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## **A SPECTROGRAPHIC INVESTIGATION OF TRACE ELEMENTS IN HUMAN TEETH**

**LADDIE B. FIELDS and GEORGE W. CHARLES,  
University of Oklahoma, Norman**

### **INTRODUCTION**

Schriever and Diamond (2) have reported the existence of electromotive forces in the mouth as a result of voltaic action from saliva and bone fluid with restoration metal. Hazel, Charles, and Diamond (1) have made a study of the relation between these electromotive forces and leukoplakia. This investigation was undertaken to find out whether there is a migration of restoration metals through teeth, as might be expected if there is a voltaic action in the mouth. As the work progressed, some information was obtained about trace elements present in unfilled teeth.

### **EXPERIMENTAL DETAILS**

The results presented in this paper were obtained by qualitative spectrographic analysis. Twenty-six teeth have been investigated. Six of these

had amalgam or silver restorations. Eight had gold restorations. Twelve had been extracted without restorations. All samples were cut into transverse sections about one millimeter thick with a fine-toothed saw blade. No section containing restoration metals was used as a sample. The sections were placed in cavities drilled in spectrographic carbon rods. The spectra were excited with a high voltage A.C. arc. Spectrograms covering the range 2500 Å to 4500 Å were made with ten minute exposures on Eastman 103-0 plates. On each exposure to the spectrum of a tooth sample, an identical exposure to the spectrum of the carbons alone was made as a control. A further control was the analysis of the spectrum of one of the saw blades used for sectioning the samples. An iron spectrum was superimposed on the spectrum of each sample as a guide to the identification of lines appearing in the spectrum of the sample. The spectrograms were analysed on the Applied Research Laboratories comparator.

#### RESULTS

Each sample investigated showed the presence of calcium, magnesium, phosphorus, sodium, and to a lesser extent, copper. Boron was observed in some of the unfilled teeth, although not all the spectrograms cover the region where the persistent boron lines lie. Zinc was found in all samples. Lead and silver were found in most of the samples which were made from filled teeth; their occurrence was less frequent in the spectra of the unfilled teeth. Tin was found in a few samples, mercury in four, and gold in four. Palladium appeared in one sample and bismuth in one sample. In general, the concentrations of silver, zinc, tin and lead increased as the crown of the tooth was approached if the tooth had been filled; no such systematic increase was noted for the unfilled teeth. This fact, together with the appearance of gold and mercury in some samples and the appearance of silver and lead in only part of the unfilled teeth, supports the migration hypothesis.

#### DISCUSSION

Some evidence has been obtained by other workers for the presence of zinc, silver, and lead in normal teeth. These results have been obtained on a small sample. A statistical study of a large sample of normal teeth would be of interest. Some correlation between the composition of the tooth and its history should be made. Significant factors are type of filling, length of time in the tooth, and fillings in neighboring teeth. Quantitative analyses should be made to eliminate uncertainties due to variations in source conditions.

#### LITERATURE CITED

1. HAZEL, O. G., CHARLES, G. W., and DIAMOND, L. E. 1950. Leukoplakia buccalis. *Arch. Dermatol. and Syphilol.* 61: 781-790.
  2. SCHRIEVER, WILLIAM and DIAMOND, L. E. 1951. E. M. F.'s and electric currents caused by metallic dental fillings. *J. Am. Dental Assoc.* 41. (In press).
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