TYMPANOSCLEROSIS*

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BEFORE otosclerosis had been recognized as a disease beginning in the bony capsule of the labyrinth, attention had been drawn to the sclerotic changes in the mucosa of the tympanic cavity which might cause deafness. Von Tröltsch described, for the first time, in 1873, "Sclerosis of the tympanum-tissue" in which the mucosa of the tympanic cavity becomes denser, stiffer and less elastic. In Schwartze's text-book, Walb devotes a special chapter to sclerosis of the mucosa of the tympanic cavity, but no differentiation had as yet been made between this and the bony changes of otosclerosis. At the same time he had already described the changes in question—a tendon-like alteration of the fibrous tissue in the deeper layers of the mucous membrane, and the disappearance of many blood vessels. There were also finely granular changes in the mucous membrane, with the deposit of minute calcareous particles. This is a very good description of a process that was completely forgotten during the intensive study of otosclerosis, which condition is much more frequently observed. In later text-books only the expressions "adhesive process", or "residuum", are found to describe the various scarring, healing processes in the middle ear. The use of the operating microscope in plastic surgery of the sound-conducting apparatus has again drawn attention to the various forms of degenerative scar-like processes which assume a special significance. When these changes were first observed, the grotesque appearances in the mucous membrane of the tympanum, attic and antrum created considerable surprise. They are rarely spread equally throughout the middle-ear cavity, and they are most impressive, when in a completely dry middle-ear cavity, comparatively large areas have undergone this change. This can well be compared with the so-called "sugar coating" thickening of the serous membranes covering the liver and spleen. When the air spaces in the mastoid process are opened, slightly raised but completely smooth and white areas are observed, and are clearly defined from the normal mucous membrane through which can be observed the yellow colour of the bone. In specially marked cases, the ossicles are completely covered by thick sclerotic masses, and the attic completely filled by a massive block of this material as shown in Figure 1*a*. In other cases only localized areas in the attic, on the medial wall of the tympanum, or on the drumhead

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have undergone these sclerotic changes. In the latter case the foci on the tympanic membrane form the well-known "chalk patches". As the

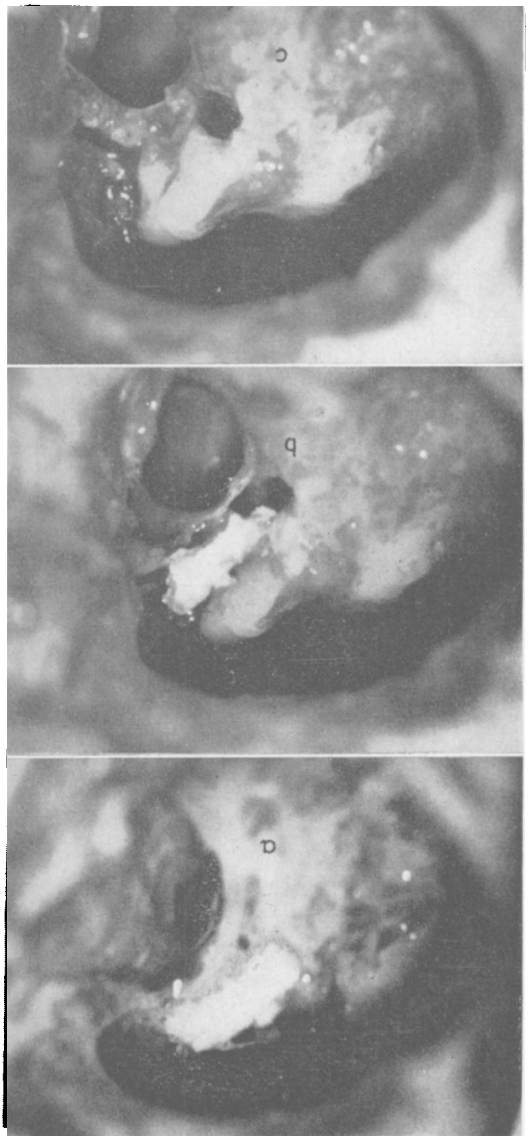


FIG. 1.
Removal of sclerotic masses from the attic with emergence of the ossicles.

localization of the changes is by no means regular, these sclerotic changes can be seen before operation, by otoscopic investigation in a limited number of cases only. Even in chronic suppurative otitis media with

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central perforations, and swollen mucous membrane sclerotic changes may be hidden in the depths of the tympanum and only discovered at operation.

