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The Role of Sound and Sound Effects in Theatrical Productions

Sheila K. Adams

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Bryan Reeder
Chair, Department of Theatre

Donnell Walsh
Committee Member

Robert Scoggins
Committee Member

COMMITTEE IN CHARGE OF CANDIDACY

Bryan Reeder

Associate Professor and Director of Theatre

Donnell Walsh

Associate Professor of Theatre

Robert Scoggins

Associate Professor of Theatre and Dance

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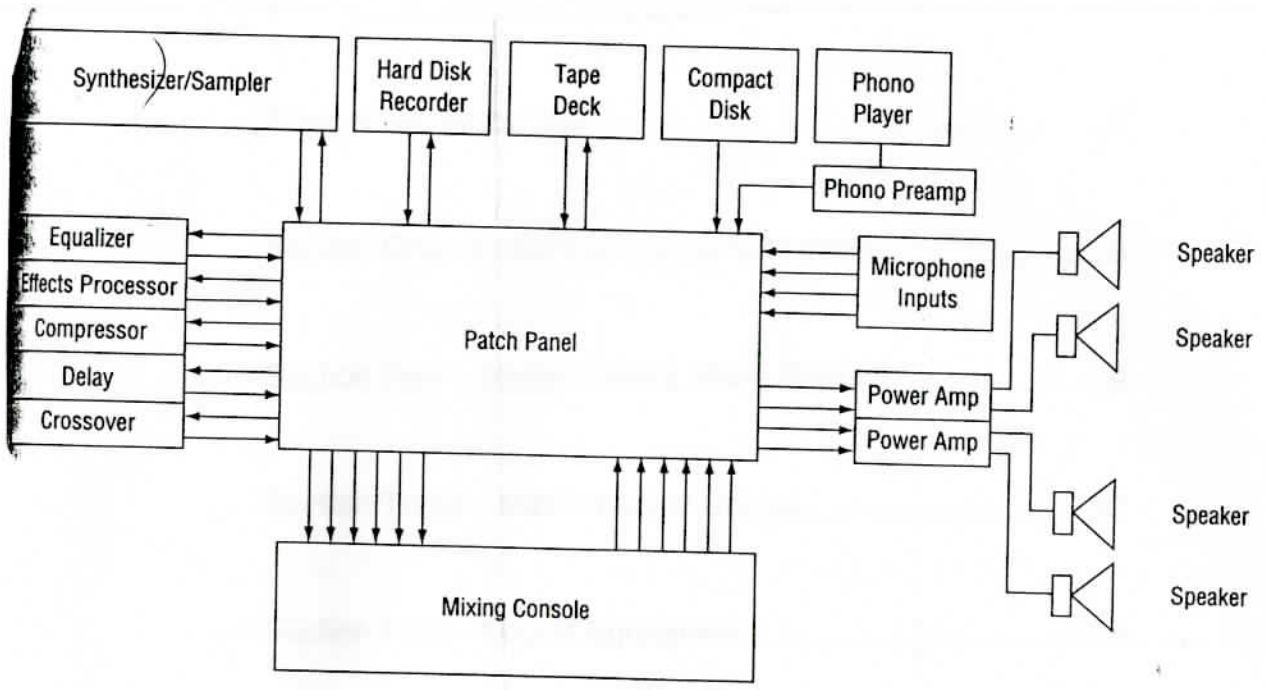

Block Diagram of a Combination Sound System

A system such as the one shown is typical of most theatre sound systems in that it combines reinforcement, playback, and recording possibilities.

(PARKER and WOLF 347)

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Prospectus for Sound

Sound is the creation of oscillating waves that can be enhanced and manipulated by sound equipment to achieve a desired and cohesive quality of sound.

In theatrical production and real life, one relies much on visual presentations; however, sound plays a role which seemingly goes unnoticed. Sound provides an underlying role of enhancing and aiding in the translation of a visual presentation; yet, on its own, sound can also create that presentation in a distinctive way.

Audio presentations link the picture (or image) to the audience. With audio presentations, one has a chance to experience different sensations. Sound presents the mind with a tool to translate what it has heard and create an image. Sound can allow one to use imagination and create whatever story or image that applies to the given sound at that time without a visual presentation. Sound enhances the emotions, feelings and attitudes of the audience to improve a production. It can help add to a production; or, if not done properly, it can ruin one.

SECTION ONE: HISTORY OF SOUND IN THEATRE

Early plays in England before 1574, were held wherever the actors could find a place to perform - - mostly in bearbaiting and bullbaiting arenas, courtyards of inns, great halls and at court. In 1574, the Common Council passed legislation which required plays and playing places in London to be licensed. England's first permanent stage was constructed by James Burbage in 1576. Burbage rented a plot of land outside the jurisdiction of England and built a building. A "theatre" is what he called it. It was in the shape of an amphitheatre and made of wood. It was round and resembled a bearbaiting arena. The theatre was about three stories high with the yard partly sheltered by the roof of the hut where gear and equipment were stored. (Barnet 6) The Fortune Theatre was the first square theatre with its dimensions ranging from approximately eighty feet outside and fifty-five feet inside. Most theatre's during this period seated one thousand to three thousand people. (Barnet 6)

Sound effects, such as the sound of a cannon's boom, were used even in early theatrical performances. The sound effects, along with costumes, props and the actors' performances, helped to communicate the meaning of the play. (Barnet 16) The lack of technology prevented these performances to incorporate many sound effects or sounds other than the actors' voices.

