JOURNAL OF ANATOMY

THE FUNCTION OF THE EPIGLOTTIS

By V. E. NEGUS, M.S., F.R.C.S.
Junior Surgeon for diseases of the Nose and Throat, King's College Hospital, London

PREVIOUS VIEWS OF FUNCTION

It was at one time thought that the epiglottis acted as "the lid of the larynx"; it was supposed that during deglutition it fell back like a flap over the laryngeal aperture in order to prevent ingress of food or water. This erroneous view was dispelled by Stuart, who proved that during swallowing the epiglottis actually moved forwards, to be squeezed between the base of the tongue and the rest of the larynx. This view cannot be disputed by anyone capable of judging, and the truth of it is borne out when observing a patient whose epiglottis has been almost entirely destroyed by lupus, but whose powers of swallowing remain unaffected.

Having disposed of the prevailing theory as to the function of the organ Stuart did not supply any alternative; therefore the subject can be approached without any bias or preconceived ideas.

LACK OF NECESSITY DURING DEGLUTITION

The greater part of the epiglottis can be dispensed with in Man without detriment to deglutition, and similar conclusions as to its lack of importance in regard to this function are derived from observation of many of the lower animals, in which no traces are found. Examples are seen in frogs, salamanders, newts, snakes, lizards, crocodiles, alligators, tortoises, turtles and Birds. It is true that there is a rudiment present in certain teguexin, monitor and iguana lizards, in some pythons and copper-head snakes, in boa constrictors, and in certain storks, herons and one or two other birds.

The remainder of the animals mentioned have no epiglottis and yet they swallow easily, while among Mammals, the sea lion also is found to be almost destitute of the organ.

LACK OF NECESSITY DURING RESPIRATION

With regard to respiration there is no real necessity for the presence of an epiglottis. When a man runs fast he opens his mouth widely, and, on the authority of Prof. Leonard Hill, he gains thereby, as the cool air entering his lungs is an actual advantage to him. In Birds, lizards, and many other animals, air enters by the mouth during exertion with no detrimental effects, and for this and for other reasons it is concluded that the epiglottis was not

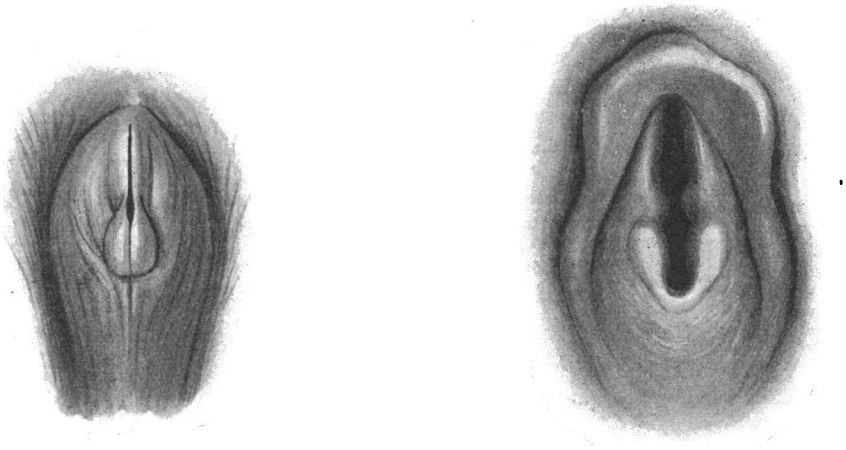

Fig. 1. View from above of larynx of alligator (*Crocodilus americanus*) (left), J 225. 4. R.C.S. Museum (natural size); spotted hyaena (*Crocuta maculata*) (right) (natural size). In the former there is no epiglottis and in the latter the organ does not prevent inundation of the posterior end of the laryngeal aperture; therefore the aperture must be closed in both animals during the swallowing of liquids.