The history of the patient usually includes an otitis media in childhood, in other cases a continuous suppuration for a number of decades, and in a few there is no known record of suppuration. This variable distribution and history make it doubtful whether the condition is a definite pathological entity or a degenerative sequel of various inflammatory processes. The latter of these two possibilities is the more likely. From an operative point of view however it is essential to regard the condition as a separate entity. Our experiences which we gathered slowly, step by step, during treatment and observation of such ears, taught us two things. Firstly this type of sclerosis, which in most cases constitutes a complete obstacle to vibration in the malleus and incus and also in the stapes, can be removed without disturbing the ossicular chain. Secondly, that the sclerosis does not tend to recur after operation, as it is a completed pathological process, and in this it differs from the keloid changes in the skin. We have observed in a number of cases that after removal of these foci, there is healing, with complete recovery of the mobility of the ossicles. Even free skin grafts when applied to the sclerotic tissues in the drumhead or to the wall of the tympanum become adherent and live. One must suppose therefore, that during a limited period the ear is in a special condition in which these sclerotic changes may occur, and that after healing of this process, although the sclerotic changes remain, the reaction to surgical intervention is that of a normal ear.

For these reasons we feel that the resuscitation of the expression "Paukensclerose" in the sense of a sclerosis of the mucous membrane of the tympanic cavity, is important.

To understand the possibility of successful surgery the histological changes must be known, and they are located in the deeper layer of the submucosa. This means that on the one hand the epithelial layer of the mucosa is intact and that on the other hand the foci of sclerosis are not in direct contact with the bone of the labyrinth or of the ossicles. According to Walb the scleroses consist of densely packed fibrous tissue with hyalin degeneration and with few nuclei. Figure 2 shows the section of a sclerotic mass which was removed from the body of the incus in a case similar to that of Figure 1. The fibrous tissue *2b* surrounds an epithelialized cavity (*d*). Some of the fibrous tissue is changed to bony tissue by calcareous deposits. The surface of this area is covered by unbroken epithelium. In some of the sections there occur, in the areolar tissue between the sclerosed areas, numerous eosinophil cells, which may perhaps indicate an allergic origin of the sclerosis.

On the first occasion on which this wide-spread sclerosis was met, and was found to have changed the mucosa of the whole antrum, and converted the ossicles into a solid block, it was felt that the whole of this sclerosed

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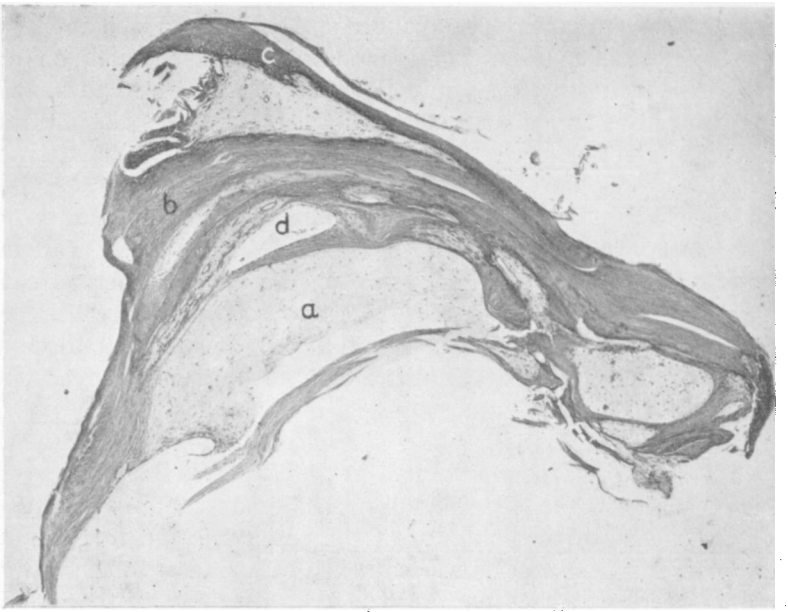


FIG. 2.
A section through a sclerotic mass removed from the incus.