In 1888, Heinrich Hertz, a physicist, produced electromagnetic waves. In 1890, Guglielmo Marconi and James Clerk Maxwell experimented with electromagnetic fields. Marconi used their theories to invent a way to transmit sound. The theory was to use the dots and dashes of Morse code without using wires. (Black and Whitney 205) Lee De Forest in 1906 perfected the vacuum tube which made possible the clear transmission of music and voice. (Black and Whitney 206) This technology breakthrough began radio station broadcasting.

Many audio performances were created to be broadcast over the radio. These performances included various sound effects. An early radio broadcast was " The Whistler." It was one of the first "Gothic thrillers to send chills up and down spines in darkened room." (Black and Whitney 215) "The Shadow" had a sinister voice in the opening that said "Who knows what evil lurks in the hearts of men?" (Black and Whitney 215) These mysteries and others like them activated the imagination of the audience with sound effects. Some of the sounds were solitary steps in a lonely alley, creaking stairs or a clap of thunder when least expected. (Black and Whitney 215)

Radio broadcast performances created a foundation of sound effects for use in theatre and later in films. In 1905-06, Leon Gaumont invented the chronophone (Eyman 26). In music halls the performers would come out from behind a curtain. A small camera would record the performance while a sound horn behind the camera recorded the sound at the same time. The actors had to speak their lines very loudly. The amplification was made by pneumatic sound boxes powered by a one horsepower compressor that blew air through the speakers and the sound out into the auditorium (Eyman 27).

Jack Foley designed theories on sound design. Today they are known as the Foley techniques. The sound effects are done manually along with the film. The sound production is utilized to add the sounds that were missed when the live recordings of the acting were done. This is to give a touch of realism to the production. The trick is for the sound effects person to become the actor and coordinate the sounds to convince the audience of the realism. The best are able to look at a subject and imagine the sound it would make. The Foley procedure is much like the early ones, except today there is a crew that has individual jobs. One makes the sound, another records, and yet another mixes it. (Filmsound 1)

Arthur W. Nichols invented the first sound effects machine. This was used mainly in theatres. (Maltin 89) This machine contained most of the sounds used on stage. The device was built in a single cabinet or table. It was five feet high and less than two feet deep. The sound effects machine was to be used by a drummer in the orchestra and contained sounds such as falling trees, crashing glass, trolley cars, doors slamming, hand saw and many other unusual noises. (Maltin 89)

SECTION TWO: SOUND EFFECTS MADE POPULAR

Some sound effects are done with imagination. Sound Technicians very often have to make synthetic noises to replicate real ones. (Eyman 276)

The "thunder sheet" is the most commonly known sound effect. It is simply a piece of sheet metal hung from a rack and when struck with a hammer produces the sound of a loud thunder crack. Also, when the metal is tugged back and forth it makes the rumbling sound of thunder.

In the 1930's someone would quietly shell peanuts next to an open microphone and make a sound that resembled sharp crashes of thunder and lightning. A woman wearing silk stockings sat near a microphone, and when she crossed her legs the sound designer heard the sound as a tornado. (Eyman 276) After this discovery, the sound technicians just rubbed the silk stockings together to produce a tornado sound. Rifle fire was made by breaking kitchen matches. Wind through the trees was produced by an old stage technique of revolving a canvas strip over a cylinder of wooden slats. A falling body was simulated by dropping a ripe pumpkin. Collapsing buildings were made tearing heavy paper very near the microphone. (Eyman 277)

John Houseman discovered a sound effect for simulating a head falling from a guillotine blade for a production of "A Tale of Two Cities." This could be done by cleaving a head of lettuce in half. (Maltin 88) Arch Oboler used a watermelon, which he chopped to simulate a skull being cleaved. (Maltin 89)

In "Les Miserables," Victor Hugo imitated the caverns of Paris by reverberating the sound of their studio men's bathroom (Maltin 88).

Sound effects, especially on radio, force the audience to use its imagination (Maltin 87). Coconut shells or beating on the chest close to a microphone

would create hoof beats. Special boards were installed so that foot steps could be enacted and clearly heard. (Maltin 88)

Rouben Manoulian, 1932, believed that sound was the best part of movies. He believed in the use of sound imaginatively. (Eyman 224) Manoulian was interested in using sound for dramatic effect. During a quiet dramatic scene in "Wings Over Europe," he had a stage manager carry a loud metronome from far backstage down to the back wall of the set. The ticking duplicated a clock sound on the mantel and slowly enveloped the audience. (Eyman 224)

In the 1930's, the sound of Buck Rogers' rocket ship was created by the use of an air conditioner. The exhaust and intake consisted of huge grates at least four foot square. Plaster and a spare script were used. The sound effects person plastered the pages over the whole area of the grate. They stuck due to the draw of the air. He left a small opening in the middle where he placed a microphone. The air conditioner created a rocket ship sound. When different ships were introduced, the air was sent through a filter for a different sound. (Maltin 89)

A gun shot is made by striking a pillow with a stick. An airplane can be done by attaching a piece of cardboard or leather to a fan. (Maltin 92)

Ora Nichols, head of Columbia's sound department in 1934, discovered that an egg beater whirring next to a microphone makes the sound of a lawn mower. (Maltin 91)

For squeaky hinges the process was normally to take the hinges, bury them in dirt and water them down like plants for a couple of weeks to get them nice and rusty. Terry Ross, a New York sound man in the 1930's, was doing a production of "Inner Sanctum," which required a door with squeaky hinges. He had gone through the process explained above and mounted them on the door.

