A Course In Phonetics And Phonology

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Abercrombie (1967) defines Phonetics as "the study of the medium of the spoken language". Catford(1988), for his part, defines Phonetics as "the systematic study of human speech sounds". Furthermore, Lass(1984) defines Phonetics as "a rather more 'neutral' study of the sounds themselves as phenomena in the physical world, and the physiological, anatomical, neurological and psychological propertiesof the human beings that make them.

Recently, Helen Fraser(1999) in a manuscript entitled as Forensic Speech Science" defines Phonetics as "the science of speech". It is a branch of linguistics which involves the systematic study of the sounds of language,including:1) their production ,i.e. how they are formed in the mouth,2)their acoustic properties, 3) their perception and recognition by humans and computers and 4)their acquisition ,i.e. .how they learned, both in the native language and second language. In a somehow similar view, Brosnahan(1970) argue that the expression substance is the basic field of study of Phonetics; Phonetics is accordingly concerned 1)with the operations which go on the nerves and muscles of the speech mechanism of the speaker during the process of realization of the expression form,2)with the nature and the characteristics of the sound waves which are emitted by the speaker ,3)with the processes of hearing which go no in the processes of hearing which go on in the auditory apparatus up to the point where the expression form is abstracted from the expression substance and finally 4) with the relations between the data of each of these topics.

Phonetics is really a technically based subject concerned with measuring sounds, recording frequencies and generally studying the frequencies the physiology of speech. But one can simply defines Phonetics as "the study of how speech sounds are produced (articulated), transmitted and perceived.

Phonetics is ,then, a pure science and need not be studied in connection to one particular language ; it is universal (but one can talk about English Phonetics and Arabic Phonetics). That is why some scholars consider Phonetics to be outside the central core of linguistic proper (intralinguistic),but most would include it under the heading (linguistic sciences). And the linguistic aspects of Phonetics ,i.e. the study of the sound systems of particular languages, is part of phonology.

The study of Phonetics can be divided into three main branches:1) articulatory(physiological) Phonetics-the study of the movements of the speech organs in the articulation (production/performance) of speech, 2) acoustic (physical phonetics-the study of the physical properties of speech Phonetics sounds such as frequency ,intensity and amplitude in their transmission, 3)auditory (perceptual) Phonetics-the study of the hearing and perception of speech sounds.

For Clark and Yallop (1995) these different branches (or aspects) of speech are ,of course, integrated (firmly connected); speech sounds cannot be divorced from the organs that articulate them, a sound wave does not exist in isolation from the source that generates it, and so on .They have to be studied theoretically and experimentally(experimental laboratory).

The following is a review of some of the applications of Phonetics:

1)In Language Teaching: Brosnahan and Malmberg (1970) argue that a knowledge of the structure of the sound systems and of the acoustic properties and the production of speech is indispensable in the teaching of foreign languages .The teacher has to know the starting point, which is the sound system and the pronunciation of the pupil's mother tongue, as well as the aim of his teaching, which is a mastery of the sound system and the pronunciation of the language to be learnt .He must be able to point out the differences between these two, and to arrange adequate training exercises. Articulatory training and ear training are both equally important in modern language teaching. The introduction of technical equipment-gramophone, tape-recorders, language laboratories ,etc- has brought about a revolution in the teaching of the pronunciation of foreign languages.

Catford (1988) ,for his part, states that the teacher of language, including the teacher of English as a second language, must be able to diagnose the pronunciation errors made by students, and to devise means of correcting them ,this is impossible without theoretical and practical knowledge of Phonetics.

2)In Speech And Voice Pathology(or Therapy)(Medical Phonetics):Catford (1988) states that speech pathologists have an obvious need for Phonetics which they readily knowledge, both for a general understanding of how the vocal apparatus works for the diagnosis and treatment of minor articulatory defects without a clear understanding of all the different aspects for normal speech and normal language .Phoniatrics and logopedics belong to Phonetics and linguistics

just as much as ,if not more than to Medicine .All kinds of training of the voice and of articulation, whether the treatment of pathological defects or simply the development of better speech habits for public speakers ,actors, broadcasters ,etc., must be based on knowledge and experience gained in the study of the speech organs and of the acoustic and auditory characteristic of the sounds used in speech.

3)In Medical Audiology: for the development of adequate ear-training exercises and hearing tests for the hard of hearing, as well as for the construction of technical devices to facilitate the perception of speech by the defective ear, a thorough knowledge of the acoustic properties of speech sounds and of their auditory effect is essential. This is equally the case in the teaching of speech to the deaf, whether such therapy is directed at the training of residual hearing or at the teaching of the spoken language exclusively or mainly by articulatory training, the traditional method of teaching speech to the so-called deaf-mute children. With regard to the former, recent discoveries in the field of Acoustic Phonetics have established a firm basis for the practice of ear training with small children, in order to make such residual hearing as they may have been (normally in the lower register of the tone scale) useful for language learning. The acoustic analysis of speech sounds has shown why, and to what extent, such training is possible and may be successful.(Brosnahan and Malmberg,1970).

4)In Theatrical Performance :Catford(1998) expects that Phonetics is of great importance in the teaching of speech production-actors, especially those who wish to master numerous dialects and foreign accents, certainly ought to have a thorough knowledge of Phonetic. Besides, broadcasters also must have a well mastery of pronunciation.

5)InCommunication and Computer Engineering (Engineering And Computational Phonetics):Catford(1988) thinks that communication and computer engineers and other "speech scientists" working on the improvement of speech transmission systems, on speech synthesis, and on automatic speech recognition, need to have a considerable knowledge of Phonetics.

Brosnahan and Malmberg (1970) add that in recent years, Phonetics and Phonemics have become important in a number of technical fields connected with communications , those concerned with the development and improvement of sound-recording and reproducing apparatus, of telegraph and telephone systems, and so on. As a result, some work of considerable importance for

Phonetics, especially on the acoustic side, has been done by sound or communications engineers, often in collaboration with phoneticians. Today a number of machines have been constructed which are able to synthesize with a high degree of intelligibility the sounds of the human speech, and in the experimental stage are devices for "reading" the printed page ,i.e. for converting the printed symbols or letters into synthetic speech. A little further away but apparently well within the bounds of possibility is the automatic or phonetic type writer, which will convert speech directly into printed words on paper. Because of these important practical advances in these fields, it is certain that further collaboration will develop between Phonetics and sound engineering, to the mutual benefit of each.

