PHYSICS

Sounds in the Air

Theatrical Revolution Is Foreseen With New Techniques By Which Audiences Can Hear Voices Emanate From Space

By JAMES STOKLEY

COLUMNS of troops are heard marching down the aisle of a theater—even though that aisle is empty.

Or a line of tanks rumbles over the heads of the audience.

An airplane is heard approaching—it flies around the auditorium and crashes in the orchestra pit.

Angel voices seem to be all around, coming from no apparent source.

These are some of the newest of sound effects for theaters. They have been worked out experimentally by Harold Burris-Meyer, in the Stevens Institute of Technology at Hoboken, N. J. Perhaps, soon they will be used to give the opera a new degree of realism. Imagine having the Valkyries riding right over your head! In fact, the effects that can be achieved lead some to think that this may be the start of a new era, that may affect the movies, television and many other activities.

Mr. Burris-Meyer expressed his philosophy in an address before the Acoustical Society of America.

"We have a theory," he said, "that the whole auditory component of a show should have enough unity and dramatic significance to form a complete work of art even if divorced from the visual component. That doesn't mean a radio play. Most radio plays would be intolerable if anything were visible.

Greater Dramatic Power

"It does mean that speech, prop sounds, background music, all the sound in the show, if planned according to the principles of musical composition, can have many times the dramatic power that they now have. We have made a number of experiments to test the theory. They have been exciting. A production whose whole auditory component is composed as music has all the advantages of opera minus the heavy soprano or the limitations of the human voice or the musical instrument."

As a result of his experiments, he continued, "the limitations on the auditory component of the show are off. The players may speak with the tongues of men and of angels. With sound you can compel the audience to laugh, to weep. You can knock them off their seats, you can lay them in the aisles, you can make them believe what you will. It has been done."

Variety of Equipment

Many kinds of equipment are used to obtain the effects. The actual sounds, of course, come from loud speakers, placed at various positions around the theater—some on the stage, others in the auditorium. In some productions, as many as 16 speakers have been employed, though never more than half at a time. There are electrical controls to energize various speakers, or groups of speakers, and to fade smoothly from one to another. There are the amplifiers, one of which must be provided for each channel in use, so that different sounds can be obtained. Eight are used in the complete installation. These can be adjusted to give the greatest fidelity, or, desirable in some cases, deliberately to introduce distortions for special effects.

There are the microphones of various types and characteristics, to pick up sounds from living actors, or musicians. There are the devices for reproducing recorded sounds, some from disks, others from film, or from magnetized wires. And in addition there are other, novel, sound producing devices which feed into the electrical circuits.

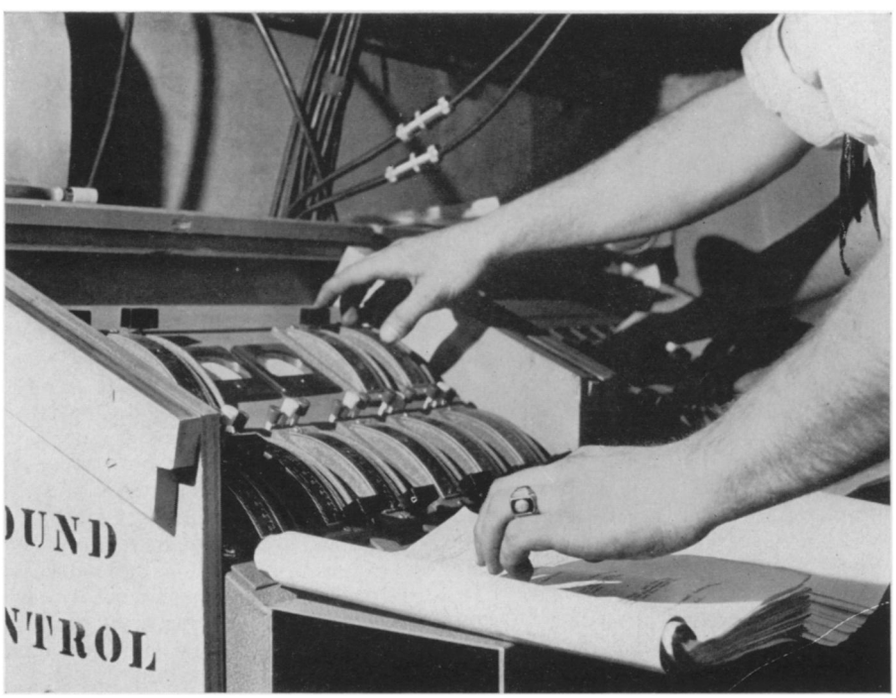
The research program began in 1930, when recorded sound was being used as the background for a motion picture in a performance at the Stevens Theater.

