shudder with revulsion, gentle reader, but Bert Pruitt has asked me to assume his toga for a brief moment while he concentrates on the vacation business. It has leaked out that he intends to paint his house. After all this period of whitewashing our activities at Cleveland and laying it on thick, the house painting job should be quite a snap. You who have followed the Journal know that Bert has done a lot of writing but probably very few of you know that he is a regular Eddie Guest and whips out at least one poem every day — usually with a little other writing on the side. This well-known poet-philosopher has already gone places and you may get ready to say you knew him when.

Another house painter is Jerome. Jerry has painted a lot of things by means of spray guns, and it was quite a surprise to find that he had put it on with a brush. However, he has also coated and baked a lot of tin cans by the lithograph and other processes similar to it and one could hardly expect a baked enamel job on the house.

Attention NBC's D'Agostino! Earl Holl suffered minor injuries and averted a serious accident a short time ago when he was planting potatoes in his strip of the WTAM Transmitter victory garden. He was bending over carefully placing a spud when a sneak attack was made on his coccyx. He escaped with comparatively minor lacerations and contusions and a careful investigation revealed that the potatoes were growing so fast that the ones he had just planted were responsible for the said boot in the fanny. To prevent any more such serious results, it is reliably reported that the NBC Safety Department is about to issue a special bulletin about turning your back on vegetables and such like in the immediate vicinity of radio stations. The ground is so fertile, you know, because of the high grade bull that has been dished out for years.

The place has somewhat the air of a farmers' exchange, what with tracking in dirt from the garden and long discussions about the merits of pickling beans. (Incidentally, the guards have promised to bring their own salt for Russell's Muskmelons.) However, there is a faint odor of education and knowledge and learning and research about the place. Several of the boys are studying math, or making a stab at it. Some higher and some lower math, but those involved are Walker, Holl, Butler, Everett, Jerome, and Brandt claims he bought a whole set of math books. Besides that, the boys have been bringing out the technical books and have started a pretty fair library. It is surprising the lineup that results when everyone chips in. There is nothing formal about it, but we're just keeping our books out at the station, instead of home, to our mutual benefit.

A. W. Kramer, Chief Engineer of WAOV, Vincennes, Indiana, says that he and his engineering staff composed of Messrs. Hatzell, Poe, Flory and Kennedy, are "beginning to feel more like farmers than radio men!" That sounds like a successful Victory Garden. About two months ago, WAOV carried several on-the-spot flood relays with Army cooperation, during the Vincennes flood threat.—Ed. S.

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Los Angeles

CAPTAIN WILLIAM F. GRIMES, well-known to radio engineers here for his many years of capable direction of the Radio Interference Engineering Bureau, until recalled to active service in the Navy two years ago, died in the Navy Hospital at Norco a few weeks ago. Only forty-nine at the time of his passing, he was 11th Naval District Communications Officer, with headquarters at San Diego. He was a veteran of the last war, having served as Chief Radio Electrician on the Pennsylvania and Rhode Island in the Atlantic Fleet. He was also prominent in the development of the Naval Communications Reserve on this coast.

The pictures of **WOR Recording Studios** and the accompanying article by **R. A. Schlegel**, in the July issue of the Journal, were scanned here with much interest, and favorable comment (likewise Schlegel's articles in the Journal in past years) and we hope to see like descriptions of other departments and equipment in the near future. Also the picture of **Crosley Square Master Control** and the not-too-technical description evoked laughs and recollections of the "Invisible Engineer" who is well and unfavorably known here. Let's have more pictures, with descriptions. The same request goes to all other stations.

Robert O. Cook has been elected Chairman of the KFI-KECA Section of the Hollywood Chapter of NABET and has appointed **Edwin E. Starr** to succeed him as Secretary-Treasurer, the office Bob has so capably filled for the past year.

After more than twelve years' service with **Don Lee Network** stations, **Robert C. Moody** left his position as Development Engineer in KHJ's lab here and is now Transmission Engineer with Western Electric (ERPI Div.) in Hollywood. Moody is also secretary of the Los Angeles Section of IRE.

A. Donald Galbraith, at Don Lee stations for almost twelve years, resigned his position in Master Control at KHJ Los Angeles and joined the Forest Service, to install and maintain radio and telephone equipment. A current special assignment will keep him out-of-doors the remainder of the summer, traveling to mountain tops all the way from the Mexican border to Portland.

Four other engineers, well-known in Los Angeles, have left Don Lee's KHJ and/or W6XAO television station to engage in radar work: **Glenn Turner** and **Bob Pitzer** to Western Electric in New York (Pitzer is reported in Ottawa at present); **Lloyd Mitchell** and **T. L. Ragland** to



Jews By H. M. McDonald

Raytheon, presently working in the San Francisco bay district.

Robert P. McGaughey has left KFI-KECA Studios to become Chief Engineer at KFEL, the 5KW MBS outlet in Denver. We wish him the best of luck.

Richard T. Taggart, at KFI transmitter and studios for the past year, has resigned to accept a position in the scenic department of M.G.M. Studios. Taggart is an accomplished painter of both portraits and landscapes and his work has been shown in the best galleries on both coasts. He has also been honored with the highest offices in art societies and clubs here, and listed in Who's Who.

We hear indirectly that **Frank Pease**, a Cal Tech man long with Southern California distributors of W. E. broadcast transmitters and p.a. systems, has been commissioned a major in the Army and has left M.I.T. for duty overseas.

Henry Whitaker has transferred from WBBM Chicago to KNX Los Angeles studios.

Jim Pincock, ex-KMTR, here, and **Stanley Carr**, ex-KFMB San Diego, are now at KNX Los Angeles studios.

Glen Litten, at KFI transmitter until he rejoined the Navy two and a half years ago, has been promoted to Lieut. Commander. He is an instructor in the Radio and Signal School here at the Naval and Marine Corps Armory. He and **Norol Evans**, now at KFI transmitter, and **Roy Tindall** of KFWB Los Angeles, grew up and went through school together at Orange and were heard 'round the world from that little city in 1927 when each of them had a kilowatt on the air, W6CGO, W6ADT, and W6AJO, respectively.

Ray Walling, ex-KFI T.E., is also a Lieut. Commander in the U.S.N.; stationed at San Diego where he is District Radio Materiel Officer.

Two new men at KFI-KECA studios: **Wayne R. Johnson**, formerly at Oakland and San Francisco stations KLX, KALW and KYA; **Willard B. Guimont**, ten years in radio, mostly with airlines around Chicago, but more recently with Pan-American Grace Airways at Lima, Peru, for six months. Welcome, fellows.

Speaking of new arrivals, there's a brand new baby girl at the home of **Curtis W. Mason**, co-Chief Engineer of KFI-KECA; all doing well.

Alan N. Cormack, formerly Chief at KFRC San Francisco (MBS) has been commissioned a Lieut. in the USNR and is stationed at Alameda.

Tom Mitchell, with RCA from 1927 until joining the Signal Corps last year, is now a Lieut. Colonel, stationed in

(Continued on Page Twenty-one)

W. H. Trevarthen

Newly-Appointed Blue Network Staff Engineer

BILL TREVARTHEN was born on March 26, 1908, in South Range, that part of Northern Michigan producing copper, which is probably the most important basic metal used in the radio industry. It is no wonder, therefore, that he became interested in radio and built his first one-tube receiver back in 1922.