6) In Linguistic Researches Working on Comparative-Historical Linguistics:

For Catford(1988) Phonetics is absolutely essential to the student of Linguistics, for it is virtually impossible to do serious work in Linguistics without a thorough knowledge of Phonetics. Field-work, the most important source of linguistic data, is impossible without Phonetics, and phonological rules become meaningless and unmotivated rules of letter substitution. Even in the study of Syntax and Morphology, questions of Phonetics frequently arise. Catford (ibid) adds that Phonetics has an important application to what Sweet calls "Scientific Philology" (What we now call Comparative Historical Linguistics) "without a knowledge of the laws of sound-change, Scientific Philology ... is impossible, and without Phonetics their study degenerates into a mere mechanical enumeration of letter-changes".

Brosnahan and Malmberg (1970) expound that Phonetics and Phonetic analysis are very important in the study of language. An understanding of them, they argue, is a prerequisite to any adequate understanding of the structure or working of language. No kind of linguistic study can ,then ,be made without constant consideration of the material on the expression level. Furthermore ,Brosnahan and Malmberg argue that this is equally true of what has come to be called the traditional or 19th century linguistics, with its historical diachronic orientation and its concentration on language change and development- in which sound-change and the so-called sound-laws, the study of which might be termed Evolutive Phonetics, are central problems- and of the different modern schools or approaches which prefer to lay stress on language as a synchronic phenomenon and as a tool of communication. It is evident thereby to consider Phonetics the basic branch of the science of Linguistics :neither linguistic theory nor linguistic

practice can do without Phonetics, and no language description is complete without Phonetics.

7)In Criminology Phonetics (particularly Forensic Phonetics): Phonetics has proved to be essential in criminology of which Forensic Phonetics is of extreme importance. Helen Fraser (1999) defines Forensic Phonetics as "the use of knowledge of speech science (sound's acoustic properties, their production, their perception and recognition by humans and computers, their acquisition and their relationships to one another in different languages), for legal purposes, and the extension of Phonetic research to investigations relevant to legal situations". Fraser, further proposes some common applications of Forensic Phonetics:

1-Speaker Identification, in which phonetic expertise is used to give evidence as to the likelihood that a particular recorded voice was produced by a particular person. Another less common use of Phonetics in speaker identification is to give evidence as to the extent to which a witness's identification of a person from their voice alone should be considered reliable.

2)Transcription ,in which phonetic expertise is used either to create a transcript of a recording that is difficult to understand, or to give evidence as to the reliability of such a transcript.

3-Authentication of recordings, in which phonetic expertise is used to give evidence as to whether a recording has been tampered with or falsified in some way.

4-language or accent identification ,in which phonetic expertise is used to give evidence as to the likely place of origin of a particular speaker.

Phonetics is a concrete linguistic sign, natural and highly universal whereas Phonology is an abstract linguistic sign, it is a highly theoretical language science and language specific.

Katamba (1989) defines Phonology as "the branch of Linguistics which investigates the ways in which sounds are used systematically in different languages". Lass (1984) argues that Phonology ,broadly speaking, is "that subdiscipline within Linguistics concerned with the sounds of language"; more narrowly Phonology proper is "concerned with the function ,behaviour and organization of sounds as linguistic items".

Phonology studies the way in which speech sounds form systems and patterns in human language. The Phonology of a language is the system and pattern of speech sounds(how sounds cluster together),i.e. the way those sounds are arranged in so far as the phonological rule of that language permits. In contemporary usage, the term "Phonology" covers not only the field of Phonemics,i.e Synchronic Phonology, but also the study of sound changes in the history of a given language ,i .e .Diachronic Prescriptive Phonology.

Phonology ,as such, is essentially preoccupied with sound as a system of carrying meaning. It's fundamental concern is with identifying phonemes. Simply, it is the study of how sounds are organized and used in natural languages. Different models of Phonology contribute to our knowledge of phonological representations and processes :

1)In Classical Phonemics, Phonemes and their possible combinations are central.

2)In Standard Generative Phonology,distinctive features are central. A stream of speech is portrayed as linear sequence of discrete sound-segments. Each segment is composed of simultaneously occurring features.

3)In non-linear models of Phonology, a stream of speech is represented as multidimensional, not simply as a linear sequence of sound segment. These non-linear models grew out of Generative Phonology :a)Autosegmental Phonology, b) Lexical Phonology.

Phonology, it is important to mention, is one of several aspects of language. It is related to other aspects such as Phonetics ,Morphology ,Syntax and Pragmatics. The phonological system of a language in turn, includes:1)an inventory of sounds and their features, and 2)rules which specify how sounds interact with each other. Here are some of the applications of Phonology:

1)In analyzing the patterning of sounds in language and includes the functional, phonemic behaviour of these sounds for distinctive purposes.

2) In showing the nature and use of prosodic features such as intonation, stress and length (phonological terms); pitch, loudness and duration (phonetic terms). Length is an impressionistic phonological feature deducted by ear whereas duration is a concrete phonetic feature deducted by instruments.

3) In distinguishing combinatory possibilities of phonemes , i.e. syllabic structures (in that particular language) . Gimson (1980) argues that English does

not exploit all the possible combinations of its phonemes whether in the word or in the syllable. For instance, long vowels and diphthongs do not precede /ŋ/ ; /e, æ, ʌ,ɒ/ do not occur finally; the number of consonant cluster permitted are subject to constraints. Initially,/ŋ/ does not occur; no combinations are possible with / ʧ, ʤ, ð , z/; /r ,j ,w/ can occur in clusters only as the non- initial element; such initial sequences as /fs, mh, stl/ are unknown, etc. Finally , only /l/ may occur before non-syllabic /m,n/; /h, r, j, w/ do not occur in the type of phonemic analysis used here; terminal sequences such as /kf, sp,Iə/are unknown.

Conclusions:

In summary, phonetics deals with speech sounds by identifying constituent parts of a continuous stream of sound, as elements in a universal repertoire from which all languages use a selected subset and outside of which there are only non-linguistic sounds are(e .g audible yawning or sneezing); either the physical properties of the sounds are focused on (acoustic phonetics), or their manner of production in the vocal tract (articulatory phonetics) or their reception(auditory phonetics); whereas phonology studies the way in which speech sounds form systems which enable speakers of a given language to agree on when two strings of sounds (the production which can be infinitely varied) are basically the "same"; when looked at in this way, mere sounds become "phonemes", the basic building blocks for meaningful language units such as morphemes and words.

Phonetics is the means to describe the speech sounds and how they differ; whereas phonology tells us of how they function as phonemes and are able to contrast meanings of words. The study of the physiological, physical and perceptual characteristics of speech sounds is the central concern of phonology. However, neither of these two linguistic disciplines is independent of the other; and knowledge of what features of sounds are most utilized in language, determines what aspects of sound production are most worth studying in depth.