It was found that the sound intensity affects the posture of the audience. They could be made to sit up straight, to move forward in the seat, relax, etc., merely by changing the loudness, almost irrespective of what they saw on the screen.

Powerful Tool for Artist

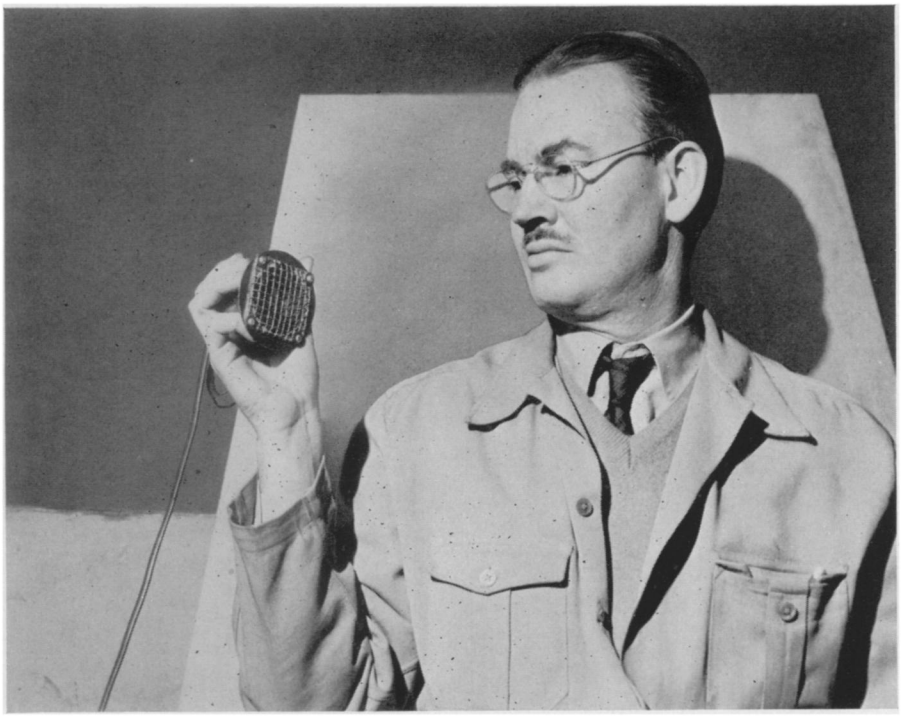
"With present-day audiences hardened by much theater-going," Mr. Burris-Meyer said, "an emotional response to a dramatic episode must be strong indeed if it is to be physiologically observable or measurable. Any device by which it is possible to achieve an obviously strong emotional response may constitute a powerful tool for the artist in the theater."

As a matter of fact, it was later found that an impression of great loudness can be produced even when the sounds them-



SOUND BLENDING

Carefully following the script the sound director plays on the switches as if on an organ console.