He entered Bliss Engineering School, Washington, D. C., in 1928, where he attained honorable mention and upon graduation attended the Western Electric Company's Equipment Engineering School, later being transferred to the Kearny plant as Equipment Engineer.

Due to the depression, Bill took some time off to see America first, traveling extensively through all the States with the exception of North Dakota. His interest in radio still did not wane and he secured his First Class Radio Telephone License during this period.

Bill spent the next two years with the General Electric Company, Bridgeport, Conn., where he advanced from radio production trouble shooter to



W. H. Trevarthen

field engineer, covering first the state of Connecticut, and later all of Southern Michigan and parts of Indiana and Ohio. He took full advantage of General Electric's courses in Radio Engineering as offered at the Bridgeport plant.

Bill returned to the Western Electric Company again for a short time after which he went to the Stewart-Warner Corporation in Chicago. In 1938, NBC offered him a position as Maintenance Engineer in New York, where his special assignment was the maintenance of the relay equipment. After three years, he was transferred to the Television Department as a Maintenance Engineer.

Several months after the war's outbreak, on a leave of absence from NBC, Bill joined the Underwater Sound Laboratory at Harvard University as Special Research Associate, finally being put in charge of a group at the Lab. While there, he took an intensive course in Radio Mathematics at Boston College.

In June of this year he returned to the Engineering Staff of NBC, transferring to his present position with the Blue Network on July 16th with the title of staff engineer, as assistant to Chief Engineer G. O. Milne.

Mr. Trevarthen resides in his own home in New Hyde Park, Long Island, with his wife and four-year-old daughter, Gayle.

See Page 18



Photo by Joe Conn

New York News By George F. Anderson, Jr.

News From and of Those Working for Uncle Sam

ENS. HARRY GRELCK, USNR, is now at Princeton University for indoctrination and he reports that the Navy believes in physical training. He runs around a two-mile track several times a day and is gradually finding out that his feet are developing many, many blisters. However, they make up for that in the excellency of the steaks and roasts that are served daily.

Lt. Charles Younger, AUS, writing from Fort Monmouth, confirms what Harry says about physical training and food. Both the Army and the Navy go in for excellent meals. Steaks are a thing of the past here in New York for the remaining Gain grinders.

Raymond Jean-Claude, SE, NBC, has been called for duty with Uncle Sam and he reported to the Army on July 23. Jean will save a cot for anybody who wants one.

Claude Clayton, SE, Blue, received a very interesting "V" mail letter from Capt. Charles Carvajal, AUS, former NBC engineer and International department announcer and Production, mailed from North Africa. He says that doing network broadcasting is a pipe dream compared to what they are doing over there and not half as interesting. He has met several former NBC boys but did not mention any names. Among those stationed over there from New York are: Capt. Walter Brown, SE NBC; Lt. Victor Tervola, Ref. Rec.; Lt. William Perry, SE NBC., and Staff Sergeant Jack Arber, SE NBC.

John Ross, SE NBC, became Ensign John Ross, USNR, on July 31 and he reports to Quonsett, R. I. A very informal party was held for him and the refreshments were furnished by Johnny Ross. Glasses by everyone. Keep 'em sailing.

On July 23, William Trevarthen, formerly of Mtce., was appointed a staff engineer for the Blue Network. He will be in charge of engineering operating details for New York and will be assistant to George Milne, Chief Engineer, Blue Network. Good luck, Bill, and don't have too much trouble with priorities.

New York Operating Group held council elections recently and the results are as follows: MCD, Milton W. Kitchen; Rec., Edward Schabbehar; Day Studio, H. M. Gabrielson; Field, M. Jacobson; WEA, J. N. Flynn; WJZ, S. Crabtree; Nite Studio, G. Markle; Mtce., E. Costello.

Newcomers This Month Include:

Dudley J. Connolly, SE, NBC, who has been in radio for many years, having done Police radio and BC station

operating both here and in Birmingham, Ala., and for the last few years was at WWRL, Woodside, L. I.

Elliot Emmerson, Apprentice MTCE, arrives from the Army, from which he was given an honorable discharge. He was a technician, fifth class, and is now attending RCAI and shooting trouble for the Maintenance Department.

Also arriving here in New York is SE Gerry Werst, who transferred from Washington, as mentioned in last month's "Washington News."

This month (July) also sees Howard Cooley, Ref. Rec., transferring out to Hollywood to work with Sil Caranchini on the War Department Special Services recordings. Funny it seems the chaps in Washington want to come to New York and those in New York want to go to Hollywood. Speaking for myself, I prefer New England's green hills to California dew.

Hot Stuff

Felix Ghirlando, Field, quietly eating his free dinner at the Hotel Taft Grill Room and enjoying a steak (?) when he suddenly decides that it is not the steak that is burned but that there must be a fire some place. By using a combination of two senses, sight and smell, he arrives at the conclusion that the smoke he sees is not from a hot orchestra but from some other incendiary. Doing a bit of third degreing, he is informed that, one, the Hotel Taft does have a slight fire; two, it is not serious; three, the Grill Room will be closed for the evening as soon as everyone leaves, and last, but not least, four, he may finish his dinner but the orchestra will not go on the air that evening. Soooo—using the PL, he informs MCD of the trouble and they cancel the pickup. Felix finishes his dinner, packs his equipment and returns. Could that be called "A Hot Switch"?

Mtce. Sup. "Red" Shultis returns from his vacation with a tale of catching large mouth bass and of thunderstorms. It seems he and his family were out fishing and catching some nice size bass when a storm blew up and caught him in a nice size thunderstorm.

Bill Irvin, Mtce., completing construction of a new laugh meter of revolutionary design; he claims to have received the idea from watching the mercury in a thermometer going up and down here in the East.

Flash!!!!!! July 25th, 1943 — New York Chapter Chairman Harry Hiller has been appointed NABET representative by Prexy Brown for the forthcoming meetings between NABET, NBC and WLB in regards to the okaying by the WLB of the new contract. 73 'til next month.

San Francisco News

By Bob Shover

Jim Summers, CS, on vacation wheeling the baby around Lake Merritt in Oakland.

Will Watson, SE, is now the proud papa of a baby girl named Betty Anne. Why is it that girls are so predominate among the engineering staff?

Thomas (Senator) Watson, SE, was seen about town and at the Ice Follies with a bee-youtiful blonde. Tommy, how do you do it?

Andy Mitchell, RE, busy these days house hunting down the peninsula.

Don Hall, ME, winding up his Stanford Radio Class. My, my, you should see some of his feminine students.