Phonetics, thus, depends to some extent upon phonology to indicate areas of linguistic relevance and importance. Phonology, on the other hand, is heavily dependent on phonetics since it is phonetics that provides the insights that enable one to discover what sound features are linguistically utilized. And it is phonetics again that supplies the terminology for the description and classification of the linguistically relevant features of sounds.

All in all, Phonetics is the basis for phonological analysis; whereas phonology is the basis for further work in morphology, syntax, discourse and orthography design. Besides, phonetics analyzes the production of all human speech sounds regardless of language; whereas phonology analyzes the sound patterns of a particular language by determining which phonetic sounds are significant and explaining howthese soundsare interpreted by the native speaker.

The Phases of Speech Production:

Speech is one of the basic abilities that set us apart from animals and are closely connected with our ability to think abstractly; it is man's most convenient form of communication. The production of speech sounds in the human vocal tract begins in the nervous activity in the cortex of the brain. Rom such activity, trains (series) of electro-chemical impulses stream (move) along nerves through various routes in the lower brain to the muscles controlling and manipulating the vocal apparatus. The following diagram can be outlined as :

Linguistic level---Physiological level----acoustic level---Physiological level—linguistic level

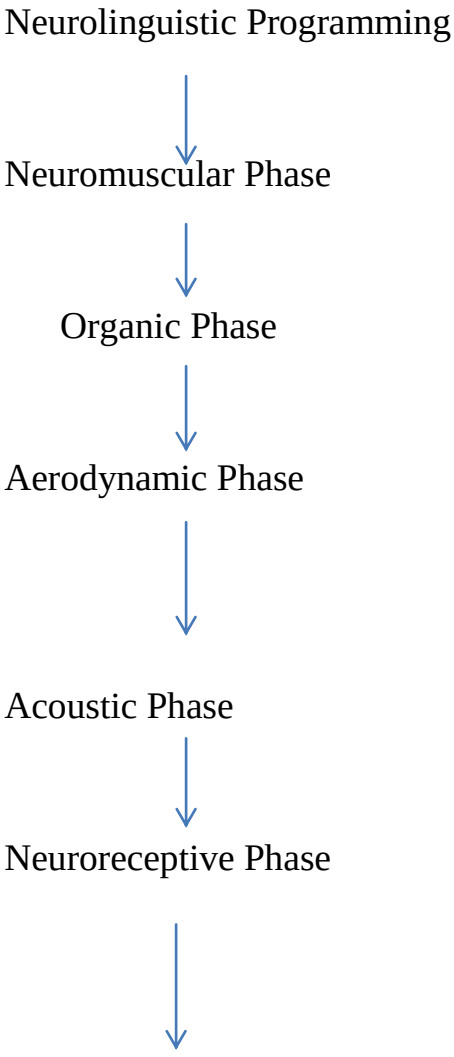
The Speech Chain

The first thing the speaker has to do is arrange his thoughts, decide what he wants to say and put what he wants to say into linguistic form; by selecting the right words and phrases and placing them in the correct order required by the grammatical rules of the language. This process is associated with activity, in the speaker's brain, and it is in the brain that appropriate instructions, in the form of impulses along the motor nerves, are sent to the muscles of the vocal organs, the tongue, the lips and the vocal cords. The nerve impulses set the vocal muscles into movement which ,in turn, produces minute pressure changes in the surrounding air known as "sound waves". These pressure changes, in turn, activate the listener's hearing mechanism and produce nerve impulses that travel along the acoustic nerve to the listener's brain where a considerable amount of place, being modified by the nerve impulses arriving from the ear. This modification of brain activity brings about recognition of the speaker's message. This chain of events is called the speech chain(Denes&Pinson, 1963).

Both the speaker and the listener have in some way the same linguistic and physiological level but the acoustic level is outside the domain (control) of the two parts ,i.e. the sender and the receiver.

As phoneticians, our concern is in the speaker's behaviour, and more especially in the concrete speech level, the formation of sounds, the transmission of sounds and the perception of sounds .Therefore, we must examine the speaker's articulatory stage, to discover how the various organs behave in order to produce sounds.

According to Catford(1977), speech phases are illustrated in the following diagram:



1-Neurolinguistic Programming: the selection-sequencing and timing of what follows. This is the purely phonetic part of the speech process beginning with the execution of a short-term programme in the central nervous system, which is triggered by the lexico-grammatical structure of the utterance and determines the nature and sequencing of everything that follows. Catford (1977) argues that "the neurolinguistic programming and the entire neuromuscular phaseare "merely the mechanics" underlying the genuine activity of speech".

2-Neuromuscular Phase: transmission of outbound (motor) neural impulses and the contraction of individual muscles. Here specific (motor commands) flow out through motor nerves to muscles in the chest, throat, mouth ,etc. As a result, these muscles contract –in whole or in part, successively or simultaneously, more or less strongly.

In his Fundamental Problems in Phonetics (1977), Catford explains that this phase might provide the simplest and most direct specification of the phonological units of languages or of speech sounds in general. And that the strength of any muscular contraction depends in fact, on 1) the number of motor units involved, and 2) the rate at which they are firing. Yet, specification in terms of motor units would not yield linguistically useful or relevant classifications. This is not to say that the electromyographic study of the neuromuscular phase of speech is unimportant or uninteresting. On the contrary ,it is one aim of phonetic studies to push our understanding of the processes of speech as far back as possible.

3-Organic Phase: postures and movements of the whole organs. This happens as a result of the muscular contractions occurring in the neurolinguistic phase ;the organs to which these muscles are attached adopt particular movements- the rib-cage may contract, the vocal folds in the larynx may be brought close together, the tongue adopts a particular configuration, and so on. It is immediately accessible to the subjective observation of posture and movement of localizable places of organic contact and so on, through kinesthetic feedback.

Catford(1977) mentions that the Indian grammarians, the classical grammarians of Greece and Rome, medieval Arab scholars, and English phoneticians from Elizabethan times onwards paid primary attention to the organic phase since it is the source of taxonomic and descriptive categories.

4- Aerodynamic Phase:dilation, compression, and flow of air in and through the vocal tract. The movements of organs during the organic phase act upon the air contained within the vocal tract. They compress the air, or dilate it, and they set it moving in various ways- in rapid puffs, in sudden bursts, in a smooth flow, in a rough, eddying, turbulent stream, and so on.

In Fundamental Problems in Phonetics (1977) Catford claims that this phase is an extremely important one for it is the link between the speaker's bodily activity (in the organic phase) and the resultant sound waves (in the acoustic

phase). Organic postures and movements do not themselves generate sounds, they merely create the necessary aerodynamic conditions.

5-Acoustic Phase: propagation of sound-waves from speaker's vocal tract during the aerodynamic phase the things that happen to it set the air molecules oscillating in ways that can be perceived by our sense of hearing. In other words, the aerodynamic events generate sound-waves, in the acoustic phase, an airborne sound-wave radiates from the speaker's mouth and reaches the ear of anyone within hearing distance, including the speaker himself.