A set-up boy oiled the squeaky hinges, not knowing that these were to be used as a sound effect, and so Ross had to imitate the sound of the squeaky hinges with his voice. (Maltin 94)

Some sound effects are done with the human voice (Maltin 94). A sound effects person must be able to "do it all" (Maltin 94). They may be required to do one-half hour of hoof beats, while another day may be ringing a fire-alarm bell on cue.

The most common way today to make sound effects is with an electronic keyboard. Today, we also have sounds pre-recorded that are placed on a computer disc and easily accessible. (Parker and Wolf 337) A sound library is a collection of sounds that have already been pre-recorded. There are sound libraries full of sound effects and there are musical instruments that can also give certain sound effects.

The recorded effects one finds may or may not be the exact effects for which one is looking. Some sounds have to be recorded like an automobile, airplane, or train, the whistling of wind or the rushing of a river (Maltin 95). Live effects are better to work with because of the control working with the actors. The simplest sound can often produce the best effect.

SECTION THREE: MECHANICS OF SOUND

No sound would be of any use without the device called the ear. Sound is reproduced by the ear. The human ear has to translate all of the effects or they are useless. The ear picks up sound from the outer ear. This part is like a sounding board. It picks up sound and deflects it to the ear canal. Once it has traveled through the ear canal, it vibrates the ear drum. The sound is then amplified by the middle ear. The amplified sound travels to a fluid area, named cochlea or inner ear. The nerve endings in the inner ear receive the amplified sound waves, which now have mixed with the fluid to create a pressure effect. The nerves then send the electro-chemical signals to the brain to interpret. (Parker and Wolf 326)

Sound is caused by vibrations transmitted through an elastic material or a solid, liquid, or gas (usually the air) which are capable of being detected by the human ear. Sound waves are produced by a vibrating body, which moves in a back and forth motion. As the vibrating object moves forward, it compresses the air in front of it; when it moves back it creates more space which allows that compressed air to expand. The compression and expansion of air occurs with each vibration, and more than one vibration creates a sound wave. The sound wave is carried through the air (or other gases, liquids, or solid materials) for a certain distance. Sound waves are detected by the human ear, which translates the wave into sound. (Huetinck 58)

Sound waves consist of frequency, pitch, intensity and loudness. Frequency is an important characteristic of a sound wave. The frequency of the wave is the number of waves passing a given point in a unit of time. Frequency is measured in cycles per second or hertz. (Huetinck 55)

The pitch of a sound depends on the frequency of the tone (or note) that the ear receives. High notes are produced by an object that is vibrating a greater number of times per second than for a low note. A higher frequency creates a higher pitch (Huetinck 58).

Intensity of the sound is the amount of energy, or force, flowing through an area within a certain period of time. Intensity is measured by watts per square meter. The more watts a sound has, the more intense it will be. (Huetinck 58)

Loudness is characterized by high volume and intensity. Loudness is subjective to each individual and is dependent upon the intensity or force of sound waves on the human ear. In general, a more intense sound is also louder, in that the physical intensity of a sound wave is such that equal steps in loudness correspond roughly to equal multiples in intensity (Gettys, Keller and Skove 751). The intensity level of sound is measured in decibels. For example, normal conversation is about 60 decibels and a power saw is 110 decibels. The ear does not respond similarly at all frequencies in that two tones with different pitches but of the same intensity may appear to have a different loudness. (Huetinck 58)

Sound wave frequencies and intensities can be adjusted up or down with many variations. Sound waves can be enhanced and manipulated by certain equipment to achieve a desired quality of sound. The desired sound can also be recorded on a variety of machines, each having a different type of quality. The final result depends on the original sounds and the equipment used to alter those sounds.

SECTION FOUR: SOUND EQUIPMENT

Sound production starts with the development of sound waves. These waves have certain frequencies and intensities that determine the pitch and loudness. Sound equipment controls and alters sound waves.

Sound and its characteristics can be enhanced and manipulated by certain mechanical and electrical equipment. Different types of equipment can reproduce and alter sound. A sound designer commonly reproduces and alters sounds in preparation of and during a theatrical production.

Many sounds and sound effects needed for a theatrical production must be recorded live by the sound designer. In these cases, one has to look for the sound effect and record it. After recording it, the sound can be modified with a mixing board (A1), amplifiers or other sound modifying equipment. Some devices like MIDI can help if one has computer accessibility. MIDI, or Musical Instrument Digital Interface, is a digital language used to communicate between components. The right equipment is important for productions and post-production.

In order to begin recording any sound, one must have an input device. The most commonly used input device for recording live sound is the microphone.