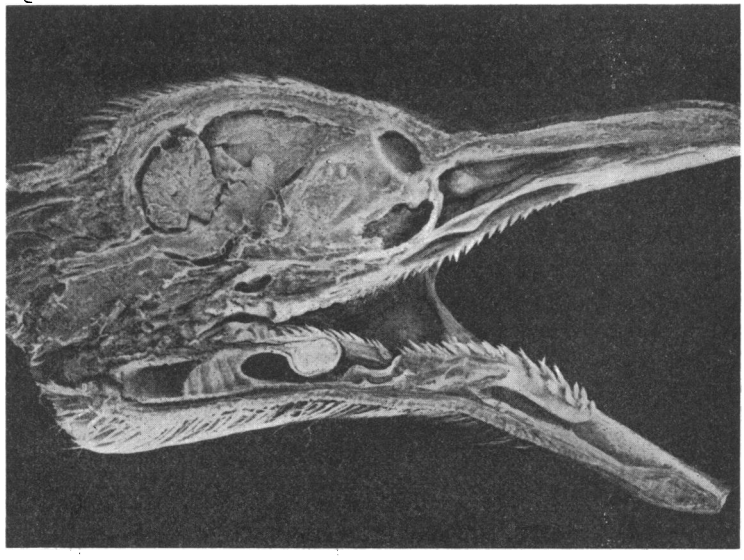

Fig. 2. Sagittal section of head of a penguin (*Spheniscus demersus*). ($\frac{2}{3}$ natural size.) The absence of an epiglottis allows all air to enter by the mouth when the latter is open.

developed for respiratory purposes, although—as will be pointed out later—it does, in certain instances, add to efficiency in this respect.

LACK OF NECESSITY DURING PHONATION

The function of phonation again does not require an epiglottis; in man the organ does not appear to assist in phonation, and in song birds there is no epiglottis at all; gibbons are poorly provided for and sea lions have nothing more than a rudiment.

Consequently some other reason must be looked for.

OLFACTORY FUNCTION OF EPIGLOTTIS

It is found that the epiglottis is best developed in such animals as deer and antelopes, and on examining all species it is borne in on the observer that it is in the macrosmatic animals that development is best, while in microsmatic species it is deficient.

The correct route by which to arrive at any conclusion is to compare the anatomical structure of each animal with its habits; the result of such a study need not be set out in detail, as it will suffice merely to mention what deductions have been made.

In brief it is concluded as the result of observation that the epiglottis is an accessory olfactory organ, and that its primary function is to aid certain species which rely on powers of scent, sometimes for their actual existence.

An antelope or deer has to spend a large amount of time in grazing, as it must consume a great deal of grass in order to derive sufficient nourishment. It eats with its tail to the wind so that the scent of any enemy may be borne down wind to it; at the same time the laterally placed eyes keep watch on either side and in front. By this means it is protected on all four sides against sudden attack, but when its eyes are engaged in keeping watch it is impossible for them to see what is being eaten. Therefore the animal has its anterior nostrils placed in close proximity to its mouth in order that the odour of all prospective food shall reach the olfactory nerve endings and be appraised before any mouthful is swallowed.

While the animal is cropping grass or other herbage its tongue assists in drawing grass, leaves, or shoots towards the teeth and the mouth itself is partly opened. Under such conditions the natural tendency would be for the greater part of the inspired air to enter by the mouth and not by the more narrow nose. But if the olfactory sense is to be keen enough to detect both enemies and poisonous food-stuff it is a necessity that a large current of air should enter by the nose to pass over the olfactory mucous membrane. It is found that the means of attaining this end and of preventing the mouth from admitting air is by the provision of an epiglottis. The organ effectively shuts off the buccal cavity and ensures that all inspired air shall enter by the nose.

Animals without this arrangement—such as Birds, snakes, tortoises, or sea lions—cannot be keen scented when the mouth is open, while others such as