Arguments have been put forward, notably Jacobson, Fant and Halle (1952) for the absolute primacy of the acoustic phase of speech over all others as a basis for all description of speech over all others as a basis for all description of speech. But Catford (1977) argues that, on the contrary, it is the least relevant to speech and language for language is human, social phenomenon by which a human being manifests utterances generated by his internalized grammatical rules. Nevertheless, Catford adds, the study of acoustic phase is of considerable interest and value since it casts light on the preceding organic and aerodynamic phases and on the following perceptual phases, which are not otherwise easily accessible. Moreover, the study of acoustic phonetics has important engineering applications in relation to the development of equipment for the transmission, recognition and synthesis of speech.

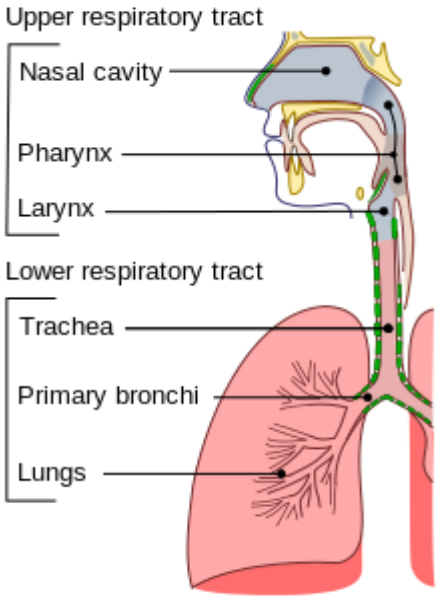
6-Neuroreceptive Phase: peripheral auditory stimulation and transmission of inbound neural impulses. The sound-wave, impinging on the hearer's ear-drum, sets it vibrating in step with the wave-form, and these vibrations are transmitted by the little bones of the middle ear to the inner ear, or cochlea, where they stimulate sensory endings of the auditory nerve. Neural impulses from the nerve-endings travel up the auditory nerve to the brain, where they give rise sensations of sound. We call this whole process of peripheral stimulation and afferent transmission (the Neuroreceptive phase).

7-Neurolinguistic Identification: potential or actual identification of incoming signals as specific speech-sounds. Here, an interpretative process occurs in which the incoming Neuroreceptive signals are identified as this or that particular vocal sound or sound-sequence. This is the phase of neurolinguistic identification which we can regard as more or less the obverse of the neurolinguistic programming phase with which the phonetic event begin. Though there may always be some awareness of sound in this phase, the

identification as particular speech-sounds is usually below the threshold of consciousness. In the actual exchange of conversation, attention is directed more to the meaning of what is said than to the sounds by which that meaning is manifested.

The Respiratory System:

The respiratory system furnishes (provides) the air-flow needed for the majority of sounds used in speech.



The Lungs:

The lungs are spongy bodies composed basically of many small air sacks (very small balloon shaped figures), the alveoli, where the blood is cleaned of its carbon-dioxide and provided with fresh oxygen from the outer air. The alveoli receive their air from small tubes, the bronchi, the right and the left. The bronchi in turn join the trachea through which the air passes from throat to the lungs. The lungs are enclosed in a large sack or pleura, are enclosed in the thoracic cavity, bounded above and laterally by the rib-cage and below the diaphragm.

The act of respiration involves two phases, inspiration and expiration. When the thoracic volume is increased-by means of a downward movement of the diaphragm and an outward and upward movements of the rip- the air pressure inside diminishes and air from outside (atmospheric air) flow into the larynx (inspiration). On the other hand, when the muscles initiating such movements

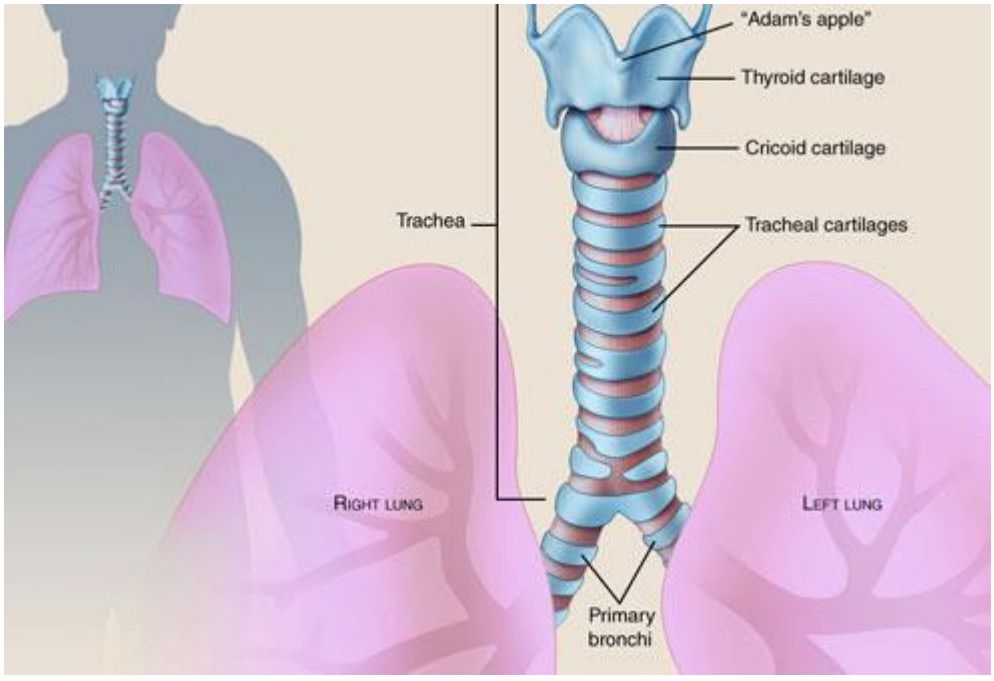
of the diaphragm and the rib-cage and are relaxed, the diaphragm returns upward and the rib-cage downward and inward, decreasing the volume of the lungs and forcing air out of the lungs(expiration).

It is important to make a distinction between normal breathing, when no sound is being produced, and speech breathing. In the type of breathing, the expulsion of the air in expiration is essentially due to the pressure exerted on the lungs by the weight and elasticity of the organs displaced during the inhalation. This type of expiration is thus relatively passive although forced inspiration is possible.

In speech breathing, the inspiration phase is accelerated, the expiration phase, on the contrary, is prolonged, for the reason that the articulation of most speech sounds involves an obstruction afford to the air-stream from the lungs at some points in the vocal tract.