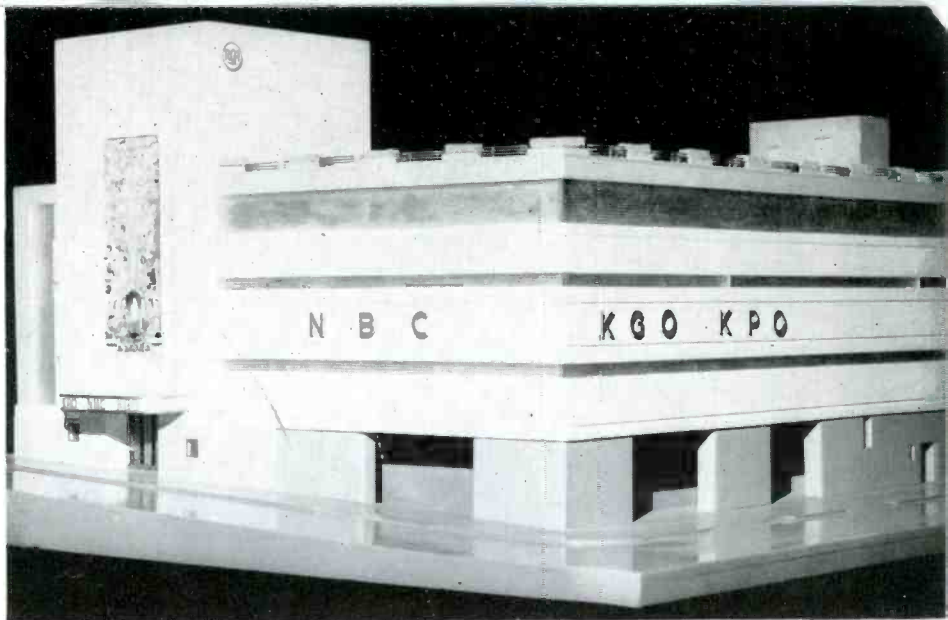
George McElwain, FS, on vacation and working on his Victory Garden.

Frank Barron, SE, is still getting darker and darker from his daily sun baths.

McDonnell, SE, seems to be quite an authority on determining nationalities of various radio celebs. He has a very unique way of checking on them. If you want the lowdown, ask him sometime.

Art McDermott, SE, who spends most of his time on the Mid Run, is shooting pictures of all the gals in the building in his spare time.

Chas. Kilgore, CS, spent a part of his time during his vacation on Clif Rothery's ranch supervising flower bulb



digging. How many bulbs can you dig, clean, label and pack in an hour, Charlie?

From the Transmitters

Irwin, TE, off to Yosemite, but did not take his car as he did not want the OPA on his tail.

Joe Baker, TE, vacationing on their boat, might even catch a few fish; can't tell.

KGO's garden doing swell. Lots of tomatoes, squash (on towers) and even potatoes. Kramer still in the lead on his plot.

Dunton, TE, has been painting the inside of his house, but there is more paint on Dunton than on the walls.

Kellogg, TE, on vacation.

Stubbe and Mort went on a fishing trip together—NO FISH. Both arguing about the ones that got away.

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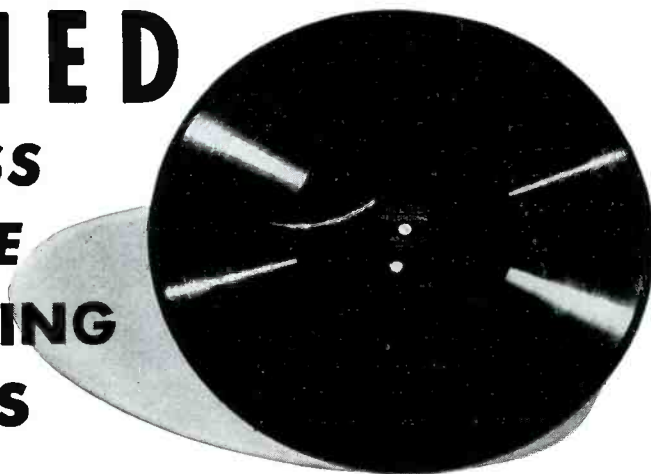
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Who's Who at WPTF—Raleigh By J. Willard Dean

HOOD WALDO ROOD was born in Stuart, Virginia, July 5, 1910. After graduating from the New Point High School at Shadow, Virginia in 1926, Waldo accepted a position with the local telephone company at Heastville, Virginia, remaining there until 1928. After a couple of years of telephone work he decided to move to Tennessee, where he first enrolled for college. Staying in Tennessee for two years, he decided to pull stakes and moved to Raleigh, North Carolina, taking up his studies at N. C. State College, where he obtained his B.S. degree in 1932.



Hood Waldo Rood

Upon completion of his formal education, Waldo moved to Cary, N. C., just eight miles west of Raleigh and started teaching at the Cary High School. Since that time he informs me that a lot of water has passed over the dam. Having participated in just about every undertaking that has occurred since taking up residence there, his time has been rather crowded. During 1937 Waldo decided to give up teaching as a profession and joined the sales staff of Durham Life Insurance

Company (parent company of WPTF) where he remained until the spring of 1941, at which time he joined the WPTF engineering department and soon took up the prescribed duties of a control operator.

July 5th has been a most memorable date in his life because it was on this date in the year 1935 that he and one of his former co-workers at Cary—Hi, Miss Elizabeth S. Wilkinson strolled up the isle to the tune of "Here Comes the Bride". They are now the proud parents of one son, Robert Thomas, born March 30, 1942.

During his off hours Waldo probably utilizes his time just about as completely as anybody you should ever hope to know, wiring somebody's new dwelling today, victory gardening tomorrow, and overhauling his car the next day, or something of the like. . . . No, life isn't just a continuous work-day for him. . . . He still finds time for tennis, hunting and fishing occasionally. . . . Don't ask me how.

W. LAWTON METCALFE, the youngest member of WPTF's engineering staff, was born July 11th, 1921, in Tampa, Florida. While attending the local public schools of the "Sunshine State," and enjoying the resort temperatures that it is noted for, Lawton always welcomed the school holidays, when he and the family shoved off for a summer retreat, in the mountains of western North Carolina. Joining the ever increasing ranks of amateurs in 1938, Lawton relates that he found radio most fascinating and decided to make a career of it. While enrolled at Tampa University in 1940, he applied for part-time duties with station WDAE, which resulted in his first experience, in the commercial field. During his stay at WDAE, he was engaged in the prescribed duties of an operator, doing maintenance, construction, and the like. Leaving Florida and Tampa University in August of 1941, he moved to Raleigh, North Carolina, where he enrolled at North Carolina State College to study Electrical Engineering and Communications. Now in the Junior Class, Lawton has already made somewhat of a name for himself around the campus as a top-flight radio man, having just recently been initiated into the State College Chapter of Eta Kappa Nu, honorary Electrical Engineering Fraternity. During April of 1942, he came to WPTF on a part-time basis, as a control operator, but soon took on a full-time schedule, working the evening shift and continuing his studies at State during the day.



W. Lawton Metcalfe

When time permits, which isn't often, he finds a diversion in tennis, swimming and the movies, also that of a good confab, enjoying a BULL SESSION no end . . .

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WOR - MUTUAL Theater Studio

By Herman
G. Berger

BY THE not altogether simple expedient of transforming a theater stage into a giant exponential horn, WOR's engineering staff at New York City has effectively licked a worrisome problem of reverberation and so greatly improved acoustics that a whisper from anywhere on the 1500 square foot stage is heard with equal intensity, clarity and brilliance in any part of the theater. Not only has this desirable result been achieved, starting with a theater of known tonal defects, but in achieving it the engineers have

also evolved an ingenious mechanical means of fitting the size of the "horn" to the size requirements of the entertainment being broadcast.

Through a combination of convex curved walls and ceiling, proportioned to form an immense horn of true exponential design, coupled with the use of hard surfaces, sound reflection has been boosted to 97 per cent at 4000 cycles, with but 3 per cent absorption; at 128 cycles, side walls and ceiling flats have an approximate absorption of 20 per cent with 80 per cent reflection.