There are four basic microphones: omnidirectional, bi-directional, cardioid, and supercardioid. The omnidirectional microphone receives sounds from all directions. This is good for group recordings, but feedback is usually a problem with this microphone. Feedback is when the microphone is too close to an object and the sound waves bounce off the object back to the microphone and back to the object. This effect creates what is known as a reamplification. (Parker and Wolf 353)

A bi-directional microphone picks up sound from two opposite directions. This microphone is good for recording a two-person interview. (Parker and Wolf 353)

A cardioid microphone is best for theatrical productions. The sound is automatically rejected, lessening the possibility of feedback. (Parker and Wolf 353)

The supercardioid microphone picks up sounds from a longer distance than the cardioid microphone. This microphone can be placed downstage at the edge of the curtain area and used for general vocal pickup. (Parker and Wolf 353)

There is also a PZM, or pressure zone microphone. It has an omnidirectional pickup pattern and is placed along the boundaries of the stage to pick up zones. (Parker and Wolf 348)

Once the input device is chosen, the recording equipment must be set up. The equipment used for recording sound during the audio production and post-production includes an audio tape recorder(A3), audio cassette, compact disc(A3), and digital computer system. (Zettl 202)

In production studios, most of the output is recorded onto a "reel-to-reel audio tape recorder (ATR)." (Zettl 202) A reel-to-reel has two reels - one holds the audio tape and the other receives it. The audio tape has magnetic tracks. As the tape passes through the reel-to-reel audio tape recorder, it passes over three magnetic heads - an eraser head, recorder head and a playback head. (Zettl 202) The eraser head clears the track of the tape to allow the recorder head to record sound on clean tape. The playback head simply allows one to play the tape to listen to sound already recorded.

One of the most simple forms of sound equipment is the personal cassette recorder, which doesn't have much audio control. It has a built-in micro-

phone that has to be turned on, and the AGC (Automatic Gain Control) mode automatically adjusts the volume of various sounds to normal levels. The audio cassette recorder is a smaller version of the ATR. The tape has two sides. When one is finished recording or playing on the first side, the tape can then be turned over to record or play on the other side. (The ATR can provide this feature also.) The cassette machine also uses magnetic heads, but it only has the recorder head and playback head. The cassette is used only for small productions of lesser quality. The advantage to a cassette machine is that it can be portable. (Zettl 204)

Reel-to-reel audio tape recorders are used more widely than cassette recorders in production because the reels hold more tape than a cassette tape holds; therefore, a recording session can last longer. Also, on the ATR, the output sound is clearer than that from a cassette tape because of the eraser head.

The compact disc player is another recording/playback device. This machine uses a laser beam and not magnetic tape. The laser beam reads digital information that is electronically placed onto the disc it reads (Zettl 204). The compact disc (CD) is noise free. On a tape, playback can include sound that was not recorded, but that is simply a part of the tape itself. The CD, on the other hand, only plays back what was recorded on the disc. A CD can have many tracks, while most tapes only have two (side A and B). An advantage of a CD player is that one can select the track number to be played using the counter selection button, and the player will go right to it and begin playing. The cassette and reel-to-reel tapes do not have such a feature, and one can spend a lot of time searching the tape to find the desired sound. (Zettl 205) A disadvantage is that the disc requires an expensive special electronic device in order to record onto it. (Zettl 205) For this reason, CD's are usually read only and not recorded on by the general public.

Sounds can also be created with a phonograph. While some sounds on an album are required to play at their normal speed, one can speed the revolutions up or slow them down to get a totally different sound than the one actually recorded on the record. This effect is hard to get on compact discs (CD's) or pre-recorded tapes. (Maltin 98)

The digital computer system is used to remember certain music cues, help to control the mixing functions, activate certain procedures and edit sound (Zettl 205). This device aids in music cues by storing them for easy and instant access. While mixing and recording sounds, a stored sound can be retrieved and added. Sound waves can also be seen on the screen or attached monitor and can be adjusted by sight to the desired level. When viewing the sound waves, the waves can be selected and placed elsewhere in the sequence (Zettl 206). The digital computer system can take the completed material and store it on a hard drive for further use in editing (Zettl 205). The digital computer system is ideal to use with video. Each selection made can match certain frames or scenes of the video (Zettl 206). This is a good source for film producers.

When the audio requirements become more demanding, such as controlling the volume of people's voices or mixing two or more sounds, then one needs to use special audio control equipment. This consists of an audio mixer and an audio console. (Zettl 196)

An audio mixer aids in obtaining the proper audio level output for which the production calls. The audio mixer amplifies (makes louder) a weak signal coming from sound sources. It allows one to control the volume and to mix two or more sounds. The signals are controlled and mixed by the audio mixer, then translated back into actual sounds by the speakers.

The advantage of using a mixer is that it allows the control operator to alter each sound input to a desired level of volume for output. Input sounds may

come in at various levels. The control operator decides which sounds need to be louder and which ones softer in order to achieve the desired output. For example, a control operator has two input sounds - one of a man talking and the other of street noise. If the control operator wants the street noise to be obnoxious and overpowering to the man's speech who is talking, the operator would increase the volume of the street noise and decrease the volume of the man talking until the desired level of each sound is found.

The volume levels can be monitored by a volume unit (VU) meter. This usually has numbers on it to show the peak of the audio or to measure the loudness. It also has a red area to show over-modulation. Over-modulation means the sound is not clear - it is distorted. While watching this meter and observing the sound output, a potentiometer (pot) can be used. The pot is a rotary knob that controls the volume of output. (Zettl 196)

There are two types of mixers - monophonic and stereo. A monophonic audio mixer has two to four inputs and one output. All of the sounds are fed into the monophonic mixer as inputs. These sounds are mixed by the mixer and are then recorded or amplified as one combined sound, which is the final output. (Zettl 196)

A stereo mixer has two inputs - one left and one right. It also has two outputs - one left and one right. One sound source will come in through the left input and another source, which is complimentary to the first, will come in through the right input. The left input sound is altered by the mixer and then becomes an output in the left channel. Similarly, the right input sound goes through the mixer and is output in the right channel. (Zettl 196)

The advantage of stereo mixers over monophonic mixers is that with the right and left channels, the output has a more realistic sound, since one hears

different sounds in each ear - the right versus the left. From the monophonic mixer, one hears simply one flat sound with no right and left separations.