The movements of respiration delimits the limits of speech called breath group (or breath phase) being the stretch of an utterance produced between two intakes of air .In technically good speech, these breath groups correspond regularly to naturally delimited units of content. When this is not the case, the speaker is said to have a poor respiration technique (Brosnahan and Malmberg, 1970:30-31).

The Trachea:

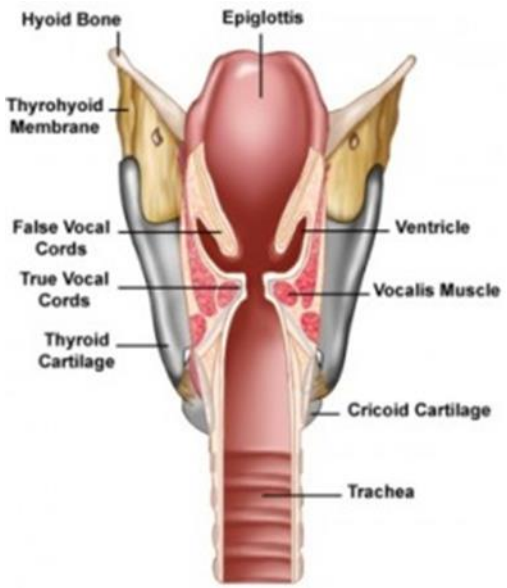


It consists of a series of roughly horse-shoe shaped cartilaginous sections held (bind firmly) together by membranous tissue. It is approximately 11 cm long and 205 cm in diameter. The upper part of the trachea, viz, cricoide cartilage, forms the base of the larynx.

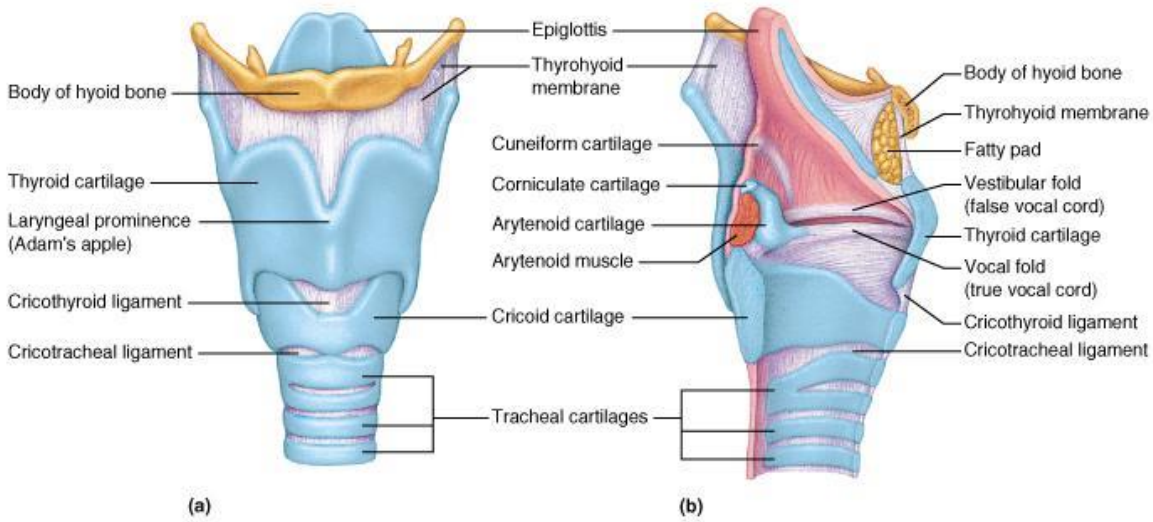
The trachea begins at the level of the cricoide cartilage in front of the sixth cervical vertebra .From that point it extends downwards and backwards, in front of the vertebral column, into the thorax.

The trachea or windpipe is a wide tube kept constantly patent by the cartilaginous curved bars embedded in its walls. The bars are deficient posteriorly, and the posterior surface of the trachea is therefore flat. The trachea is continuous above with the larynx; and, in the neck,it is in the median plane. Posteriorly, it rests on the gullet (esophagus- a tube , with thick muscular walls and narrow lumen, which extends from the pharynx to the stomach).

The Larynx:



The larynx (or the organ of the voice) is the upper expanded portion of the windpipe which is specially modified for the production of the voice .It's walls are composed of cartilages, ligaments, membranes and muscles, and it has an internal lining of mucous membrane.



The larynx is placed in the upper part of the front of the neck, where it forms a marked projection. It lies below the hyoid bone, and tongue, and is directly continuous with the trachea inferiorly .Interiorly it is covered by the skin and fasciae, and, on each side of the median plane, by two thin strata of muscles. On each side a lobe of the thyroid gland is prolonged upwards on it, deep to the muscles; and it is related to the great vessels of the neck. Posteriorly it is in relation to the pharynx, which separates it from the prevertebral muscles.

The functions of the larynx are: 1) respiration, 2)phonation and 3) fixation of the chest in severe muscular effort (Coleman, 1992). And Clark and Yallop (1999) expound that the basic function of the larynx is as a valve in the respiratory system. Thus in the process of swallowing, the larynx is automatically shut to ensure that food or drink pass through the pharyngeal cavity into the esophagus and not into the windpipe. The valve action of the larynx is also important in short-term physical exertion as a means of stiffening the thorax when we inhale deeply and hold our breath. In speech, the larynx is important as a source of sound and as an articulator.

The larynx has a skeletal frame formed by a series of cartilages:

1-The Cricoid Cartilage:

This forms the base of the larynx, and according to Snell's treatment (1958) it is also the last cartilaginous section of the trachea. It is a complete ring that extends upwards at the back to form a plate(lamina), while in front, it is a continuation of the rings forming the trachea. It is a complete ring whereas those below it are completed by flexible connective tissue.

The cricoide cartilage is shaped like a signet-ring; it is of the hyaline variety and tends to ossify. It is smaller, but thicker and stronger than the thyroid, and forms the lower and posterior parts of the wall of the larynx. The broad, posterior part, called the lamina, is quadrangular in outline and measures from above downward about 2 or 3 cm; on its posterior surface, in the middle line, is a vertical ridge to the lower part of which are attached the longitudinal fibers for the cricoarytyenoide posterior. The anterior part of the cricoid cartilage is the arch which is narrow and convex, and measures vertically from 5 to 7 mm; it affords attachment externally in front and at the sides to the circothyroide, and behind, to part of the constrictor pharynges inferior.

2-The Thyroid Cartilage:

Snell(1958) observes that this cartilage consists of two flat plates forming an angle of 90^0 in men and 120^0 in women. Because the angle is more acute in men than in women; therefore it is easily noticeable from the outside in men and it is usually known as Adam's Apple. It's major function is to act as a shield for the vocal folds.