The effect of this unusual construction is to put the entertainers on

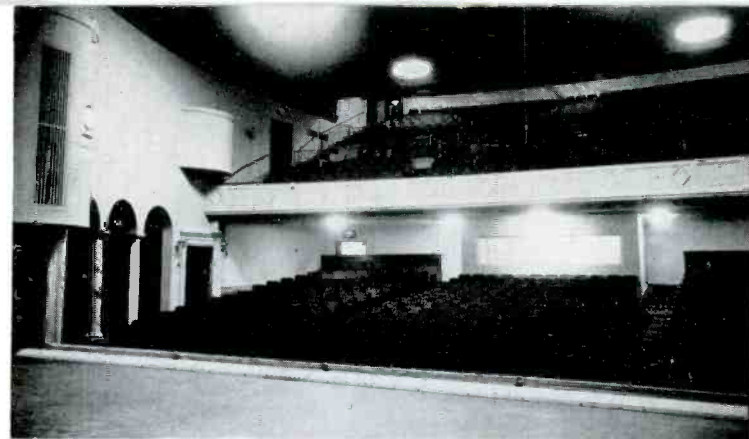


Edward J. Content
Assistant Chief Engineer of WOR
The man responsible for the interior construction and acoustics of the WOR Mutual Theater Studio

the stage virtually within the throat of the horn, with the audience, occupying the 890 seats in the body of the theater, located, in effect, at its mouth. The result is that all sounds originating on the stage are reflected into the audience.

The complete stage is large enough to accommodate a full symphony orchestra of 125 musicians. However, when smaller groups of entertainers must be accommodated, a huge convex "drop" normally retained in place above the stage and weighing some two tons, may be lowered into position. With the "drop" lowered, the size of the stage is halved without changing its reflective and acoustic properties. Even the control room at the left has been shaped into the general contour of the stage sidewall so as not to destroy the true exponential effect of the stage.

Mutual's new studio was designed and installed by J. R. Poppele, chief engineer of WOR; Edward J. Content, assistant chief engineer, and Harry Miller, supervisor of theater activities.



From top to bottom, the photos are (1 and 2) interior views of the studio; (3) the Client's Booth; and (4) exterior view of the Theater-Studio.

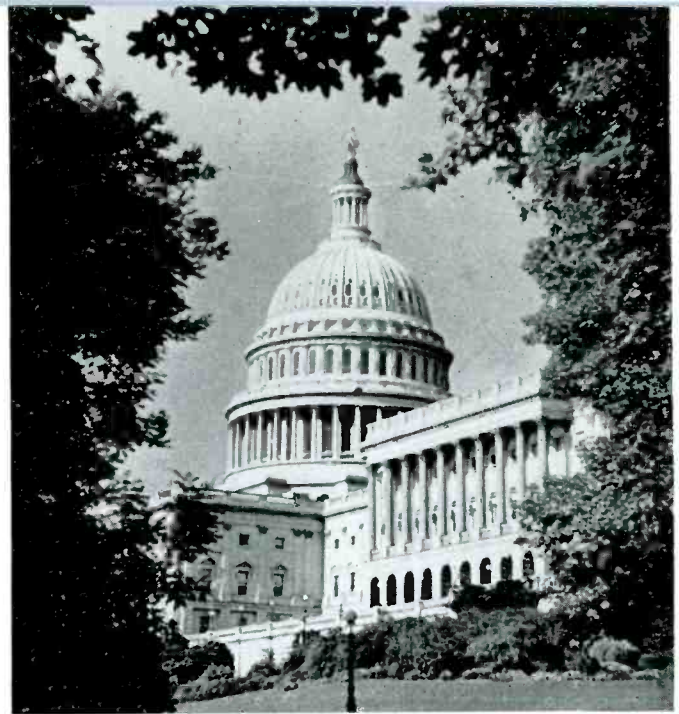
Washington News

WRC — WMAL

By R. E. Shenton

BEFORE embarking on our monthly revue of engineering escapades, please accept a slice of our birthday cake; incidentally, that candle you find on your piece is one of twenty that were placed on the whole item. All of which is merely a cryptic manner of saying that on Sunday, August 1, Station WRC celebrated its twentieth year of constant operation, marking the momentous day with a pair of special anniversary programs tracing the development of "Washington's First Station" up to its present position of prominence as an NBC key station. During the twenty year period, the studios have been located in three different places in town, including the present Trans-Lux building layout, which has been occupied since 1937. Advance publicity for the occasion included station break announcements, as well as the playing of a series of twenty-year-old jazz records such as were current fare when WRC was an infant. Many of these old discs were real collectors' items, by the way. May the next twenty years be equally happy and progressive ones.

Two events in the engineering department compete for top billing this month — first, the return to the forty-hour week, and second, the inauguration of an apprentice system here at the Washington plant. Having survived only a few blissful months, the forty-eight-hour week was scrapped the last week in July, returning the force to the customary five-day basis. It is distressing just how much smaller the "Not Over \$500" pink slips look after they've had a 20 per cent deduction, plus the removal of the eight hours OT each week. Ah, but it was beautiful while it lasted. We are informed that the move was made because Washington had the distinction of being the only NBC outlet operating on the six-day week, a condition well liked by the local boys, but not so favorably contemplated by the gentlemen who fill



R. E. Shenton

in the digits on the aforementioned pink slips. A small faction tried to make us believe that the shortage of red pencils was the real motive for the change, but the perspicacious editorial department was loathe to swallow that explanation. For an explanation of the "red pencil" situation, see the Broadcast Engineers' Journal, Vol. 10, No. 6, p. 23, paragraph 1.

Being a relatively small establishment, NBC Washington has had no apprentice system for new engineers in the past, but with the hiring of Bill Smay, recording apprentice, we inaugurate something new and different. Although Recording Supervisor Nick Close is now on his vacation, Bill has been learning the intricacies of the Scullys and Prestos from the gang, and seems to be doing fine. Bill is no newcomer to the engineers, because he has been working at NBC, although not employed by the firm. Explanation of this rather contradictory statement is that Bill was a Burns Agency guard, on duty at the studios for about a year, during which he became known and well liked by all of the NBC tribe. As his history is quite interesting, we feel justified in devoting a little more footage to him. Bill is a former Navy man, having served quite a few years in that service as a dive bomber pilot, at which post he amassed some 1,500 hours flying time! An interesting sidelight is that on his application for his recently acquired position, Bill found it necessary to use an additional piece of paper in order to list all of the countries in which he has been in the last decade or so. If you think we're exaggerating, you can come down and count 'em for yourself — all thirty-six of them! We feel that few NBCites can claim a more imposing record, especially those that have not as yet passed their twenty-fifth birthday. It's swell to have you *officially* one of the boys now, Bill.

As announced in detail last issue, Jerry (not Gerry, we report, apologizing for the error) Werst is now a Studio Engineer at New York, having assumed his duties in the big town on August 2. We repeat our Good Luck wishes, feeling sincerely sorry to lose you. The vacancy left by SE Werst will be filled by Mr. McCollom, formerly with the Bethlehem Steel Company, at which establishment he was engaged in radio work.

Another newcomer to the clan is WMAL TE Archer S. Taylor, who received his engineering training at Antioch,

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and who came to us from the National Bureau of Standards here in Washington. Taylor is married, has one child, and lives in Arlington, Virginia, home of an ever-increasing number of Washington engineers.