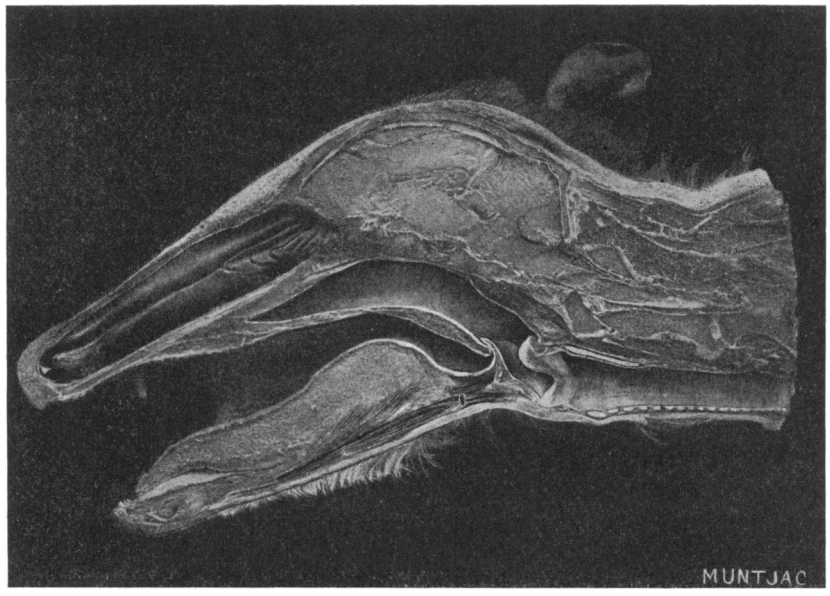

Fig. 3. Saggital section of head of a muntjac or barking deer (*Cervulus muntjac*), showing how the epiglottis shuts off the mouth from the air stream. ($\frac{2}{3}$ natural size.)

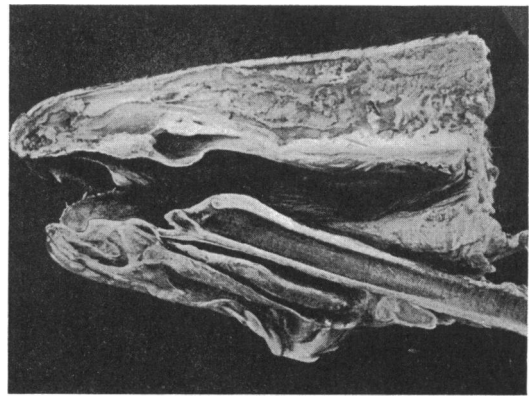

Fig. 4. Sagittal section of head of a python (*Python molurus*) in which the olfactory sense must be feeble when the mouth is open. ($\frac{2}{3}$ natural size.)

deer, antelopes, wolves, and lions are able to open the mouth widely and yet to preserve undiminished the integrity of their powers of scent.

The corollary is that most of those animals with a degenerate or without any epiglottis are microsmatic, while those with an efficient organ are for the most part keen scented.

Aquatic animals like sea lions and keen-sighted species like man, are microsmatic and do not need an efficient epiglottis; a few species deficient in powers of scent are found to retain a big one for other reasons.

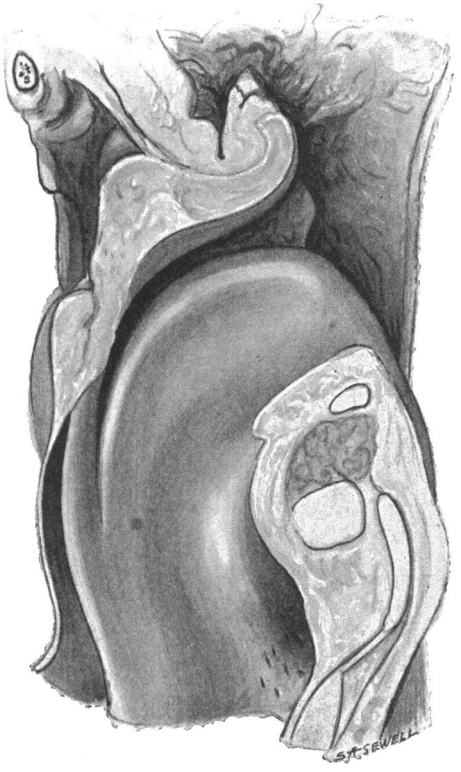

Fig. 5. Right half of larynx of a Californian sea lion (*Otaria gillespii*) in which the epiglottis is extremely degenerate. (1172 Lea. R.C.S. Museum.) (Almost natural size.)

ASSOCIATED DEVELOPMENT OF SOFT PALATE

To enable the epiglottis to shut off the mouth it is necessary that the nasal air tube should be long if the air tract is to be complete from the anterior nostrils to the trachea. This end is attained by lengthening of the soft palate in order that the epiglottis may lie above it in the intra-narial position and thus bring the laryngeal aperture into direct communication with the naso-pharynx.

Lateral palatine folds are also necessary to complete the partition at the

hinder end of the mouth; these folds are approximated to the lateral folds of the epiglottis, or to the side of the ary-epiglottic folds in certain instances.

In microsmatic man the soft palate is relatively short and does not reach the epiglottis.

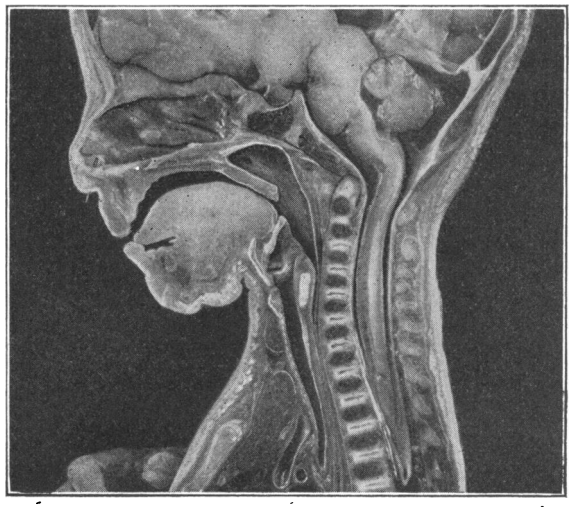

Fig 6. Right half of the head of a human foetus at the seventh month. The epiglottis is relatively small and the soft palate is short; there is no means of preventing entrance of air by the mouth when it is open except by approximation of the tongue against the palate. ($\frac{1}{2}$ natural size.)

SECONDARY FUNCTION IN RESPIRATION

In fast-running keen-scented animals the big epiglottis is tilted downwards together with the aperture of the larynx in such a way that the air tract is almost straight and devoid of eddies, whereby passage of air in and out of the lungs is facilitated.

SECONDARY FUNCTION IN DEGLUTITION

Lateral epiglottic folds are useful in preventing inundation of the anterior end of the larynx, and ary-epiglottic folds are still more efficient.

In the latter instances however the part of the epiglottis above the level of the ary-epiglottic folds is of no importance in deglutition, as may be seen in men in whom disease has left merely the ary-epiglottic folds after destroying the greater part of the epiglottis itself.

In herbage-eating species and particularly in Ruminants the larynx is high and spout-like and is surrounded by a muscular sphincter or arcus palato-pharyngeus made up of very long lateral palatine folds which meet behind the laryngeal aperture. In whales and dolphins this arrangement is extremely well marked and is highly efficient in allowing respiration to continue while the mouth and pharynx are full of water.