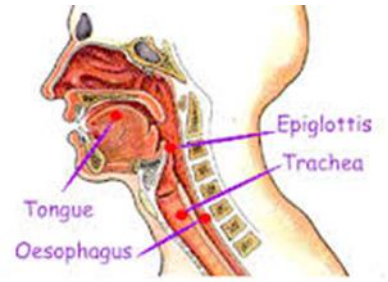
The thyroid cartilage is of the hyaline variety and may show early ossification. It is the largest of the larynx in men and is manifested best by the thyroid cartilage. It is in the form of a pair of broad, quadrilateral lamina which are fused together in front but are widely separated behind.

The anterior borders of the lamina are fused only in their lower parts. Above they are separated by a deep, narrow v-shaped thyroid notch. In men, the angle formed by the meeting of the anterior borders of the two lamina, especially in the upper part, is very projecting; and with the margins of the notch, it makes the marked, subcutaneous laryngeal prominence, colloquially known as Adam's Apple.

3-Arytenoid Cartilages:

These cartilages, mainly hyaline, are situated at the upper border of the larynx. They are a pair of three-sided pyramids that rest on the upper border of the lamina of the cricoide cartilage. The apex of each is directed upwards, and it curves backwards and medially; and it supports the corniculate cartilage. The base articulates with the upper border of the cricoid lamina. Their rotational movements affect the shape, size and tension of the vocal folds. They are related to the cricoid cartilage by means of joints (ligaments) which permit them to move laterally on it (Brosnahan and Malmberg, 1970:30).

4-The Epiglottis:

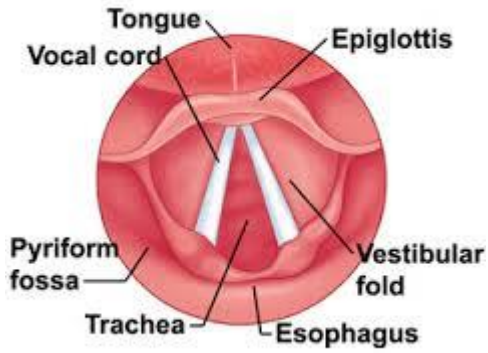


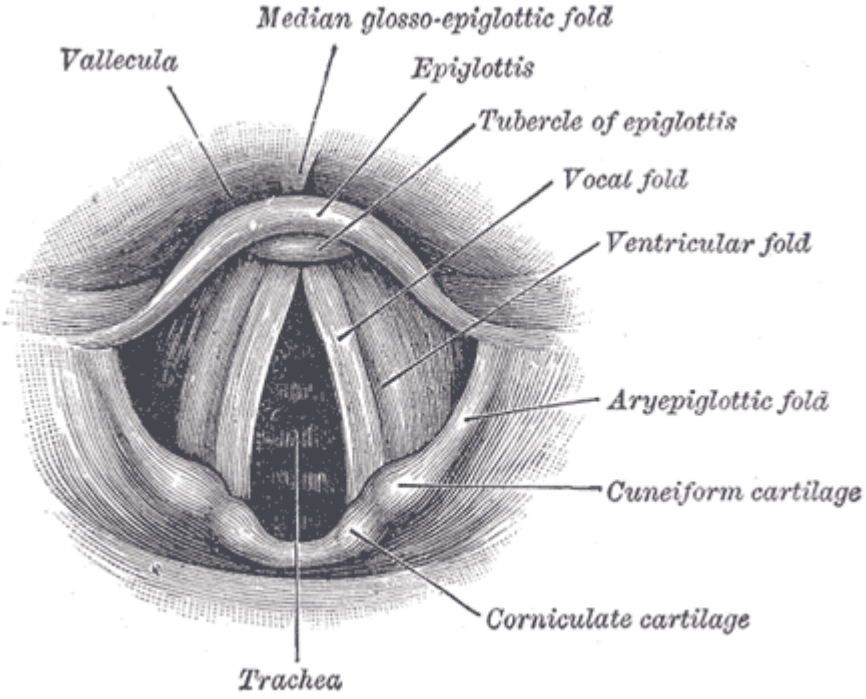
It is a spoon-shaped cartilage whose lower part is fastened to the inner protrusion of the thyroid cartilage. It is a thin, leaf-like lamina of elastic fibro-cartilage placed behind the tongue and the body of the hyoid bone, i the anterior boundary of the inlet and vestibule of the larynx It is connected to the hyoid bone by a ligament, and to the base of the tongue by the glosso-epiglottic fold. The epiglottis has no direct muscular attachments; therefore, it can be moved only by movement of the tongue and the hyoid bone. In this way, it can be pushed backward to cover the opening of the glottis. It's basic function is to protect the vocal folds and avoid foreign objects from entering in to the larynx. Quite recently, it has been found that the epiglottis plays a major role in producing epiglottic sounds (somehow identical to pharyngeal (ح و عsound, like)) in Arabic.

The vocal folds:

They are two pairs of folds composed of ligament and muscle, Each vocal fold is sharp and prominent and its mucous membrane is thin and is firmly bound down to the vocal ligament, which is enclosed within it. In colour, it is pale- almost pearly white- whilst posteriorly, where the fold ends, the point of

the vocal process of the arytenoide cartilage stands out in relief and presents a yellowish tinge. In coronal section, the vocal fold is prismatic in form, and the free border looks upwards and medially.





The vocal folds are the agents by means of which the voice is produced. The ventricular (false) folds are of little importance in this respect; indeed, they can be destroyed , in great part, without any appreciable effect upon the voice.

The vocal folds can be brought together in various degrees or be kept wide apart under the effect of the movement of the arytenoid cartilages. The long-slit like laryngeal valve aperture between the two folds is known as the glottis. The edges of the glottis (the inside edges), viz, the length of the vocal folds