* * *

Although we haven't as yet broken out the ol' Graflex to make some produce pix, we have a junior communique from the WMAL gang telling all about situations between the masts. Brother Nagy is reported as "most likely to succeed" with his back-to-the-soil activity, being one of the hardy few who can weed the artichokes by day and heed the R. F. chokes by night. (Apologies to all for the Golden Bantam.) Speaking of corn, we learn that a horrible malady known as the "black rot" has invaded the WMAL crop in full force, together with a flight of crows, and, rather marvelously, a platoon of horses from a nearby riding stable who delight in neatly removing tender new growth from just about any kind of plants. The potatoes also seem to suffer from lack of enough of them, resembling, we are told, marbles. Tomatoes, carrots, radishes, turnips, etc., are flourishing, and the yield promises to be very gratifying both in quantity and quality.

One of more novel features of the WMAL farm is the cooperative system between a Bradley Hills native and the station gang. Said native, it seems, owns a cow and a horse, which are free to roam over the grass surrounding the transmitter shack and to imbibe the tender green leaves, keeping the whole place as neat as a golf course, we hear. In return for their free pasturage, the WMAL gardeners are allowed to harness up ol' Dobbin to the plow and to cultivate the gardens with the animal. The native seems to draw the line there, though; he frowns on any illicit milking of the cow by the Xmitter boys. Too bad, that, because a little fresh milk goes nicely with a dry luncheon of sandwiches. Perhaps this excellent bit of cooperation may give some other transmitter crews an idea.

* * *

And so to the ludicrous side of the news. WMAL transmitter chief, Dan Hunter, now on vacation, incidentally, is an experimenter of no mean ability. One of his later and more successful creations is what he has dubbed an "intrusion alarm" which is sort of an electronic G-man, designed to turn on a battery of powerful flood lights should any unwanted prowler come too close to the station at night. This device works with a rather complex aggregation of photoelectric cells, sensitive relays, etc., which, once properly adjusted, form a very sensitive mechanism, set off by the slightest disturbance. As might be well imagined, setting the gadget up is a tedious task, and requires hours of delicate work. Mr. Hunter went through this process one afternoon and evening, finally securing the results which he sought. Weary after his long session, he packed up his scalpel and soldering iron, preparing to go home for a much needed night's sleep. Scarcely were the tools packed, however, when the yard was filled with dazzling light, and the associated bells, buzzers, sirens broke into an unholy din; surely this was a coincidence to catch an intruder only a few minutes after the alarm was installed. Grabbing the artillery, the boys rushed out to catch the spy, only to find that the neighbor's lawn-mowing bovine, introduced in the preceding paragraph, had wandered into the photo-cell path, probably wondering why the boys were so active on this particular evening. Mr. Hunter welcomes any suggestions on how to cow-proof his gadget, offers a prize of a quart of grade-A milk for the best idea submitted to him. And thus with Hunter's beef, we will Septemberize you next month.

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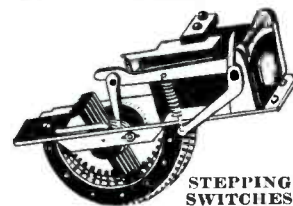
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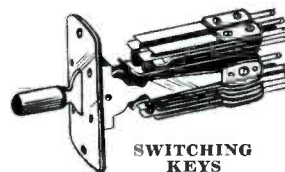
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TECHNICAL PRESS REVIEW

By Ed. Stolzenberger

Proceedings of the IRE - (July, 1943)

Beyond the Ultra-Short Waves

By G. C. Southworth

This article reviews briefly the work done many years ago by the pioneering physicists with the so-called electric waves as well as the more recent efforts by engineers to put these waves to practical use.

Tubes for High-Power Short-Wave Broadcast Stations — Their Characteristics and Use

By G. Chevigny

This paper outlines the vacuum-tube requirements necessary because of the increasing power of short-wave broadcast transmitters. The development of a sealed tube capable of 250 KW carrier output for two tubes in parallel is described. A broadcast center in which the tubes are used is briefly described, plus a short description of high-power grid-controlled rectifiers.

Analysis of Rectifier Operation

By O. H. Shade

An analysis of rectifier operation in principal circuits is made. The introduction of linear equivalent diode resistance values permits a simplified and accurate treatment of circuits containing high-vacuum diodes and series resistance.

Radiation From Vee Antennas

By C. W. Harrison

Certain aspects of the directional qualities of a non-resonant inclined vee antenna are discussed briefly, and show that the antenna is unidirectional when center driven.

Charts for Simplifying High-Impedance Measurements with the Radio-Frequency Bridge

By R. L. Nielson

The equal-arm capacitance bridge for making radio-frequency impedance measurements gives excellent results with little labor, provided the magnitude of the unknown impedance is not too high. The charts are helpful when the impedance is high and varies rapidly with frequency, and when a shunt capacity is used across the unknown impedance to increase the accuracy of measurements.

Bell System Technical Journal (July, 1943)

A Mineral Survey for Piezo-Electric Materials

By W. L. Bond

The Fundamental Equations of Electron Motion (Dynamics of High Speed Particles)

By L. A. MacColl

Quartz Crystal Applications

By W. P. Mason

Methods for Specifying Quartz Crystal Orientation and Their Determination by Optical Means

By W. L. Bond

A Note on the Transmission Line Equation in Terms of Impedance

By J. R. Pierce

Bell Laboratories Record - (July, 1943)

Electron Diffraction by Large Molecules

By K. H. Stork

The relatively large force required to break a single cotton fibre and the ultimate architecture which makes its strength possible has long been a subject for speculation. The cause was pure inference, however, until x-rays were used to probe the structure of the material. Recently a second tool, electron diffraction, has been found helpful in similar studies, and is discussed in this paper.

Electronics - - - - (July, 1943)

Transmission Line Charts

By R. F. Baum

Graphs enable simple computation of voltage, current, and impedance distribution for any point on a long transmission line, and for any termination producing standing waves.

V-H-F Receiver Oscillator Design

By S. Y. White

Secular stability; unitary construction; choice of materials; tuned circuit types; circuit Q; series resistance; voltage stability; selectivity; tube characteristics; interelectrode variations; and transit time and inverse feedback loading are discussed.

Recording Audio Analyzer

A heterodyne audio frequency analyzer and a high-speed graphic level recorder together trace on a chart the level of each frequency in the audio spectrum from 10 to 9,500 cycles, permitting accurate determination of predominant frequencies causing noise or vibration.

Design for Dissymmetrical T Pads

By E. Y. Webb, Jr.

Graphs for determining the resistance of the three elements of T-pad networks facilitates the design of pads having attenuation of as much as 25 db, and impedance mismatch ratios up to 5 to 1. Graphs are also adaptable to design of symmetrical pads with matched loads.

Communications - - - - (July, 1943)

F-M Receiver Design

By L. Pressman

The author presents a lot of practical information, construction hints, and circuit diagrams relating to F-M receiver design.

A Tone Selector for Radio Alert Systems

By H. E. Adams

Frequency selection is attained by means of resonant reeds; mechanical sketches and circuit diagram are included.

V-H-F Tubes and Wave Guides

By R. G. Peters

A brief discussion of various types and uses, with illustrations.

Oscillograms of Coupling Circuit Transients

By G. B. Hoadley and W. A. Lynch

Part II of a two-part paper; this section presents the

experimental evidence in the form of oscillograms to substantiate the theoretical curves presented in Part I.

Electronic Industries - - - (July, 1943)

Suppressing 10,000 Watts to 10 Watts Over 200 Degrees
By J. H. Henninger

Predictions and performance made to match with very close accuracy in radiation system using five towers.

Rating Ceramic Condensers
By F. X. Maida

Sensitivity factor method to determine required limits for temperature coefficient value simplifies specification.

Signal Generator Characteristics at UHF
By H. J. Tyzzer

Design of equipment and method of using it requires special consideration in view of many problems involved in obtaining reliable results.

Los Angeles News

(Continued from
Page Thirteen)

Washington, D. C. He built RCA's marine station KSE here in 1928 and is well-known in Honolulu as well as Los Angeles, having held various executive positions with RCA Communications in both places.

After reading Con Conrad's article in the July issue, re operator's licenses, we checked those of the thirty-six engineers at KFI-KECA and found thirty valid radiotelephone first class and one second, nine radiotelegraph firsts and seven seconds, and an ample number of men carrying verification cards.

While we're on statistics: Our secretary-treasurer reported on July 12th that all thirty-two members of the KFI-KECA Section of NABET had paid their dues to January, 1944.

John G. Gould, ex-Idaho, Utah, Arizona and northern California stations, is now at KPAS Pasadena.

L. H. Lohr, at KFNF Shenandoah, Iowa, and WGBF Evansville, Ind., in the early '30s, is now at KMPC Los Angeles.

Few will accomplish as much during their vacation as did Earl Griffin, KFI T.E. He obtained a telephone first ticket, to add to the pile of telegraph firsts which he has been accumulating for twenty years; built an air-conditioner for his home in Santa Ana, built a grape-arbor, bought a wine press, put vitamin B on the grape vines, leased and fenced the 50 x 150 lot next door and planted a Victory garden. And what a garden, watermelons, cantaloupes, rhubarb, asparagus, brussels sprouts, artichokes, celtus (a Chinese cross with a lettuce top and a celery bottom), celrad (a cross of celery and radishes), finohijo (an herb), gooseberries, squash, cucumbers, white and sweet spuds, corn, beans, etc. Everything he planted came up, and then his troubles began. Griff's a laboratory man, city bred, knows from nothing about farming. He overwatered, overfertilized, and got blisters on his feet from the nicotine poison meant for the bugs. The beans turned out to be bush type instead of vine and wouldn't climb the corn stalks as planned, and cucumbers came from what he thought were squash seeds. He was muttering "what grows, what grows here" when the girl next door, an ex-farmerette, offered some advice. Now he trades vegetables for her instruction and everything is hunky, including his seven chickens from which he gets seven eggs each day.

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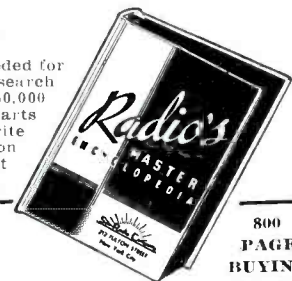
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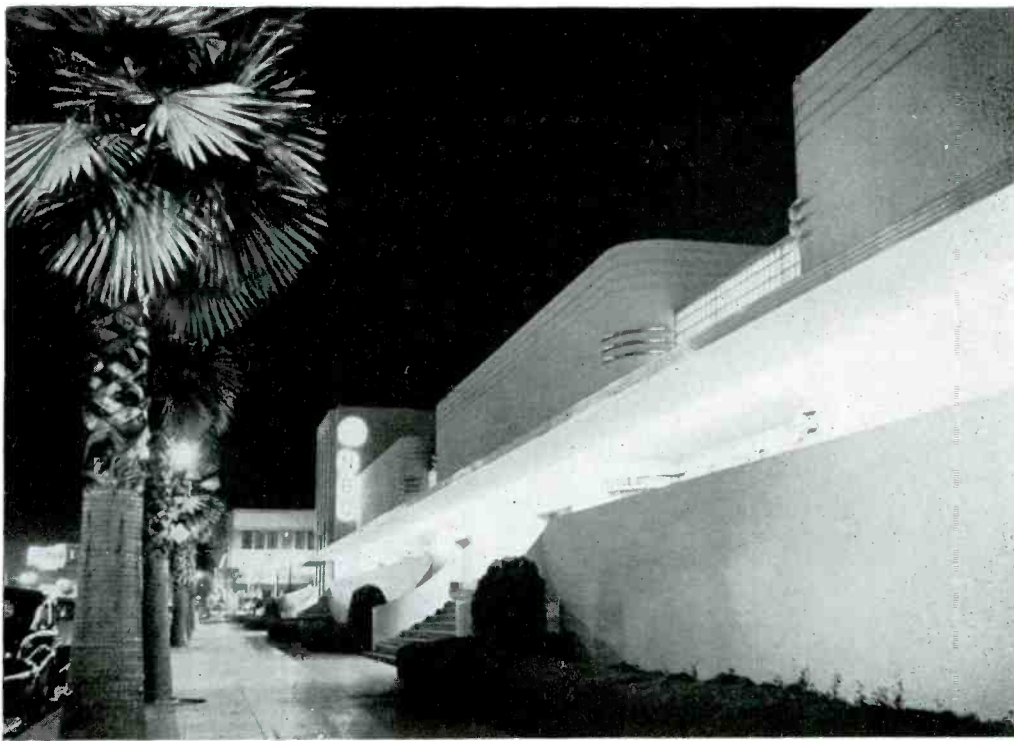
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H O L L Y N E W S O O D

By Bob Brooke



Blue Sale Stirs Comment on Coast . . . UCLA - NBC Radio Institute a Success . . . Hollywood's Busiest Summer . . . Sax Returns From NY Conference . . . Vacations End . . . Weather Fine . . . Service News . . . People Still Leave for War . . . Blue News and Visitors . . .

SUN . . . Haven't started a paragraph with "SUN" since the war began. Mostly because we've been much too busy to notice that our usual fine California weather has been with us, war or no war . . . We've had a fine year and all are deeply tanned. People are getting back to the beach again by hook or crook as they are discovering that all work and no play makes Jack a dull boy . . . (Tho there are many city tans from roofs and back yards) . . . In the extremely warm weather of late people with swimming pools have discovered many new friends . . . The old NBC State Beach Surf Board Society is sadly missing and gone are the days of Ferguson, Gage, Brooke, Frazer, Hediger, etc., riding the big green ones right up onto the beach . . . We note Serge deSomov's enlarged picture of a striped bass scale in the last Journal and beg to advise that if that's an Eastern striped bass scale it must have been a tadpole because we would have to *reduce* a baby Western striped bass scale by at least ten to even compete photographically . . . And the stories that guy used to tell us out here about those Montauk Point fish . . . We have bigger ones in the lake back of Hollywood Dam or in our air conditioning tank . . . Speaking of fish, Eddy Miller just back from his annual vacation in the High Sierras with many a trout story . . . Lorenz and Korb also getting in much fishing . . . Pop's Whiteman gave Ed Miller an expensive trout rod of the finest make to replace his old faithful . . . Some of the new boys from back East are discovering our fish and ocean and golf . . . (We still get four gallons a week on an "A" book) . . . Even Hotel-loving Ralph Reid has himself some tan . . . Most vacations have been quiet ones.

