

The Mucous Membrane of the Nose*

Charles D. Sneller, M. D.
Peoria, Illinois

THE NOSE is a remarkable organ. It has many functions very essential to the well-being of the individual. By nose we refer not merely to that proboscis projecting from the middle of the face but more particularly to its interior. This interior is made up of a right and left chamber, each about $4\frac{1}{2}$ inches long from the front to the back, about $2\frac{1}{2}$ inches high, and about $\frac{1}{2}$ to $\frac{3}{4}$ inch wide. It is the structure, the physiology, and the extent of this wall, or mucous membrane, with which this paper is concerned.

A very long time ago, between 500 and 1000 million years Paleontologists tell us, the most primitive form of animal life was a bit of animated "jelly" or protoplasm. This unicellular organism moved about in the primeval muck of the warm ocean. It must have had irritability, the power to react to its surrounding watery world, and to defend itself against destructive forces, i.e. chemical, physical, and living enemies. It must also have possessed the power of digestion and assimilation, so very essential to life itself. It must also have been able to remove oxygen from its watery environment. Lastly it surely possessed the power of reproduction so that life itself could move forward.

It was not long until external modifications of the protoplasm occurred. Finger-like processes grew out of the single cell. These cilia could move about and therefore came into greater contact with the world about. Locomotion was established. New territories were found. New experiences required adaptation and modification. And so were born cilia like those of our own mucous membrane which must have warmth, moisture, exact chemical surroundings and protection in order to function properly in this modern animal called man.

Next we come to a second consideration which takes us back to Devonian time about 350 million years ago. At this time the recently perfected backboned fish had appeared in the seas. They had made many experiments in form, size, and adaptation. The day arrived when they began to explore the shallow land streams. The hot and dry summer months came and these adventurers found themselves trapped in the dried-up pools or mud holes. Many died, but some had the power to accommodate themselves to their new environment. No longer could they take water through their gills and thereby get the oxygen needed for their very existence. Now those who were able quickly to develop

* Abstract address of the Retiring President. Presented before the General Session at the Twenty-ninth Annual Meeting of the Illinois Academy of Science, May 1, 1936.

a pouch in the front part of the foregut were able to make use of the first lung. This first lung must have been very crude. Today we find lung-fish in certain streams of Australia and South America. Their gills are used during the wet season, and their very primitive lungs come into their own as quickly as the stream dries up in hot summer months.

A third consideration deals with a concept of man as a whole. Man may be defined as a tubular mass of cells arranged into tissues and organs with a tube passing from one end, the mouth and nose, to the other, the anus. Just like simpler organisms, this tubular mass of cells is covered by a protecting coat called the skin or epidemics. The long tube is lined inside by a specially constructed coat called the mucous membrane. These coats, the external and internal, are the great protectors of the organism which lies between them. If the coats are intact, no enemy can enter the host. Life might go on forever in an organism were it not for the invading enemies which eventually destroy all.

The most remarkable part of this inner coat or protecting membrane is the nasal part. In this membrane "fortifications" have been built through long phylogenetic improvements for the defence of the grand array of cells and organs called the human being.

We have touched briefly upon the early history of the cilia, the formation of the primitive respiratory system and the relationship of these structures to the tubular mass called Man. Now let us consider briefly the more essential functions of the grand entrance to Man's interior, the NOSE.

The nose is divided into right and left chambers which run from the front part of the nose, seen on the face, back to the entrance into the throat—the naso-pharynx. Projecting into these chambers from the outer walls are three masses of extremely vascular tissue surrounding elongated pieces of bone. These masses are called turbinates and are under sympathetic nerve control.

The chambers of the nose are lined throughout by a mucous membrane. This is modified here and there by the presence of the turbinates and the openings to cavities called sinuses. The membrane is composed of an inner layer of ciliated epithelium and a submucous supporting layer. From each cell of this membrane project six to twelve little finger-like processes called cilia. There are also a great many little glands in this membrane which secrete a mucus. This constantly bathes it through its entire extent. The mucus consists of about 95 per cent water, 4 per cent mucin, and 1 per cent solids. The cilia are constantly bathed and wave back and forth in rhythmic movements or "beats," six to eight times per second.

Rhythmic movements of cilia are in definite directions like wheat in a field being blown by the wind. Bits of carbon, when placed upon the mucous membrane in various places, are carried in these definite directions by the action of the constantly beating cilia. The nervous

system does not control their movements as demonstrated by taking bits of mucosa out of the nose, placing them in a physiological saline and seeing them still wave under a microscope. Here it can be observed that oils inhibit their movement while aqueous solutions of medications, such as $\frac{1}{4}$ per cent ephedrin, stimulate their action.

Of tremendous importance to the health of the Nation is the drying of this membrane during the cold months of the winter when most people are confined in steam-heated apartments. The amount of moisture in this air is so far below the amount in the nasal mucous membrane that some of the moisture leaves the membrane and passes into the air. As the membrane dries, the cilia have greater and greater difficulty in moving dirt, bacteria, and other injurious products and rendering them harmless. The cilia must have moisture for movement and life, just as the cilia in the most primitive organisms. The nasal mucous membrane is capable of secreting about one quart of water a day. If most of this passes into the drier air, the cilia must be rendered useless or must die.

Bacteria, which are always being harboured in or on the mucous part of the membrane, penetrate the membrane between the dead or dying cilia and get into the underlying tissues. We then have the condition we call inflammation of the nose. The membranes swell. We have difficulty in getting air through the nose. We absorb toxins or poisons which the bacteria are making. No longer is the remarkable bacteriolytic action of the mucus capable of helping to defend the entrance to the body. The temperature rises. We go to bed. We have a bad case of coryza due to the drying of the mucous membrane. It may not be long before the infection has spread downward into the lining of the larynx, trachea, and bronchi. If we are more fortunate we may escape pneumonia.

Extending outward and backward from the nasal chambers are about eighteen cavities in the bones of the face and skull. These are the sinuses. They act as resonating chambers for the voice. They are lined with a membrane thinner than that of the nasal chambers. These sinuses, usually nine on each side of the nose, may likewise become infected and then the well known sinus infection develops. Various ailments affecting many other parts of the body may in time develop from unhealed sinus infections. All of these conditions might have been avoided if care in the protection of the cilia, phylogenetically very old, had been instituted before they were dried out or killed.

It may be of interest at this point to compare the size of the nasal chambers to that of a large hall. If we were to magnify the chambers three thousand times, we would witness a hall 300 feet high with cilia about one inch in height covering the walls and with bacteria about $\frac{1}{6}$ to $\frac{1}{3}$ of an inch long moving in the layer of mucus. Many rooms would be found to lead out through single doors from the sides, near the roof, and backward. These rooms would likewise be lined with a ciliated

wallpaper. The halls would be kept moist by the thousands of mucous glands in the walls and would be kept warm by the two sets of radiators called turbinates. These would be suspended part way up the lateral walls. They would have pipes of blood vessels about as large and as close together as the pipes in the radiators of our houses. These pipes would, however, be elastic. They could swell so that more warm blood would rush into the radiators or they could shrink so that less heat would be brought into the chambers. All of this would be under the control of the marvelous sympathetic nervous system, really an electrical system, without conscious control.

SUMMARY

Man may be defined as a tubular mass of cells having two protective coats, one covering the outside and the other lining the central tube. The various organs lie between the two coats. The respiratory system is an outgrowth of the forepart of this tube, as in the lung-fish. The nose is one of the two entrances to the tube. It has developed into a remarkable organ for the protection not only of the respiratory system but also of the entire organism.

The nose has many functions, some of which are:

(1) Olfactory. The uppermost parts of the chambers have numerous end-organs for smell. They are but little developed in man as compared with many other animals.

(2) Respiratory. Air normally enters and leaves the respiratory system through the nose.

(3) Temperature regulator. The very vascular turbinates act as radiators to warm the air before it reaches the more delicate and sensitive bronchi and lungs.

(4) Moisture regulator. The entire respiratory system requires moisture in order that its ciliated mucous membrane may function. The mucous glands of the nose secrete about one quart of water a day.

(5) Expulsion of foreign matter. By the act of sneezing and by the ciliary action this matter is expelled.

(6) Bacteriostatic action. The mucus has the power to inhibit the growth of and often to kill many bacteria.

(7) Resonating chambers. The nasal chambers and the sinuses act as resonating chambers to improve the quality of the voice.