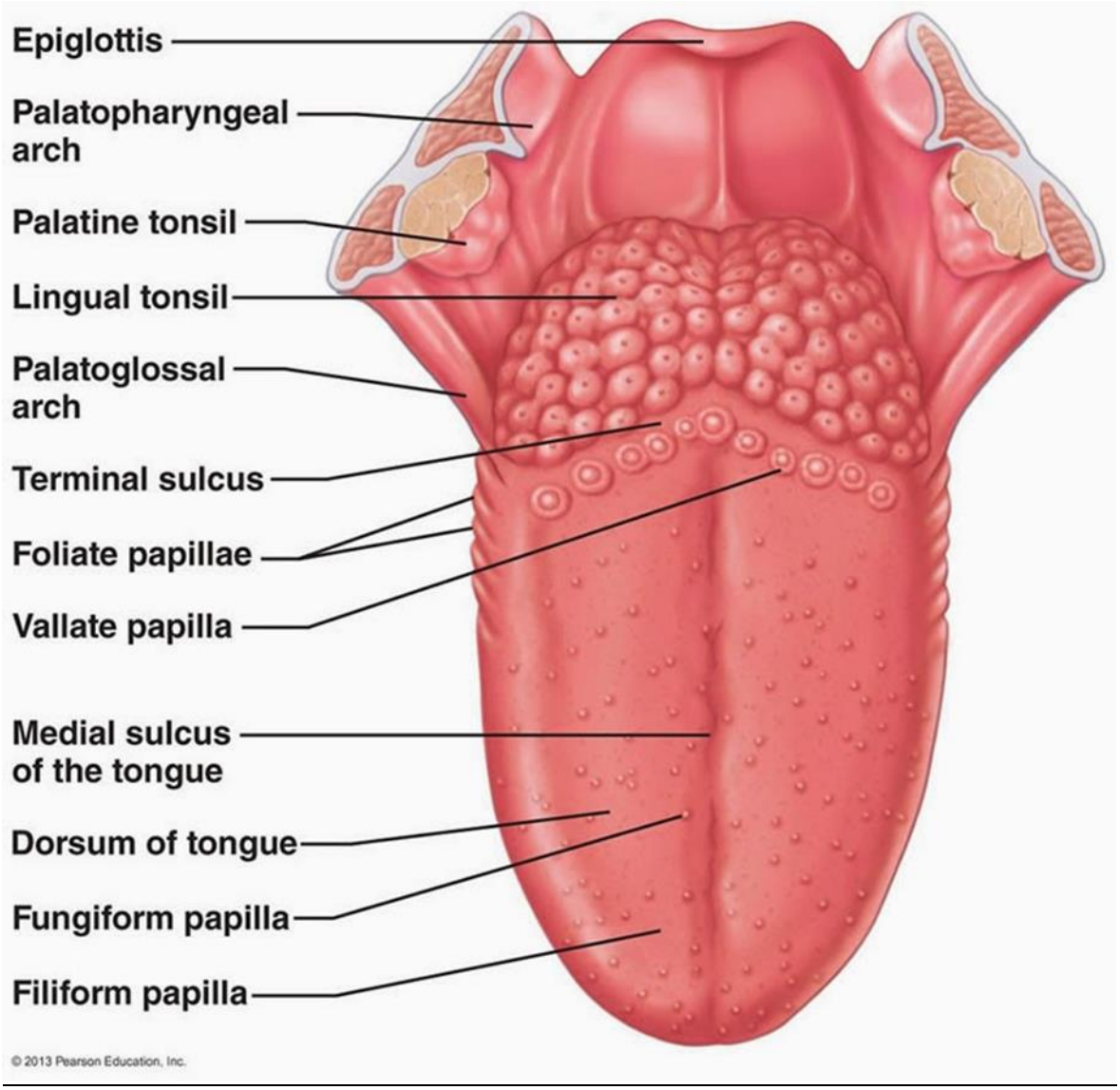
are typically about 17-22 mm long in men and about 11-16 mm in women .The vocal folds are longer and thicker in men whereas in women they are shorter and thinner. This difference in length of the vocal folds have their biological effect (impact) on voice quality after ten years of age (the age of puberty).(Brosnahan and Malmberg, 1970:34-35).

Notes:

1-Sounds are measured by Hz CPS (cycle per second).
2-Every sound depends on its context (phonetic circumstances and environments).

The Speech Organs:

The Tongue:



It is a mobile, most flexible and elastic organ of speech which lies in the floor of the mouth. It lies within the oral cavity and consists largely of a mass of muscles covered with mucous membrane and interspaced with a small amount of fat and small glands. It is closely associated with the functions of taste, chewing, swallowing and speaking. The flexibility of the tongue is fundamental to speech production. For practical purposes of phonetic description, the upper surface of the tongue is usually divided into functional areas:1)the tip or apex, 2)the blade, 3)the dorsum, 4)the root or radix.Or it may be divided as :1)

front (blade +first part of the dorsum), 2)middle,3)back. Through the root pass the muscles which connect the tongue with the hyoid bone and the mandible. The tip and blade lie against the teeth and the gums. The lower surface of the tongue is related to the floor of the mouth. The dorsum is divided into two parts-palatine and pharyngeal. The palatine part of the dorsum looks upward and is the part visible in the living mouth. The pharyngeal part is the back of the tongue, it forms the anterior wall of the lower part of the oral pharynx, and is related to the epiglottis.

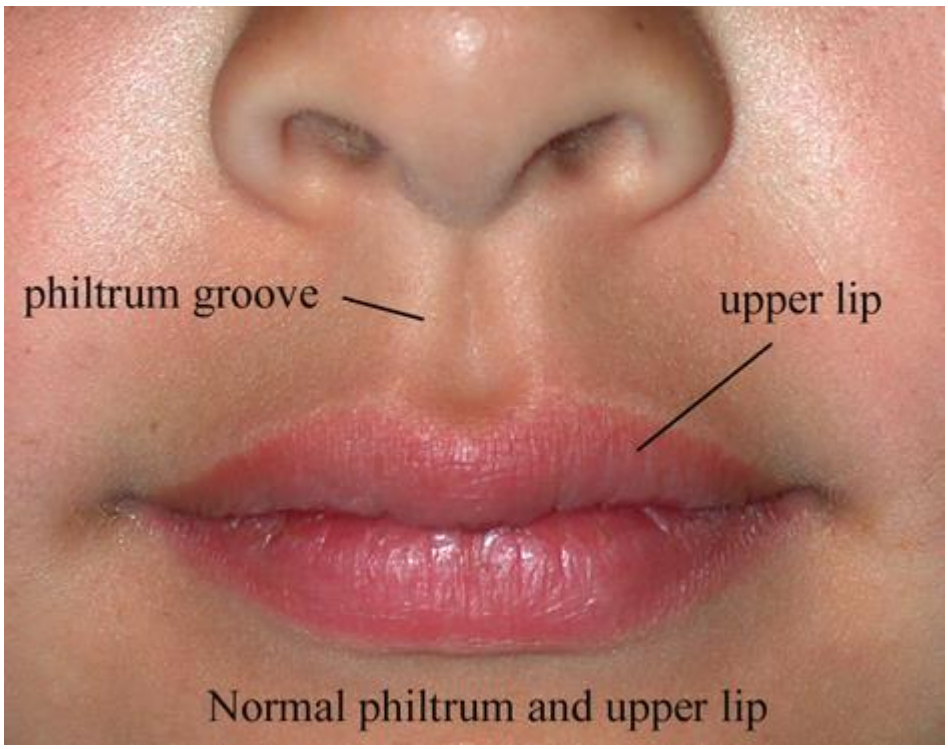
Snell (1958) adds that the tongue is a mass of striated muscle with mucous membrane. Its anterior two-thirds lies in the mouth, and its posterior third lies in the pharynx. The muscles attach the tongue to the styloid process and the soft palate above and to the mandible and the hyoid bone below. The tongue is divided into right and left halves by a median fibrous septum.