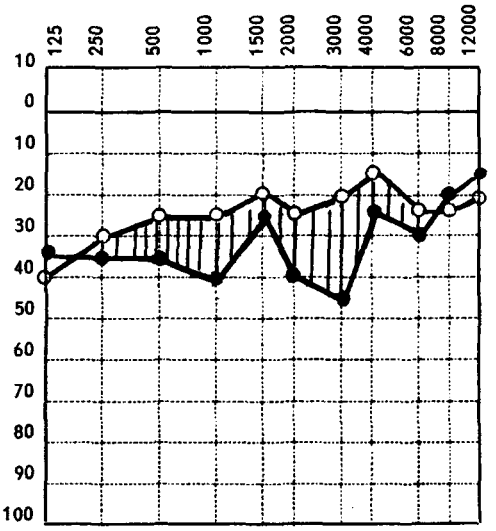


FIG. 3.
The gain in hearing after freeing of malleus and incus and closing of a large perforation of the drumhead.

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tissue should be removed. Later it was appreciated that this partly cartilaginous, partly calcareous coating could be peeled off the ossicles without altering their position or destroying their continuity or their capacity to conduct sound. The early cases were recently described in the *Zeitschrift für Laryngologie* (Zöllner-Beck, 1955). Case No. 7 in that paper is illustrated in Figure 1 in the present paper. In 1*a* the entrance to the antrum is seen to be blocked by a hard white chalk-like mass. 1*b* shows the area after removal of the mass. The body of the incus and the handle of the malleous can be seen, to their right is a deeper part of the sclerosed mass, and next to this is a large central perforation. In 1*c* the ossicles have been completely freed, the oval window was not sclerosed and the ossicular chain moved well. In spite of the removal of the sclerosis, parts of the ligaments and of the epithelial lining of the attic remained intact. The large gap in the drumhead was closed by a free graft, after freshening the

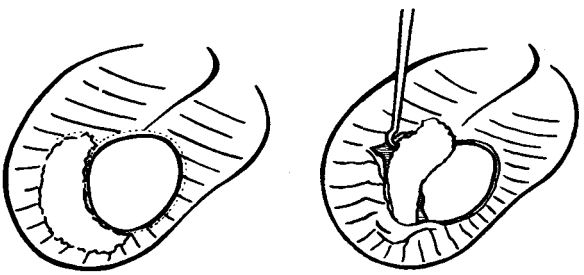


FIG. 4.
Removal of chalk patch from immediate vicinity of perforation of tympanic membrane.

edges. The ear healed well, the drum was closed and the Eustachian tube became patent. The hearing (Figure 3) was not normal but the improvement after operation showed that the ossicles were functioning again to some degree.

Observation of the histogenesis of the changes renders the recovery of function understandable. As the sclerosis arises in the submucous layer there may be areas of intact mucosa in the attic, on the ossicles or their ligaments. If these masses are carefully removed, the remaining intact mucosa prevents adhesions.

Chalk patches are not too difficult to remove from the drumhead. They are situated in the stratum fibrosum and can be removed by incising either the epithelial layer or the edge of the perforation as in Figure 4. In some cases this serves a useful purpose, as by removing some of the outer cuticular layer a bed is prepared for the graft. If excision of chalk and fibrous tissue is carried too far, and the annulus fibrosus of the drumhead is reached, there is a danger that the tympanic membrane may fall into the drum cavity. By so doing a valuable basis for the new membrane is

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destroyed. Grafts heal well on the sclerotic layer after removal of the epithelium in spite of its poor blood supply. This has been observed in a number of patients and in some elderly ones also, and it is surprising how well the grafts take even in ears in which the structures of the tympanic membrane are almost entirely replaced by chalk.

It is a recent experience that it is possible to remobilize the stapes. The pathological changes in this region can assume different forms. Figure 5 shows a sclerosis of the annular ligament (Ringbandsclerose) as

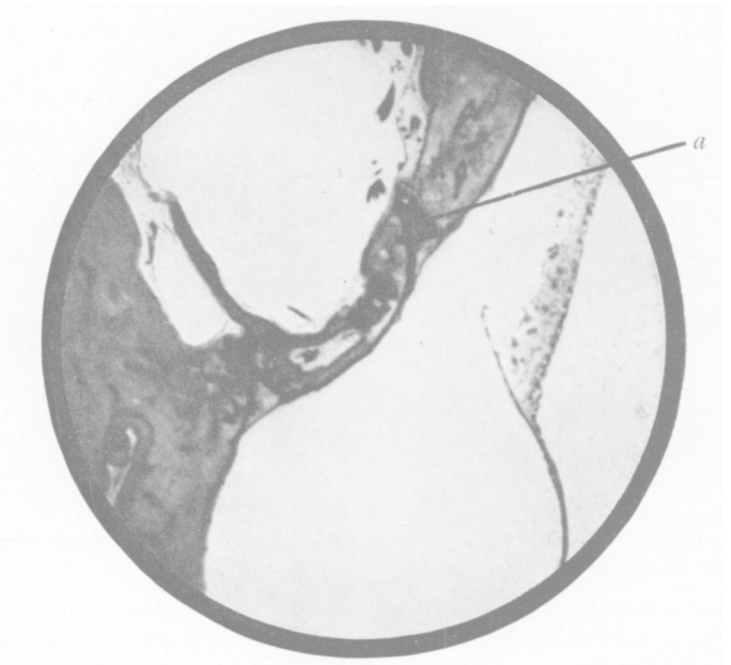


FIG. 5.
Sclerosis confined to the annular ligament only. (Ringbandsclerose) (Habermann's specimen)
a.—annular ligament.

described by Habermann in 1892. If the sclerosis as seen in this specimen is restricted to the annular ligament of the oval window it is difficult to differentiate it from an otosclerotic ankylosis even after a surgical opening of the middle ear. This form of fixation of the stapes has recently become of greater interest and importance, because, as compared with the solid bone formation in otosclerosis, the brittle chalk deposits in this type of sclerosis are easily fragmented by pressure on the stapes as in Rosen's stapes mobilization operation. But the type of stapes fixation observed in these cases of advanced tympanosclerosis was different. In a number of cases the niche of the oval window was completely and evenly filled by the white sclerotic masses. In some cases this was so complete that it was

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difficult to recognize any landmark, especially if the long process of the incus was missing and only a part of the head of the stapes could be seen.

First attempts to mobilize the stapes by removal of these masses of chalky fibrous tissue failed because of the hesitant and incomplete nature of the excision. Later, however, more thorough and complete removal resulted in the submerged stapes becoming again mobile and the stapedius reflex becoming positive.

Case L.M. Female, aged 26 years. Bilateral middle-ear deafness due to large central perforations of both drumheads following scarlet fever in childhood. Both ears were dry. February 2nd, 1955, operation on the right ear, attico-antrotomy. Comparatively small antrum with tough mucous membrane. Freeing of incus, which was covered by thickened mucosa. The long process of the incus was missing. Below the body of the incus, the niche of the oval window and the promontory were visible, and were both covered by thickened mucous membrane. Only the head of the stapes and the tendon of the stapedius muscle were seen and the whole of the stapes niche was filled up by whitish tissue. There was no stapedius reflex. On touching the head there was complete immobility. On touching the head of the stapes with the acoustic probe there was for a tone of 1000 cycles a loss of hearing in the neighbourhood of 35 db., only very little better than on touching the promontory (45 db.). By widening the chorda-facialis gap, but preserving the remaining edge of the drumhead the region of the stapes was exposed and the stapes freed by slowly peeling off the sclerosed masses in its niche. The sclerotic tissue was partly like plaster, and partly in the form of fine plates, and some of the covering mucous membrane could be preserved by pushing it aside. Both crura of the stapes emerged, the stapes became mobile, the stapedius reflex positive and the threshold of hearing for the 1000 cycle tone as indicated by the acoustic probe was then between 10 and 15 db. Because the sound conducting chain was interrupted by destruction of the long process of the incus, the body of the incus was rotated so as to lie between the neck of the malleus and the head of the stapes, preserving the blood supply in the ligaments. (See Fig. 8, Zöllner, *J. Laryng.*, 1955). The re-established continuity of the chain was proved when on touching the handle of the malleus, the incus and head of stapes moved. To fix the incus in this position small pieces of foam were placed next to it. From the posterior part of the edge of the drumhead a small chalk layer was peeled off to get better mobility. The large perforation was then closed by a free graft. The attic and the mastoid process remained open towards the auditory meatus.

Figure 6 shows how the chalk layers immobilize the stapes and how they are removed. So as to avoid dislocation of the stapes whilst carrying this out, the density of the enveloping masses should be determined by slitting them. It is the most convenient to begin at the side of the promontory, next to the stapes, incising the mucosa and pushing it downwards,

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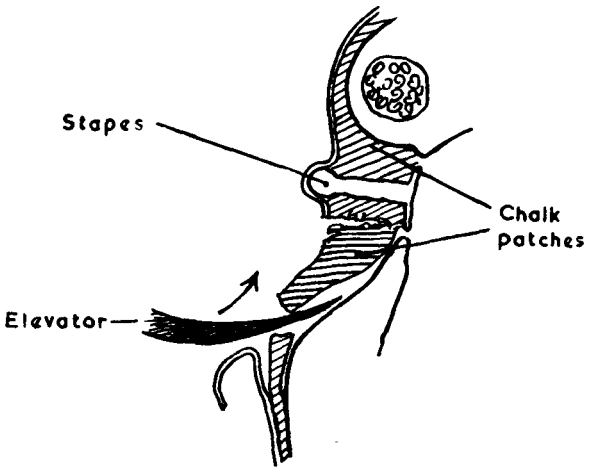


FIG. 6.
Chalky deposits immobilizing stapes and method of removal.

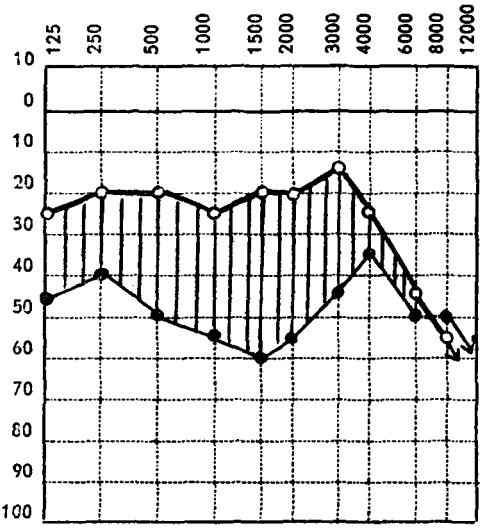


FIG. 7.
Hearing gain after mobilization of the stapes, rotation of incus and closure of perforation.

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then slitting the chalk patches and lifting off their several layers, again working from the stapes. The chalk masses lying between the facial ridge and the stapes were removed by the finest needles and blades. Figure 7 shows the gain in hearing after this operation, which was rather complicated as not only had the stapes to be freed, but at the same time the incus had to be dislocated and the perforation closed by a free graft.

Even though such a conservative method of freeing and re-establishing the function of the ossicular chain cannot be successful in every case, a method is indicated in which this can be achieved in a great many cases.

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