The audio mixer is valuable in a studio atmosphere. It assures that all the sound going out is level. This ability increases the sound clarity and quality when mixing two or more sounds.

The audio console is similar to a mixer, but enables one to control more than the volume. The audio console provides the sound with character qualities, such as bass, treble, distortion, echo, etc.

Similar to the mixer, the audio console has inputs, volume controls, VU meters and outputs. The audio console has a slide pot instead of the rotary pot found on a mixer. (Zettl 198) The audio console also permits one to control each input sound by adding an echo, taking out unwanted sounds and adding or subtracting bass or treble. It gives the operator the ability to turn on individual sounds and mix only the ones needed at that time.

The audio console also has more inputs than a mixer. (Zettl 198) More inputs helps accommodate more sounds, and this can allow for a more elaborate production. Whether the purpose is to create a simple or lavish sound production, the audio console can attain it, control it and present an impressive final output.

Once the sound waves are controlled and at a level to be recorded the quality of output must be of production quality, which entails clear and precise sounds stored on devices that are built to last.

In audio post-production, one attempts to eliminate some of the unwanted sounds or add something to the existing audio track on a tape. This process is called sweetening. Once the sound is at a level of satisfaction, it is then re-recorded. In audio post-production one can create an entirely new audio track.

The end of the sound production chain is the output device, usually a loudspeaker. A loudspeaker is a device that converts electrical signals from the sound equipment into sound. The quality of the sound depends on the equipment used during the sound recording and manipulation processes.

The location of loudspeakers that will be used for sound effects should be near the source or in the general areas from where the sound that was created may come. A basic rule for location of a sound effect speaker is fifteen degrees horizontally and sixty degrees vertically from where the sound would be coming. This will help give a naturalistic sound effect. (Thomas and Bell 24)

Speakers are best when placed above the stage for a good directional perspective of the actors' performance. The reasons for doing this are to get a good sound effect out of actors and to keep the sound cables off of the floor out of the way of the actors and audience. (Parker and Wolf 339)

Finding the music or sound effects and mixing a master tape is just the start of sound designing. The follow through to the end of a good production will make it complete.

SECTION FIVE: THE EXPERIENCE OF SOUND PRODUCTION

To find sound and make a good production, one needs to look deep into the script (Hodge 7). Script analysis can help with this. This is when a play is dissected scene by scene and word by word.

In a script, there are cues, which are signals. Cues can be words or actions used to indicate another event in a performance, such as an actor's speech or entrance, a change in lighting, or a sound effect. In a script, a cue might read "(... a scratch of a chalk board here is heard)." The writer is telling the reader or the sound designer to put this sound in at this cue.

Imagination can also exceed what is written by using script analysis. A sound designer or the director can place a sound effect in a given spot of the play to help the outcome of the audience reaction. When one analyzes the script, the undertone or hidden cues can be found. One must analyze the script carefully to find any hidden sound effects.

It is imperative to understand the director and the types of sound effects for which he or she is looking. The director has the final say whether to incorporate any sound effects the sound designer has created for a play or film. Ray Erlenborn, a sound effects designer, recounts:

> You had to understand the director you were working with, because you do it the way they want it, not the way you do, unless they give you a free hand... (Maltin 99).

If one gets along with the director, the job of sound designing is much easier to do. The only way the sounds can be done as the sound designer would like them is to be given free reign from the director. (Maltin 99) Each director has his/her own techniques, with different approaches to sound effects.

Some directors use very little sound effects, many times to save on time and money. (Maltin 98)

I worked on a sound design project for Lindenwood Theatre Department for the play Hay Fever by Noel Coward. At the beginning of the play, the guests arrive at their hosts' house in the country. What should have been an excitable weekend became a not so pleasant experience for the guests. By the end of the play the guests are in a hurry to leave after their peculiar experiences. The play portrayed the guests leaving in a rush.

One of the sounds needed was that of glass breakage in one particular scene. This was accomplished by a window breakage recorded and then slowed down in post-production to give the sound of a porcelain cup breaking. Another scene which required certain sounds was when the guests were leaving. I decided to have them leave in a speeding car. The director agreed this would be a humorous addition. I recorded an actual car starting and revving it's engine, then leaving.

The time period is always a factor to consider for sounds. Since the play had a setting of the early 1900's, big engines weren't yet invented. I needed a small, low-geared engine. A modern car with a four-cylinder engine fit the case. Automatic transmissions were not popular around that time either, so I needed a stick shift. The early automobiles had a metal sound when the doors were shut that had to be present to give an authentic feel of the environment created. In plays, accuracy does help the performance. The audience won't pay much attention, but if there were any questions, the illusion would be gone. I took the car to a lightly graveled road in order to create the sound of a country home drive way. I had friends help me and we began recording. First, we recorded the slamming of four doors (one for each guest leaving). When we slammed the four doors like one normally would, it sounded all wrong. It was too slow or two

or more would slam together, creating one slam when recorded. Another problem was the ding that would sound when the driver's door would open (another part of modern technology not found in the early 1900's). To bypass these problems, we alternated the back doors with slams. This action created four separate door slams that were quick. After recording these sounds, another blank tape was put in the recorder to record the mechanical sounds of the car. The engine was started and revved up. Then we made a slight grind of the gears to portray the driver's attempt to find first gear too fast. The car spun off into the distance.

When the recorder was held with a microphone (A2) attached, there was wind noise and it sounded fake. I took the microphone off and placed the recorder in the weeds beside the road. By doing this, I incorporated sounds that enriched the effects I was aspiring for. The microphone being at ground level helped to capture the sounds of the gravel and dirt being slung off the tires and into the air. The spinning of the tires and the engine sounds were made more prominent. An attempt to record from inside the car was made, but this did not give the correct sounds I was imagining. Having the recorder in the weeds at ground level gave the effect of hearing the sounds clearly but at a distance. This was essential, because the audience and the hosts' were hearing the car leave from inside the house. In addition, I recorded the car coming towards the recorder and the engine shutting off to achieve the sound effect of the first guest arriving in the beginning of the play.

During a theatre production, it is good for the sound technician to be prepared for equipment failure. Extra cords are good to have on hand, a portable microphone, an extra headset, backup tapes in case one breaks. Also, one needs a portable compact disc and tape player(A3) prepared for stand-by.

While I was doing a production of Hay Fever, I was experiencing equipment problems all week during rehearsal. The sound-board wasn't giving an output of sufficient sound. I found a break in an external cord and replaced it with a new one. The next day the tape deck began to drag, but constantly cleaning it helped the heads. The heads were obviously going bad! I replaced the tape with a newer one the night before the first performance. Thinking all was perfect, I was ready for the actual performance. After act one, the Compact Disc player quit for no apparent reason. I had a portable Compact disc player that I hooked up to the sound board and played sound effects off of. The second show was going well, until the tape deck ate the tape used for the music of the show. Having a back up portable cassette player, it too got hooked up to the sound board. I had back up tapes of all that was to be played in the show and began playing these. The show went over well without missing a beat. This was because there was early planning of "what would I do if this happened."

I also had the opportunity to design the sounds for Macbeth by William Shakespeare. The director wanted a Celtic sound for music with dreariness evolving around it. I researched Celtic music and found great selections were of the acoustical type, with simplistic drum rhythms for accompaniment.

The sound effects were achieved by a computer, keyboards, an amplifier and about three microphones for range difference. The bells came from the beginning of a rock song. The crickets were mixed with wind and the owl sound chimed in every once in awhile. Macbeth took longer to put together than Hay Fever. In Hay Fever the sounds were manually made, recorded and mixed together on one tape to create a smooth running tape. For Macbeth, I had to synthetically make the sounds. This takes longer because each sound needs attention to imitate the real thing. Each section has to be edited in post-produc-

tion by stopping and starting the tape while recording a selected effect from another tape or from another sound onto it.

SECTION SIX: NEW TECHNIQUES

Over the years, innovations in sound manipulation have been introduced. These developments have brought about an evolved quality of sound in film.

Optical sound is an innovation which gives a monophonic sound that is produced by light. Optical soundtracks are printed simultaneously with the picture (Dolby 5). When light shines through the tracks of the tape, it produces sound. The tape has solar cells. When the light shines through the solar cells it transforms to electrical signals which are amplified by the sound equipment and produced through the speakers. (Dolby 1) The solar cells run along the side of the film. The sound track can last as long as the film. (Dolby 2)

The way the film is made has a direct effect on optical sound. The sound will have similar quality to that of the film. For example, if the film is slow and dragging in quality, the sound will be slow and dragging in quality. The sound would not be very clear. Optical sound initiated the idea to attain better sound production. Improvements to film quality were made, and these required better sound equipment to increase the sound quality as well. Because of this need, magnetic tapes were created. (Dolby 3)

The cassette and reel-to-reel tapes have a magnetic strip made of iron oxide material (Capelli 1). These strips are applied to the film, allowing the sound to be recorded and played in real time along with the film. This sound is produced by magnetic heads, versus the optical sound which is produced by light. (Dolby 3)

The magnetic heads permitted the development of multiple tracks, which were then added to both sides of the film strip. This made stereo sound

possible. (Dolby 4) For example, one person's voice in a movie would be heard on the left of the theater and another's voice would be heard on the right.

Currently, eighty per cent of the movies have "multi-channel stereo soundtracks." (Dolby 5) Dolby Laboratories are responsible for this new breakthrough in sound technology, which uses digital sound (Dolby 5). Dolby didn't like the stereo sound of simply having a track on each side of the film. The idea of using the monophonic soundtrack area of the optical sound was used. The optical sound area now has four channels to help in the production of sound. (Dolby 5) Within this same area are two soundtracks (left and right), a "third center-screen channel" and a fourth surround sound channel (Dolby 5). The fourth provides "ambient sound and effects." (Dolby 5) The multi-channel strip is read by light like the monophonic optical sound strip is read.

Dolby went on to create six channels in the monophonic strip area. These channels are: 1) left, 2) center, 3) right, 4) left surround, 5) right surround and 6) bass effects. This digital production adds a more realistic quality when listening to the sound with a film. (Dolby 5)

Optical sound for film is a simple idea using the light source of the projector. It's not very clear, it is monophonic, and the quality can be good and bad, depending on the film quality. Magnetic tape essentially replaced optical sound. With the magnetic tape, the clarity increased and stereo sound (left and right channels) came about. A problem with magnetic film sound is the high cost to produce it, and the sound system needs to be stereo. Digital film sound is now available. This sound uses the optical area of the film. It has the clearest sound quality and is very accurate, since it is produced at the same time the picture is. The optical sound is produced in a similar way, but optical sound can only be heard in monophonic sound. Digital sound is heard as surround sound, and it is cheaper than magnetic sound to produce.

A process that is becoming popular is the three-dimensional sound system called Holophonics. The recorder uses a binaural head and processing electronics that hold the imaging cues needed by the human ear. (Zuccareli 1)

With Holophonics the sounds actually come from their proper origins or directions to give it a three-dimensional sound. (Zuccareli 2) The sounds are recorded and played back so that it is perceived as a three-dimensional entity. The recorded sound acts like the human hearing process, and the listeners feel as if the sound is actually happening to them. This is not surround sound, or anything close to it. It is a realistic sound experience. With holophonics, the sound of scissors recorded close to a person's head sounds on playback like it's close to the listener's head. (Zuccareli 3)

Holophonics starts where the microphones should be. There are no microphones. It uses a proprietary sound processing technique, which captures the full spectrum of essential information from the ear to the brain. The sound creates the same sensation as being around the original sound. (Zuccareli 3)

No special equipment is required to play the sound. It's all done during the recording process. Three-way speakers are best to hear the 3D sound through, and good to basically hear any sound through. Three-way speakers add to a hearing sensation because they break the sound up into areas and let the ear mix them. In the three-way speaker, there is a woofer, mid-range, and a tweeter speaker. These take care of all the frequency ranges. (Zuccareli 3)

With new innovations and developments, sound equipment and sound quality will always be changing. These changes will allow the manipulation of sound to achieve a more clear and crisp sound that will become closer to realistic sound. Many times, sound effects are made better with imagination and basic equipment.

Sound is all around us and is usually taken for granted. It has always been a secondary effect to the visual productions. Using the old techniques or new ones, sound is a broadening avenue that is starting to be recognized as an essential part of the visual productions in the theatre business. The visual production world has begun to incorporate sound to add to the realism of its productions. Plays first started in order to imitate the real world, and that still applies today.

Just as the visual productions strive to better imitate the real world, the goal of the sound designer, sound producers, sound editors, etc. is to imitate and capture the essence of real sounds. Together they better enable the audience to feel as if the production is actually happening as a real life event.

In the quest for perfection there is always room for improvement. With the combination of sounds and sound effects with the never ending advancements in sound equipment technology, the use of sound can only become more powerful in theatrical productions.

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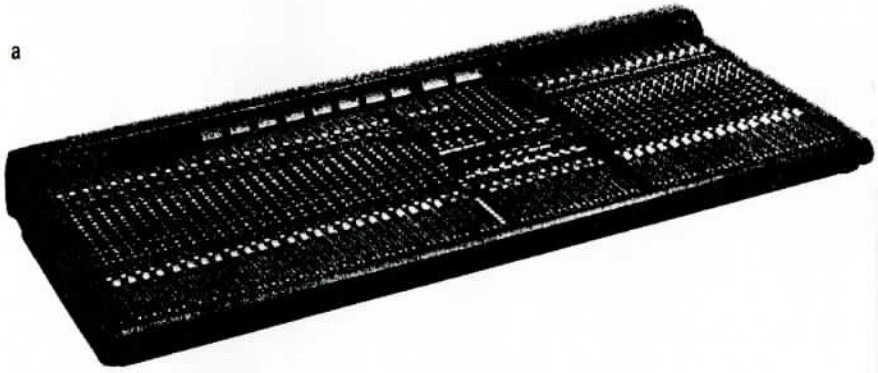
APPENDIX I

a



b

Figure 13–4
Mixers

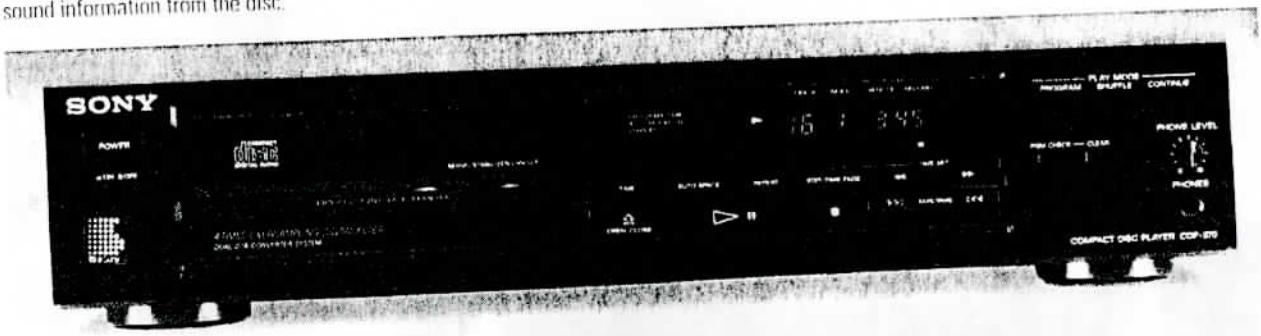
Shown are two mixers from Yamaha:
(a) The M2000 Mixing Console with 40 inputs, 8 sub-group outputs, an auxiliary mix matrix, and a stereo main output.
(b) The Pro Mix 01 digital mixer with 16 inputs, digital signal processing, digital patch bay, and MIDI dynamic-automation.
Photos courtesy Yamaha Corporation