DIRECTOR

Harold Burris-Meyer, director of the Stevens Theater, with one of the small microphones used in connection with his sound control system.

selves do not reach extremely high intensity, by the simple expedient (simple, that is, if the building is not too solid) of shaking the building itself from a direction different from that in which the sound really comes from. A very loud sound does shake the building. Consequently, if you shake the building when a sound is made, it seems loud even if it isn't!

Then they experimented with changes in frequency, that is, pitch, or "shrillness" of the sounds. A celebrated effort was in a play by Elmer Rice, called "Adding Machine," in the "brainstorm" scene. Here is Mr. Burris-Meyer's description:

Expressionism in Sound

"We tried to achieve expressionism in sound, in conformity with the idiom of the play, and drive the audience crazy as the principal character lost his reason. We almost did. And the principal device was an almost pure tone warbled, and raised in frequency and intensity for about 32 seconds while the stage spun around and Mr. Zero turned killer. The 'Adding Machine' episode showed that you could use control of frequency very simply to achieve the dramatic objective of the playwright."

The other day, to show some of their latest achievements, the Stevens Theater presented its second "Sound Show," the first having been given seven years ago, when the work was in its early stages. Leading figures in the theatrical and musical worlds crowded the modest auditorium.

The show consisted of excerpts from various plays, which brought out the effective use of the sound control. One was Shakespeare's "Tempest," a play most difficult to present if any effort is made to follow the directions.

The isle on which the action is laid, says Caliban in Act III:

". . . is full of noises,
Sounds and sweet airs, that give delight, and hurt not.
Sometimes a thousand twangling instruments
Will hum about mine ears; and sometimes voices."

An important character is Ariel, the "airy spirit," who appears, generally invisible, and departs,

". . . . . to fly,
To swim, to dive into the fire, to ride
On the curl'd clouds."

Surely the illusion suffers a severe jolt when, in such a part, appears a human being of flesh and blood, obviously just as corporeal as the other characters or any of the audience. Far different is he from Prospero's injunction:

". . . . . be subject
To no sight but thine and mine; invisible
To every eyeball else."

In the Stevens production, on the other hand, we saw what Shakespeare must have had in mind when he created the part. Prospero is on an apparently empty stage, conversing with Ariel, whose voice comes from the other side. And while his conversation continues, Ariel, as we might expect him to do, flits around the theater. His voice comes from the rear of the theater, from above—seemingly he is flying above the heads of the audience. And the music from his pipe and tabor moves about in the same way.

Ass Voice for Bottom

Another scene was from "Midsummer Night's Dream"—the one in which Titania, the fairy-queen, temporarily bewitched by her husband, Oberon, falls passionately in love with Bottom, who then has the head of an ass. Before and after this Bottom speaks with his own voice. Here the voice, though understandable, is that of an ass. But it still comes from his head, as he moves about.

This involves two techniques. First there is the remaking of the actual human voice by taking out certain frequencies, emphasizing others, to give it the quality one might expect to hear from the beast. There is the control of auditory perspective, the same as used for Ariel, to make the sound seem to come from any place desired. In the Tempest sequence, it was made to come from empty space, but in the Dream, it came from the place where Bottom happened to be.

A third Shakespeare scene was the opening one from "Macbeth," where the witches foretell Macbeth's career. The witches were unseen, though their shadows were visible. The voices were remade, to make them squeaky, to sound as a witch should.

Jungle Drums in Background

Scenes from Eugene O'Neill plays were on the program. In "Emperor Jones," the continual rhythm of the jungle drum in the background, gradually getting louder, is a most dramatic device. As presented by Mr. Burris-Meyer, it started in sub-sonics, a sound that could be felt, but not heard. This established the cadence before the sound was noticeable. In the final scene from O'Neill's "Lazarus Laughed," the laughter was formed by actual music modulated by the voice.

Reverberation is one of the most important qualities in which auditoria differ acoustically, and means have been worked out for controlling this. The Stevens Theater is the assembly hall of an old building, with very little of the qualities of a great cathedral. Yet in the

AT THE CONTROLS

Busy at the controls for the Stevens Institute of Technology's Second Sound Show are Julian Webster and Gunthers Zoehfeld, in front. In the rear is Otto Niederer, head of the Sound Department.

church scene from Gounod's "Faust," where Mephistopheles calls Margarita, reverberation, with its relative, the echo, was introduced, especially in the case of the Mephistophelian voice.

Many individuals and groups have assisted, indeed, more than half of the cast of the second "Sound Show" was professional talent. Dr. Herbert Graf, stage director of the Metropolitan Opera Co., directed the Faust scene. Margaret Webster, director of many Shakespearean plays, particularly for Maurice Evans, has been working with him. The Rockefeller Foundation and the Research Corporation have both given grants to aid in the work.

When will these methods come into general use? one might ask. That, of course, cannot be foretold. There are other workers in closely related fields, for instance, the RCA engineers who made possible Walt Disney's latest production, "Fantasia." This has still been shown in only a few cities, because of the elaborate equipment required. But it makes use of auditory perspective, controlling the apparent direction of the sound. The Bell Telephone Laboratories some years ago worked with Leopold Stokowski and the Philadelphia Orchestra, using Stereophonic Sound. By recordings, the empty stage seems peopled with a full orchestra, and each instrument, or group of instruments, is heard from the right place.

Latest demonstration of the Bell work was given a few weeks ago at the Rochester meeting of the Acoustical Society. This included a stereophonic recording of the Stevens "Emperor Jones."

Already the Metropolitan Opera authorities have shown an interest in Mr. Burris-Meyer's achievements, and a few months ago he demonstrated some at a special rehearsal. So perhaps it may not be long before they are generally applied, both in opera house and theater.

And perhaps then, as Mr. Burris-Meyer suggests, "we will see the production of the 'Tempest' Shakespeare envisioned, and a 'Gotterdammerung' which would have satisfied Wagner!"

Science News Letter, May 17, 1941

ASTRONOMY—RADIO

Radio Waves May Show Shooting Stars in Daytime

WHEN a meteor, or shooting star, passes through the atmosphere many miles above the ground, it leaves behind it a radio mirror, a line of broken atoms, which may last for many minutes. By sending radio waves up, and measuring the time of the echo produced by their return, these meteor mirrors may be detected, Dr. J. A. Pierce, of the Cruft Laboratory of Harvard University, reports. (*Physical Review.*) In this way, he suggests, it may be possible to count meteors even in the daytime or in cloudy weather.

Dr. Pierce recently returned from South Africa, where he made observations of the radio effects of the total eclipse of the sun last autumn. While making control observations, with which to compare those of the eclipse day, the Leonid meteor shower occurred, on Nov. 14.

His studies were concerned with the ionosphere, the multi-storied layer of broken or ionized atoms that reflects radio waves to earth, and makes possible long distance wireless communication by carrying the signals around the earth's curvature. A moving film recorded the exact time that a special signal left the transmitter, and when it returned.

Early in the morning hours of the 14th, several bright meteors were seen. In several cases, after 16 or more seconds, a new reflecting area appeared, and lasted for a minute in one case, and 7 minutes in another. With the coming of dawn, about four o'clock, the sky was too bright to see any more meteors. However, 14 more traces, similar to those following the earlier ones, were recorded. Records made on other nights than those of the shower showed only a couple of very faint meteor traces.

Astronomers are greatly interested in checking the numbers of meteors entering the earth's atmosphere, but cloudy weather, and daylight, prevent the records from being complete. Possibly the radio method may be a solution to their problem for, states Dr. Pierce, "this method may be made sufficiently sensitive to compare with photographic registration of meteors, and that meteor counts can be made automatically without regard to time of day or weather conditions."

Science News Letter, May 17, 1941

A world-wide bibliography of 7,500 scientific articles written about *fossil vertebrates* between 1928 and 1933 has been published by the Geological Society of America.