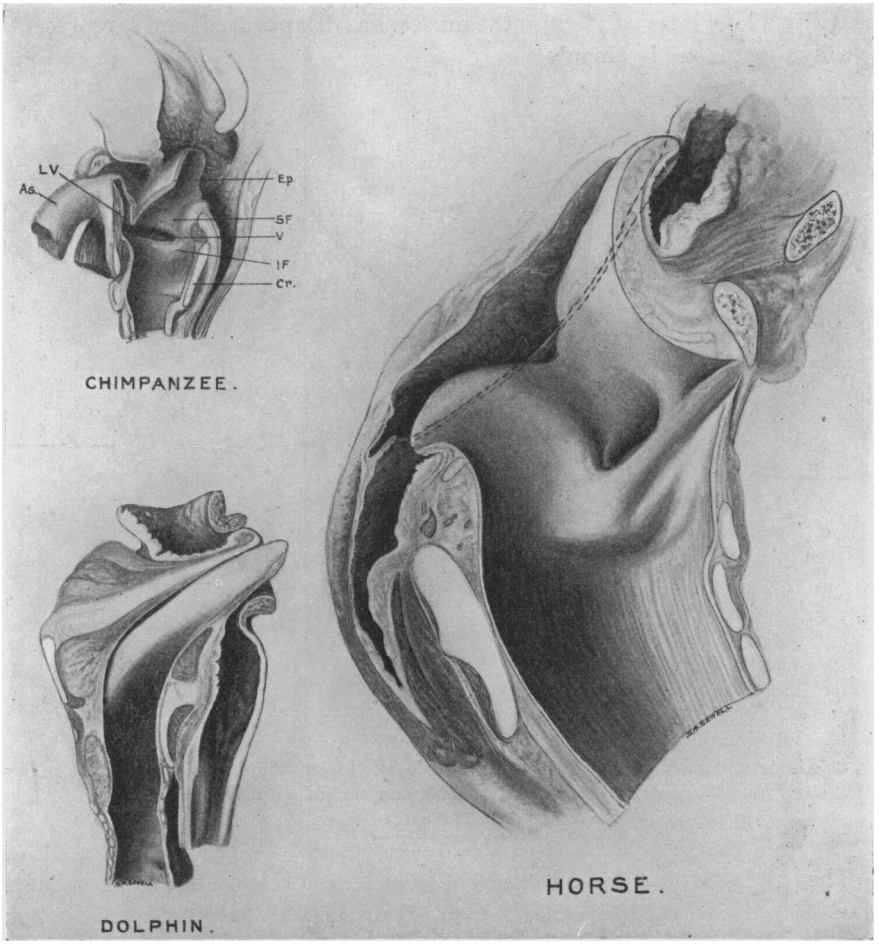

Fig. 7. Section of larynx to show the secondary function of the epiglottis in helping to form a spout through which air may enter, while food or water pass along channels on either side. In the chimpanzee (*Anthropopithecus troglodytes*) the mechanism does not exist. Horse *Equus caballus*) and dolphin (*Delphinus delphis*) show it well.

FUNCTION OF HYO-GLOSSO-EPIGLOTTIC MUSCLE

When a big epiglottis is present it must be held forward during respiration to press against the upper surface of the soft palate, thus keeping the air way freely patent. When the swallowing of a big bolus takes place the epiglottis leaves the soft palate and takes up a position at the base of the tongue.

The mechanism by which it is pulled forward in both cases is provided by the hyo-glosso-epiglottic muscle, which is big and powerful in all animals whose epiglottis is big and mobile.

In man the organ is degenerate in function and is separated from the soft palate by a long interval; in him the muscle has disappeared, and is represented by a hyo-epiglottic ligament.

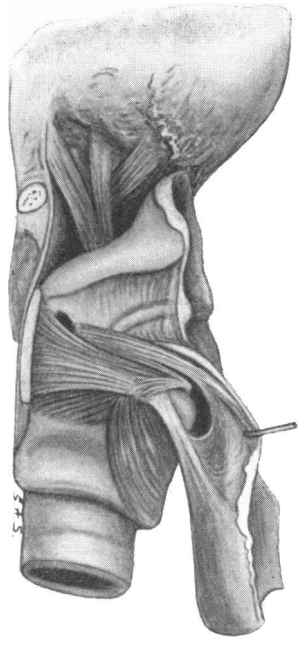

Fig. 8. Dissected larynx of a fox terrier dog (*Canis familiaris*). The hyo-glosso-epiglottic muscle is strong and the epiglottis is big and mobile. (Natural size.)

SUMMARY

The epiglottis appears to be present in order to preserve the integrity of the olfactory sense when the mouth is open. It carries out this function by coaptation to a long soft palate, thereby preventing entrance of air by the mouth.

An epiglottis is not necessary for purposes of deglutition, respiration, or phonation; in certain animals, however, it serves a secondary function during the swallowing of liquids and semi-solids, and it can also be of assistance in respiration.

Note. Four of the illustrations have been published previously in the *Journal of Laryngology and Otology*, and the *Lancet*; acknowledgment is made with thanks to these journals for their reproduction here.

The drawings are by Mr S. A. Sewell and the photographs are by Mr Henry George.

Most of the specimens illustrated are in the possession of the author and were obtained through the courtesy of the Zoological Society of London; the remainder are in the Museum of the Royal College of Surgeons of England, and are reproduced by permission.