

after oxygen was again supplied to them. A relatively low concentration of oxygen was adequate to maintain glomerular circulation in the exposed kidney. Portions of the kidneys other than the glomeruli continued in the absence of oxygen to receive a copious supply of blood, and it is believed that the asphyxia exerted its peculiar effect because of the special nature of the glomerular circulation.

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Variations in Calcification of Teeth as Shown by the Use of Grenz Rays.*

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Dental decay may be closely related to disturbances in calcium-phosphorous metabolism. There has been little evidence to indicate the mechanism by which such systemic factors operate on the fully erupted tooth. One possibility in this connection is that the tooth can undergo post-eruptive changes in calcification in response to such systemic changes. To determine whether such intradental changes do occur, Bodecker and Applebaum¹ made roentgenological study of teeth in ground section, 1 mm. thick. The radiation was obtained from an X-ray machine which operates at about 40,000 volts. By this method, only gross differences in radiolucency were recognizable—such as that between dentin and enamel, or the partial decalcification associated with a lesion of incipient caries. In no case was it possible to distinguish any minute structural detail. Similar results have been obtained by Heiwinkel.²

Recently, Fricke³ found that excellent radiographs of insects can be obtained by means of soft X-rays (Grenz or Boundary rays). He employed a specially constructed X-ray tube which operates at potentials as low as 4,000 volts. With the generous cooperation of Dr. Fricke, we were able to examine several thin sections of teeth with his apparatus. Since minute structural variations in teeth

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¹ Bodecker, C. F., and Applebaum, E. A., *Dental Cosmos*, 1931, **73**, 995.

² Heiwinkel, M., *Vierteljahrsschrift für Zahnheilkunde*, 1932, **48**, 247.

³ Fricke, H., *Radiography and Clinical Photography*, 1932, **8**, 12.

have never before been observed by this method, we report our technique.

Ground sections of teeth are prepared by means of a special planing machine.⁴ The thickness of these sections is in the neighborhood of 0.15 mm.; for any one section it is constant to ± 0.01 mm., at least in the region of the crown. Such uniformity is greater than can be obtained by hand grinding. The section is mounted in Canada balsam, between 2 layers of black paper; this prevents its drying and generally facilitates its manipulation. The section thus mounted is placed in contact with the X-ray plate in a suitable holder and an exposure is made. We now use plates with a fine grained emulsion, especially prepared by Eastman Kodak Company. These have the advantage of permitting of microscopic examination of the radiographs at a magnification of 20 X, without disturbance from the appearance of the emulsion grains. Thus it is possible to distinguish much detail that would otherwise not be discernible.

In general, the method is so sensitive to variations in radiopacity, that a difference in thickness of no more than 0.03 mm. may result in a complete over-exposure in one portion of a section, whereas another part may yield a normal picture. Even a well-planed section will require a series of exposures under different conditions of voltage, milliamperage, and time in order to yield a complete radiographic record. This is necessary because of the great difference in radiopacity of dentin and enamel, and also because of any marked differences in calcification which may obtain between adjacent portions of the section.

Some of the structures in human teeth which have been found to be associated with variations in radiopacity are as follows: bands of Schreger, early stages of secondary decay of enamel, enamel spindles, contour lines of Owen, interglobular spaces, and striated variations in the dentin which are parallel with the dentinal tubules. In addition, a number of other phenomena have been observed, which are not so well characterized; e. g., a thin enamel crack or lamella which contains a highly radiopaque filling (possibly due to "healing"), a fan-shaped radiolucency that starts at a narrow region in the roof of the pulp chamber and radiates across the dentin and into the enamel, a radiolucent zone in the dentin surrounding the pulp chamber but at a slight distance from its margin, and well defined variations in the partially decalcified enamel of incipient caries lesions.

⁴ Bodecker, C. F., *Dental Cosmos*, 1926, **68**, 860.