BLUE SALE . . . I think Hollywood impressions of the Blue Sale are like this . . . "They got it cheap" . . . "It may mean rapid advancement for relatively new personnel" . . . "After the war the Blue can build *with* the new radio era to come" . . . "It will mean another highly competitive network" . . . "It will mean immediate changes in intercompany schedules, operations, and common personnel" . . . "It

may mean a gradual move to temporary quarters even before the war's end" . . . "It will mean many jobs in new departments formed when the offices separate" . . . "The boys with the Blue are lucky" . . . "Where are the Life-savers" . . . "Maybe we can get engineering textbooks wholesale now" . . . These are just a few of the observations and wise cracks made around here in the past couple of days since the news broke officially thru the closed circuit and the talk of Mr. Noble . . . This Hollywood editor sez "Good Luck, BLUE" . . . And I know it's echoed by every member of the Hollywood staff . . . Looks like we've lost a kid brother but he hasn't gone yet . . .

UCLA - SUMMER INSTITUTE . . . The first summer session of the NBC - UCLA Radio Institute has been an unqualified success . . . Six weeks of intensive classwork was held in the NBC offices in Hollywood, Chicago, and San Francisco in cooperation with Stanford, UCLA, and Northwestern Universities . . . Engineering, Production, Acting, Announcing, News Writing, Radio Public Service, and Radio Writing were the courses offered, and regular NBC staff men did the teaching . . . In Hollywood 120 students were enrolled and the technical class numbered an even one hundred with about a ninety per cent turnout for this 8 AM stint . . . The technical study included only broadcast sound technique and did not attempt to get into tube circuits or radio frequency . . . Simplified schematic diagrams were used and much of the work was coupled with the demonstration of various acoustic, sound, and microphone phenomena through the use of loudspeakers and audio oscillators . . . Captain Meredith Wilson gave a humorous and interesting lecture on musical balance, Arch Oboler spoke on dialogue balance and the use of trick studio effects, Les Culley spoke on modern acetate recording, Ed Ludes covered sound effects with questions and a demonstration . . . The course had been planned as simply an aid to small station combination announcer-engineers but turned out to be a popular course for producers and writers

who wanted to know about some of the technical limitations of the medium . . . We were happy to find that even feminine interest held up under the shattering blows of phasing, fundamentals, harmonics, pre-amps, filters, styli, megacycles, etc. . . . Working school and NBC schedules meant seven day weeks for some of the instructors, yet all were high in praise of their classes and all were inspired by the eagerness of the student body to absorb as much radio in six weeks as was humanly possible. . . .

GOSSIP . . . We are having the busiest summer in history and see quite a few entirely new shows headed our way for fall . . . Fullaway, ex SF Journal editor, recently upped to Lt. Commander in the Navy and given command of a destroyer . . . Congratulations Ted . . . Cgos' Bob Jensen into studio from the recording department and is already proving his worth via the commercials he is corraling . . . Al Korb vacationed at the swimming pool in his back yard . . . Caught some fish too in the Sierras . . . Johnny Cravens working hard on many commercials, including the summer symphonies for Standard Oil from Hollywood Bowl . . . Bill Moyer to his old Canadian home on vacation and out with the flu last week . . . Mr. Saxton has installed his revamped television receiver in his office partly to monitor KGEI in SF . . . We understand Sax had a lot of work and fun at the summer engineering conference in NY . . . Heat terrific he sez and lost 12 pounds . . . (Glad we're in California coolness) . . . Floyd Weteland to old Portland home on his vacation . . . Foote, Cone, Belding, McQuire, and Capstaff Inc., doing fine . . . Jensen

having trouble buying California real estate . . . sez he has just missed being gyped three times . . . Johnny Morris and his Maintenance Department continue to turn out huge volumes of fine new construction, etc. . . . Now in the process of installing two Scully Master Recorders from Cgo . . . Thus increasing recording output for the umpteenth time . . . Les Culley's office moved out of the recording room to make way for the above new equipment . . . Actor and engineer's friend, Ben Alexander, sworn in as Navy Lieutenant (jg) and now awaits orders . . . Ditto veteran NBC announcer Ensign Johnny Frazer . . . Harry Bryant was out several weeks with quite serious stomach trouble . . . Glad to report that he's back in good health and looking like the rest in the hospital did him good . . . Ex-Field Supervisor Miv Adams and now a Marine Radar officer was in for a few days to collect his wife and move the family East by automobile . . . Howard Cooley and Max Burnam have joined the recording room staff . . . Howard was transferred from the NY office and Max worked at a local NY recording outfit . . . Several of the boys got Signal Corps letters that commissions from civilian life were closed . . . Ralph Reid entertaining and housing several Aussie fliers in town for week ends . . . Captain Frank Figgins still up in the chicken country of northern California and nobody's heard a word from him of late . . . John Charles Thomas bought a magnificent new place in the Santa Monica Mountains that sports a complete professional projection room . . . Was owned by an MGM producer . . . 73.

Lieutenant E. L. Berman, U. S. Signal Corps., recently paid a surprise visit to Shure Brothers, his former alma mater. He had just completed the prescribed course at Officers Candidate School, Fort Monmouth, N. J., and spent an enjoyable leave meeting old



cronies and gabfesting with his many friends. He was greeted by his brother Jack (at right) and Mr. S. N. Shure. "Gene" Berman is remembered by hundreds in the radio industry as the former sales manager of Shure Brothers, manufacturers of microphones and acoustic devices. He has been assigned to photographic research and engineering at Astoria, Long Island. Good luck, Gene!

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WOR News . . . *By Herman G. Berger*

JUST another month shot to pieces for most of us now that our vacation is ended, so let's get down to the why and wherefores of good old WOR.

Speaking of our sound department in one way very seldom heard from unless they're on a show making their usual noise; and did you know that for a while the sound department was owned by the Irish, with names such as **John M. Keane, James J. Goode, George J. Cooney, John O'Leary Glennon** and lest we forget, old timers **Frederick J. Street**, the supervisor of the department; **William B. Hoffman, Saul P. Ochs, Walter A. Gustafson**, and the newcomer, **Walter Shaver**.

Did you know that the original sound effect space and office was designed for four men, and now with nine in its place, **Fritz Street** has to hang his men on meat hooks in order to keep room on the floor for the sound effects.

A little dope from **Edwin Boquist** of Wantagh, Long Island—in regards to Victory gardening—he has over fifty tomato plants and expects not less than 200 pounds of potatoes and corn, beets, stringbeans, waxbeans, carrots, turnips, lettuce, swisschard, broccoli, kale, and peppers. Boy! oh boy! that's what we call a Victory garden. More power to you, Boquist; and don't lean too heavy on those garden tools.

Know all ye men that for the first time in six years **Ted Kasma** jumps from maintenance to help out on the board. It was on Friday, July 9, 1943, when the wires sizzled with news of the invasion of Sicily. **Jack Byrnes** was at master, **Jim O'Connor** was on John Gambling's show, so Ted took over the Gambling show while O'Connor was standing by in Studio 5 for Algiers and Australia.

From Bull Fiddlers to Bull Frogs—that's **Wernicke's** job now that he is the new propman for Jack (the Better Half) Byrnes. Poor Wernicke last month went out to buy bullfrogs, rotten tomatoes, four-foot dunce caps and a midget. Keep it up, Bill, and sooner or later the squirrels will get you too. In Bill's spare time he does the show known as Brother Bob Emery's Children's Program. Good show for Bill as he likes children and with about fifty of them in the cast he ought to feel at home.

Big **Jeff Smith** said, "I've had my vacation, and covered the whole East Coast from Baltimore to Boston looking in on radio stations en route." He still likes WOR the best. He came back to work only to find himself switched from the late evening shift to the morning shift. He was delighted, but how can you sleep in the night time? Oh! what fun to eat three meals a day and spend the evenings with the family (little woman and Jeff, Jr.)

Our latest newcomer, **James Mills** from Providence, R. I., was with Philco Corp. before coming with us.

ALL ENGINEERS PLEASE NOTE: The engineers club has moved from the Automat to Toffenetti's—announcers are welcome. Just ask for Mary, the blonde waitress, and she will take good care of you. For any further information see **Jack Byrnes**.

The station is now taking a still greater interest in the

welfare of its employees, yes, sir. Every morning you are confronted with a cup of water and three vitamin pills to pep you up. One thing we must be careful about is that we do not get too pepped up, especially the engineers. We may get so full of the three V's (Vim, Vigor and Vitality) that we will think that playing ET's at 33 1/3 RPM is too slow, and put them on 78!

Erick Herud, back from his vacation, said, "Not once did I listen to a radio." Shame on you, Erick.

Now that **Shirley (Submarine) Davis** is on his vacation we will have to wait for the great fisherman's return for a report on all the big fish he caught.

We hope that in next month's issue we will be able to give you a complete report regarding WOR and Dumont Television.

Contributions from Carteret Transmitter

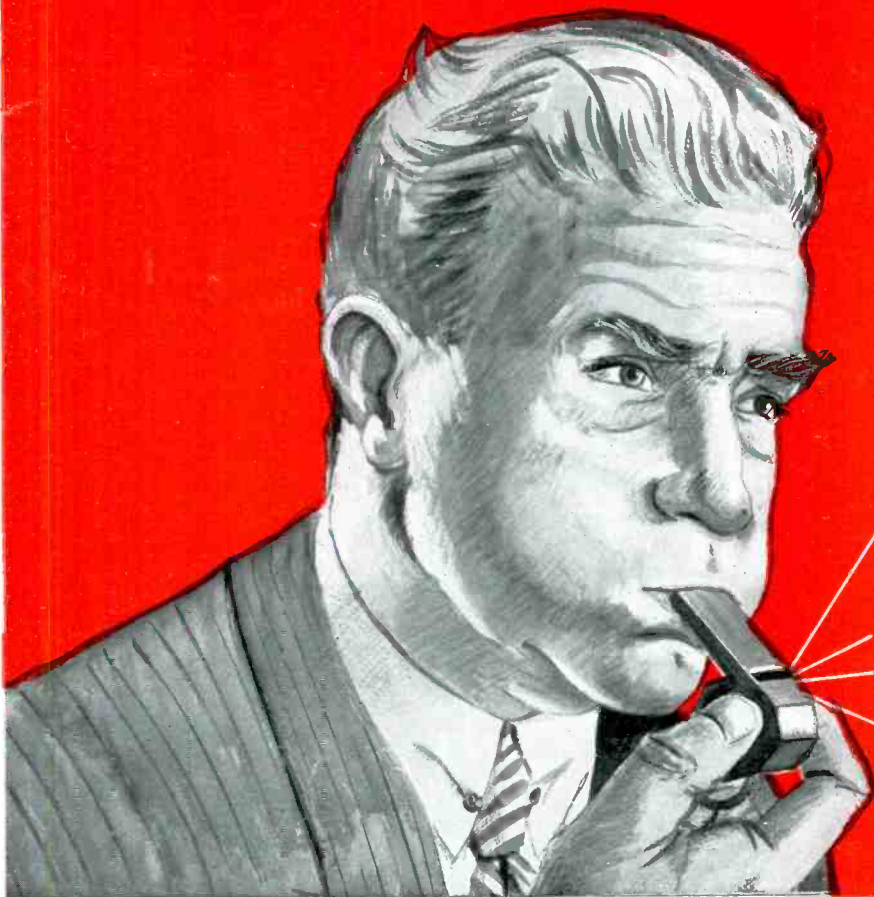
By A. W. Stanford

Vacations are in full swing and by the time these lines see print, the majority of the Transmitter Staff have had their vacations. As with many things in life, the best part about vacations are their anticipation. Here is how some of us spent our stipend of relaxation: **George W. Ruckstuhl**, recent addition to paternity, stayed at home supervising the growth and welfare of little Willie, and tying fancy knots in tri-cornered pants. **Herman Florez** treated his wife (and incidentally himself) to a trip to California. **George B. Riley** packed up the family and had a nice time in Phoenix, Penna.

Francis Garufy, who was an innocent victim of a crash between an automobile and a Public Service bus while walking along the sidewalks of Roselle, N. J., and who as a result suffered painful, but fortunately not serious, lacerations on the southern part of his anatomy, spent some time recuperating in his home town of New London, Conn. We are glad to report that Francis is once more able to eat his meals while sitting down.

In comes a report about **Donald Singer**, son of **Charles Singer**, Technical Supervisor of WOR-W71NY Transmitter, on leave of absence to serve Uncle Sam, that he is a very disappointed youngster. Just as he was ready to leave for camp, he broke out with the mumps, of all things. Cheer up, Don, it won't last.

By the way of doing its share in increasing the nation's food supply, WOR planted a sizeable Victory Garden. However, due to unseasonable weather (with apologies to California Chamber of Commerce) only the corn and tomatoes show promise of a good crop. Six hundred feet of corn and tomatoes are developing nicely, but we are sorry to report that we cannot say the same about our cabbage crop. As a matter of fact, we are willing to testify that the other mornnig we saw two rabbits standing on their hind legs sadly contemplating our rows of Brassica oleracea (cabbage to you, brother,) and shaking their heads as they slowly hopped off to lusher fields. Oh yes, we also planted fifty hills of potatoes. Three are doing nicely.

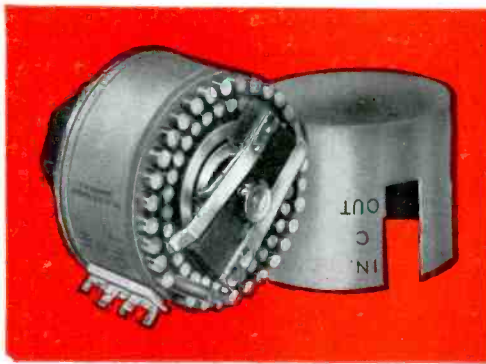


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**SERVICES OF RCA WHICH
HAVE WON OUR COUNTRY'S
HIGHEST WARTIME AWARDS**

Army-Navy "E" flags awarded to:
 RCA Victor Division, Camden, N. J., January, 1942—with two stars for continued excellence.
 RCA Victor Division, Harrison, N. J., August, 1942—with one star for continued excellence.
 Radiomarine Corporation of America, New York City, September, 1942—with one star for continued excellence.
 RCA Laboratories, Princeton, N. J., May, 1943.
Maritime Commission "M" Pennant and Victory Fleet Flag awarded to:
 Radiomarine Corporation of America, New York City, February, 1943.

 **Radio Corporation of America**