The Palate:

It is a dome-shapedstructure whose front part is bony and fixed and whose back part, I.e. the soft-palate, viz, velum, is movable. It is useful to divide the palate into three main parts:1)the alveolar ridge (the anterior convex ridge of the gums behind the upper incisors), 2)the hard palate (thehighest bony concave part of the roof of the mouth), and 3) the soft-palate (velum:the posterior , fleshy membranous part of the roof of the mouth). The uvula,i.e. the most fleshy pendulous, tip of the soft palate. It is located at the farthest end at the back part of the roof of the mouth.

Snell (1958) explains that the hard is formed by the palatine processes of maxillae and the horizontal plates of the palatine bones. It is bounded by the alveolar arches, and behind it is continuous with the soft palate. It forms the floor of the nasal cavities.
The soft palate, on the other hand, is a mobile fold attached to the posterior border of the hard palate. Its free posterior border presents in the midline a conical projection called the uvula. The soft palate is continuous at the sides with the lateral wall of the pharynx. It is composed of mucous membrane, palatine aponeurosis and muscles.

The Lips:



Normal philtrum and upper lip

Theyare also capable of the same mobility as that of the tongue. They can be firmly incontact with each other, or they can be kept right out of the way so as not to obstruct the passage of air at all, and they can take up any intermediate position. The lips can take differing positions (postures); the most common of which are: close-rounding, open-rounding, spreading and neutral. It is noteworthy that there are four layers in each lip:1)cutaneous, 2)muscular, 3)submucous and 4)mucous. The skin and mucous membrane become continuous . The skin and mucous membrane become continuous with each other at the free margin of the lip. Malmberg(1969) states that an articulation

consisting of a rounding of the lips is called labial (bilabial, if both lips are involved). If the lips remain neutral (or are stretched), the sound is unrounded. If the corners of the lips are drawn back, we sometimes talk about a spread lip position (as often for [i] or [e]. If the lips are brought together or rounded, the sound is said to be rounded or labialized. In the former case, the rounding is said to be vertical, in the latter horizontal.
Note :Muscles of the lips are(2, 3 and 4 separate the lips)
1-sphincter muscles (orbicularis oris).
2-lavator laviisuperioris
3-lavator zygomaticus minor
4-zygomaticus major
5-lavator anguli
6-risorius
7-depressor angulioris
8-depressor level inferiorus
9-mentalis

Question :What is the difference between intrinsic and extrinsic muscles?
The superior laryngeal nerve takes origin from the inferior ganglion of the gauges nerve and runs downwards behind the great vessels of the inferior constrictor muscle. At this point it divides into internal and external branches. Coleman(1992) states that the external branch is destined solely to supply the cricothyroid muscle. The internal branch, on the other hand, is entirely sensory and supplies the mucosa above the level of the vocal folds.
Snell(1958) on his part, argues that the extrinsic muscles of the larynx can be divided into two opposing groups ,the elevators of the larynx and the depressors of the larynx; whereas the intrinsic muscles can be divided into the larynx and those that move the vocal folds.
Elevators of the larynx include :1)the digastric, 2)the styhyoid,3) the mylohoid, and 4)the geniohyoid muscles. The stylopharyngeus, the salpingopharryngeus, and the palateopharyngeus which are inserted in to the posterior border of the lamina of the thyroid cartilage, also elevate the larynx.
The depressors of the larynx include:1) the stenothyroid, 2)stenothyroid and 3) omohyoid muscles. The action of these muscles is assisted by the elastic recoil of the trachea.
The intrinsic muscles are of two types:
1)Muscles controlling the laryngeal inlet.

a)Oblique arytenoid which narrows the inlet by bringing the aryepiglottis folds together.
b)Thyroepiglottic that widens the inlet by pulling the aryepiglottic folds apart.
2)Muscles controlling the movements of the vocal folds:
a)Cricothyroid that tenses the vocal folds.
b)Thyroarytenoid (vocalis) which relaxes the vocal folds.
c)Lateralcricoarytenoid:adducts the vocal folds by rotating arytenoid cartilage
d)Posteriorcricoarytenoid: abducts the vocal folds by rotating arytenoid cartilage
e)Transversearyteonid: closes posterior part of rime glottis by approximating arytenoid cartilage.
The intermittent release of expired air between the adducted vocal folds results in their vibration and in the production of sound .The frequency, or pitch of the voice is determined by the changes in the length and tension of the vocal ligaments. The quality of the voice depends on the resonators above the larynx ,viz, the pharynx, the mouth, and the paranasal sinuses. The quality is controlled by the muscles of the soft palate, tongue, floor of the mouth, cheeks, lips and jaws. Normal speech depends on the modification of the sound into recognizable consonants and vowels by use of the tongue, teeth and the lips. Vowel sounds are usually purely oral with the soft palate raised; that is, the air is channeled through the mouth rather than the nose. The physician tests the mobility of the soft palate by asking the patient to say "ah" with the mouth open.
Speech involves the intermittent release of expired air between the adducted vocal folds. In whispering, the vocal folds are adducted, but the arytenoid cartilages are separated; the vibrations are given to a consonant stream of expired air that passes through the posterior part of the rime glottis.

The speech Mechanism:

Types of Air Mechanism:

In speech production, two types of air stream are usually recognized:

1)Aggressive air-stream(outgoing)or (pulmonic) in which the air stream is pushed out (when your lungs push air out) (or it can be initiated in other parts of human body). All English sounds are normally produced in this way.

2)Ingressive Air-stream (ingoing) in which the air stream is sucked in. (atmospheric air is swallowed in).

Ladefoged(1993) mentions three types of air-stream mechanisms:

1-Pulmonic (air coming out of the lungs).

2-Glottic, when either of the following two actions occur:

a-upward movement of the closed glottis moves air out of the mouth.

b-downward movement of the closed glottis which causes air to be sucked into the mouth.

3-Velaric(movement of the body of air in the mouth).

Brosnahan and Malmberg(1970), for their part, list the following types as air mechanisms:

1)Pulmonic Mechanism:egressive air-stream through mouth. This is, they argue, the commonest of all types of air-stream and is used more frequently than any other in all known languages. With conversion of the kinetic energy of the air stream to acoustic energy only by the vibration of the vocal cords, and with general resonance in the supraglottal tract, we have one of the commonest and most widespread of types of speech sound, the voiced vocoids.

2)Pulmonic Mechanism::Ingressive air-stream through mouth: