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**Decalcification of the Teeth:  
A New Method Using Supersonic Radiation.  
(Preliminary Report.)**

By  
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**Review.**

For the decalcification of the teeth a number of organic and inorganic acids of various concentrations have been used. In many of the methods the action has been too slow, however, with consequent poor response to stains. By accelerating the decalcification this disadvantage could be overcome, while at the same time the duration of the experiment would be shorter.

Among those who have been occupied with the problems of decalcification mention may be made of LINDAHL, who in 1937 used carbon dioxide in an attempt to decalcify smaller specimens containing calcium carbonate, the gas being conducted through an aqueous suspension under a pressure of an atmosphere or more. In 1944 FORSHUFVUD used acids at pressures of 3—4 atm. which, he claimed, would prevent the destruction of the organic stroma of the enamel. AASGAARD (1943) stated that calcium and phosphorus were liberated by electrolysis, especially when the tooth served as the positive electrode, and in 1947 RICHMAN, GELFAND and HILL used an electrolytic procedure for decalcifying bone.

In 1934 G. H. WILSON introduced a method for the rapid decalcification of bone under a 'moderate vacuum'. After the action was complete he neutralized the acid with lithium carbonate —

also under reduced pressure. He used 20 % nitric acid, asserting that with the vacuum method so great a concentration was possible without swelling of the tissues or loss of nuclear staining. The completion of the decalcification was tested by pricking the specimen with a fine needle.

Further investigations along these lines were carried out by MARTIN and DELAUNAY (1936), who used vacuum for both fixation and decalcification with tri-chloroacetic acid. R. A. J. WILSON (1942) preferred a mixture of acetic and formic acids which yielded better results than nitric, although the action was slower. He, too, used vacuum conditions but found neutralization unnecessary with this procedure.

The vacuum methods referred to were, however, evolved for the decalcification of bone, which could be divided into small pieces in order to accelerate the process. In 1949 the technique was extended to teeth by WAERHAUG. He used a filter pump attached to the water tap, thus obtaining very low pressures. As the speed of the decalcification process was dependent on the vacuum pressure he recommended a depression of 740 mm Hg. He observed that the quality of the sections so obtained was superior to those prepared under ordinary pressure. He favoured continuation of the process for 12—24 hours after the evolution of gas bubbles had ceased.

### Original Method.

By super-imposing rapid variation of pressure on the vacuum the present author has tried to improve the vacuum method. If these variations reach a sufficiently high frequency and amplitude there is a more rapid and intimate contact between the particles of the decalcifying fluid and the specimen. If the acid can be kept at the optimum concentration and temperature, and the pressure is allowed to vary within convenient limits at a high frequency, a much quicker action is obtained than by using a constant pressure. Investigation of the most favourable conditions for decalcification by this method are still proceeding.

As a source of pressure variation impulses the author has used an 'Ultravibrator' *supersonic apparatus*<sup>1</sup>. This works with a fre-

<sup>1</sup> This apparatus was kindly placed at the author's disposal by The Nordiska Vexito Trading Company, Stockholm.

quency of 800 kHz which, according to POHLMAN (1951), means that with an efficiency of, for example,  $5 \text{ W/cm}^2$  a pressure change of about  $\pm 4$  atm. occurs during the time required for the supersonic wave to travel 1 mm at a speed estimated at 2,000—3,000 m/sec for dental tissues. During a period of one millionth of a second strong separating forces will be set up in the particles of the specimen. The acceleration of these particles reaches  $0.8 \cdot 10^8 \text{ cm/sec}^2$ , *i. e.* 1,000 times the acceleration due to gravity — equivalent to that of a powerful centrifuge.

The end-point of the decalcification was tested by the X-ray method introduced by GOLDHAMER (1929) for bone and by MILES (1949) for teeth.

The method described enables the period required for decalcification to be shortened. A comparison of the times of decalcification under vacuum conditions with and without supersonic radiation is proceeding.

### Staining.

Supersonic radiation may also be used for rapid and satisfactory staining of histologic preparations — a method demonstrated by v. CORONINI and LASSMAN in 1949, when block staining of nerve tissues was carried out with silver nitrate. The tissues are assumed to be undamaged by the supersonic waves for otherwise the results would be unreliable. Careful examination of this field is demanded before inferences may be drawn with confidence; the author hopes to return to these problems on another occasion.

### Summary.

A new procedure for decalcification of teeth is described. WAERHAUG's vacuum method is modified by the application of supersonic radiation.

High frequency sound waves may be applied, moreover, to the staining of histologic preparations as demonstrated by v. CORONINI and LASSMAN.

### Zusammenfassung.

Der Verfasser beschreibt eine neue Methode zur Entkalkung von Zähnen. Er schlägt eine Verbesserung der Vacuummethode von WAERHAUG (1949) vor. Dabei werden Druckvariationen dem Vacuum überlagert, was durch Verwendung von Ultraschallwellen erreicht wird. Er weist darauf hin, dass Ultraschallwellen zur schnellen Färbung von histologischen Präparaten verwendet werden können, wie es v. CORONINI und LASSMANN (1949) schon versucht haben.

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