(PARKER AND WOLF 351)

APPENDIX II

CD PLAYER

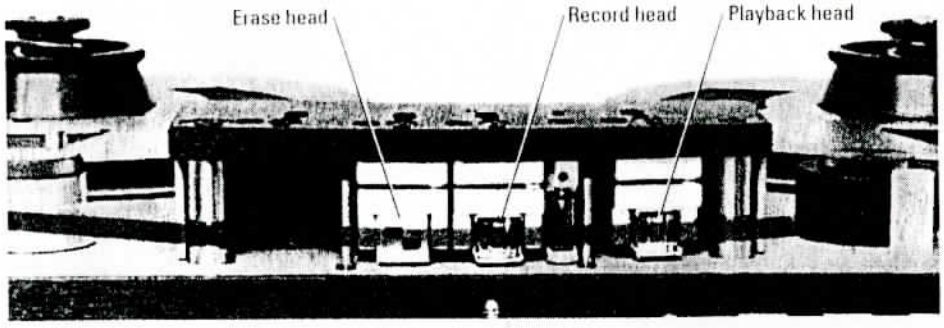
The CD player is a read-only device that cannot be used for recordings. It uses a laser light beam to retrieve the digital sound information from the disc.



(ZETTI 205)

REEL-TO-REEL AUDIOTAPE RECORDER

In a reel-to-reel audiotape recorder, the tape moves from a supply reel over the head assembly to the takeup reel.

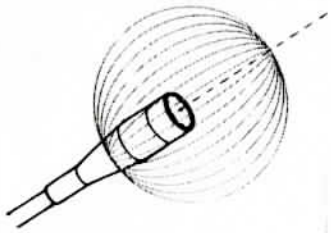


(Zettl 202)

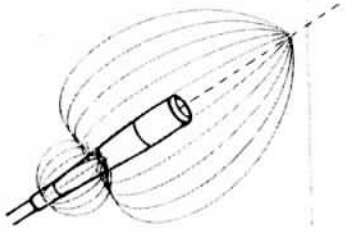
APPENDIX III

Microphone Pickup Patterns

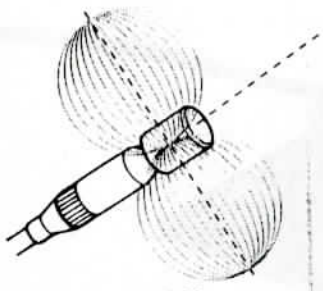
The choice of pickup pattern is determined by the specific task.



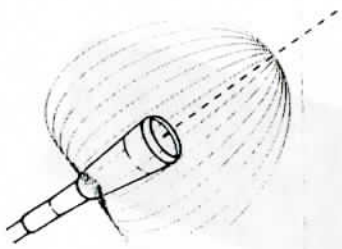
OMNIDIRECTIONAL



SUPERCARDIOID



BI–DIRECTIONAL



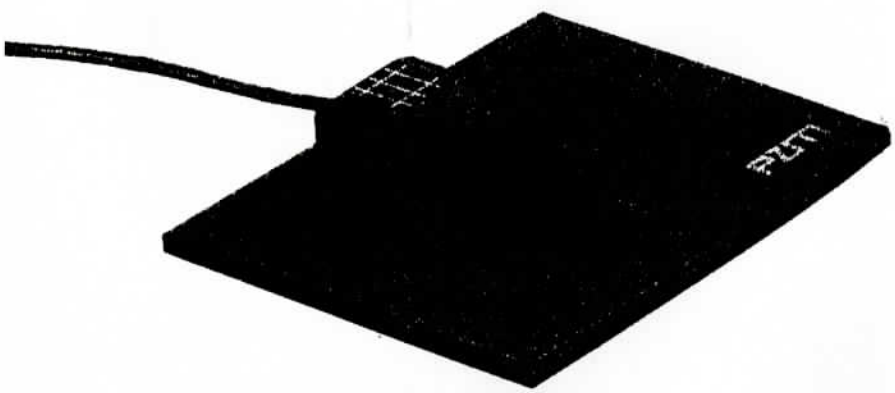
CARDIOID

(PARKER and WOLF 353)

Microphones

Four commonly used types of microphones:
(a) A hand held cardioid vocal mike, the Shure SM58. Photo courtesy Shure Brothers.
(b) The Crown PZM (Pressure Zone Microphone), a boundary microphone with an omnidirectional pickup pattern.
(c) The Crown PCC (Phase Coherent Cardioid), a boundary microphone with a cardioid pickup pattern for rear sound rejection.
(d) The Crown GLM 100, a miniature personal microphone that can be part of a wireless system. Photos courtesy Crown International.

a



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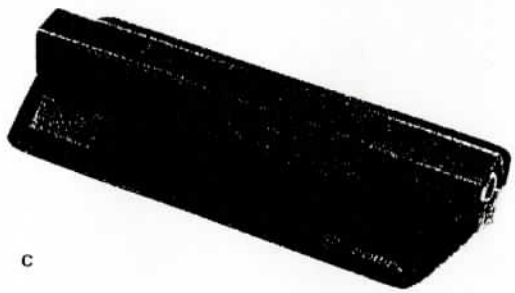

c

d

(PARKER AND WOLF 348)