

Strains 193 and 195 of *B. pyocyaneus* showed decidedly less efficiency in maintaining the original activity of the coli bacteriophage. With one of these strains (195) 12 serial passages brought about a total loss of the phage, though some activity could be demonstrated with the 11th filtrate. With strain 193 lytic activity for *B. coli* S 1 was demonstrated up to but not beyond the 20th passage.

A comparison was made of the 24th filtrate from *B. pyocyaneus* strain 194 and the original *B. coli* phage with respect to this activity toward strains of *B. coli* other than S 1. Of the 24 strains thus tested 20 gave identical results with the two filtrates. Of the other four 2 were definitely positive with the original phage and negative with the pyocyaneus filtrate, one was completely lysed by the original and only slightly by the pyocyaneus filtrate while one was definitely positive with the pyocyaneus filtrate and negative with the original phage.

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### Repair in the Paranasal Sinuses of Man Following Removal of the Mucous Membrane Lining.

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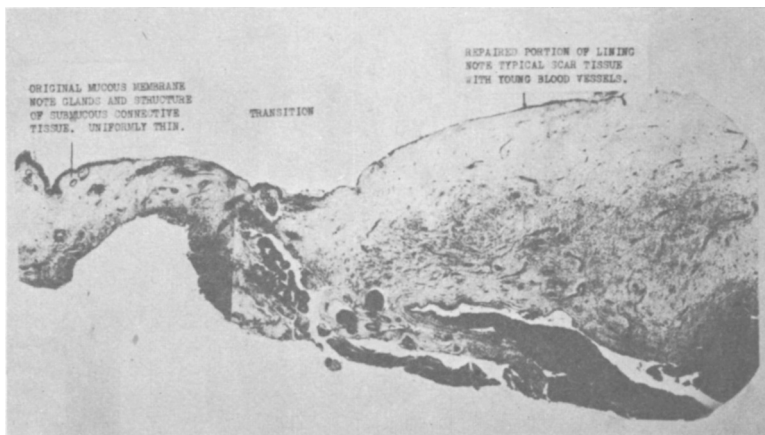
Sufficient clinical evidence has accumulated in recent years to show that certain persistent infections in degenerated mucous membranes lining the paranasal sinuses require surgical removal. In the usual operative procedure in the antrum the diseased tissue is scraped out with a curette; or the entire membrane is removed in one piece by sub-periosteal dissection through an opening in the canine fossa (Dr. Kistner). Clinically it is observed that repair occurs with variable results. In some cases the new lining is thick and in others thin. The exact nature of the new tissue has never been determined.

In our investigations human material is employed, inasmuch as there is no available experimental animal with the surgical and pathological characteristics of sinusitis in man. At the reoperation the specimens are immediately mounted on thick paper supports and immersed in Zenker's fluid. The tissues are dehydrated in alcohol, cleared in cedar oil, imbedded in paraffin and stained with hematoxylin-eosin.

*Repair After Part of the Mucous Membrane is Removed:*

1. Repair in a Small Area—Approximately one square centimeter was cut from the nasal wall of the antrum in the usual gland-bearing portion of the mucous membrane. Four months later the healed area with some adjacent membrane was removed. Microscopic sections show a layer of ciliated columnar pseudo-stratified epithelium resting on white fibrous scar tissue. No submucous glands are found.

2. Repair of a Large Area—About one-third of the mucous membrane was removed from 2 cases. Two years later the sinuses were reoperated and the entire antrum lining removed. Microscopic sections show the *original portion* of the membrane containing the normal histologic structures as follows: (1) A layer of pseudo-stratified ciliated columnar epithelium; (2) a superficial spongy layer of areolar connective tissue with large tissue spaces; (3) tubo-alveolar mucous and serous glands in the layer of loose connective tissue; (4) an orderly arrangement of branching arteries and arterioles in definite layers; (5) a definite periosteal layer of compact connective tissue. While the *repaired portion* of the lining consists of a thick mass of fibrous scar tissue covered for the most part by an indifferent layer of cubical epithelium which is stratified in some areas and entirely absent in others, an irregular vascularization of scar tissue is present. The usual histological structure of antrum mucous membrane is entirely absent. No glands are seen. No loose areolar tissue with large tissue spaces is seen. (See photomicrograph.)



**FIG. 1.**

Photomicrograph of a healed portion of sinus lining from the antrum of a human being, showing the original lining on the left, the transition point at which repair started in the center and the thick new scar tissue lining on the right.

*Repair After the Entire Mucous Membrane is Removed:*

1. Epithelization from the Nasal Mucous Membrane—After complete subperiosteal exenteration of the lining through the canine fossa a counter-opening is made in the nasal wall of the antrum to permit drainage. A flap of nasal mucous membrane several millimeters in width is usually brought into the antrum to cover the floor of the counter-opening. Two cases were examined, one 8 months and the second 18 months after the primary operation. Repair produced a great deal of bony thickening in the walls of the sinuses. Whereas the original antrum lining is easily peeled from the bone, the new lining is only torn away with difficulty. Spicules of bone are found imbedded in the scar tissue of the new lining. The healed antrum is lined by a thick, dense, firm layer of scar tissue covered by stratified columnar epithelium. The normal antral membrane contains only a few glands on the nasal wall, but the membranes obtained after repair with the nasal flap contain many more mucous and serous glands than the original lining. The glands are derived from the nasal flap and are buried in the firm scar tissue. The white fibrous scar tissue contains fibroblasts in the superficial portion, and dense wavy strands deeper in the lining. There is no loose areolar connective tissue.

Recently, Knowlton and McGregor,<sup>1</sup> working on 3 dogs curretted portions of the mucous membrane from the recess in the nasal cavity and observed complete epithelial regeneration in one dog at 3 months and gland regeneration in another dog at 5 months.

2. Epithelization from the Oral Mucous Membrane—In one case, after sub-periosteal exenteration, the opening through the canine fossa was kept patent. After 6 months the antrum was lined with a firm membrane composed of stratified squamous epithelium as recently recorded by one of us (Kistner<sup>2</sup>). This lining is similar to that of the oral cavity from which it was derived.

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<sup>1</sup> Knowlton, Charles D., and McGregor, G. W., *Arch. Otolaryng.*, 1928, viii, 647.

<sup>2</sup> Kistner, F. B., *Ann. Otol. Rhin. and Laryng.*, 1929, xxxviii, 977.